Design of a Mobile Phone App Prototype for Reflections on Perceived Stress

Åsa Smedberg
The Department of Computer and Systems Sciences
Stockholm University
Kista, Sweden
asasmed@dsv.su.se

Hélène Sandmark
School of Health, Care and Social Welfare
Division of Public Health Sciences
Mälardalen University
Västerås, Sweden
helene.sandmark@mdh.se

***Abstract*— In working life today, people often experience high levels of stress and display strong reactions to different stressors. Those who are exposed to high levels of stress for a long time face an increased risk for deterioration in physical and mental health often leading to sick leave and high consumption of healthcare. To prevent this, continuous support is needed. Development of IT-tools for continuous stress management is, however, in its early stages. We present a prototype of a mobile phone app for self-reflection, a tool that is also integrated in a larger web based stress management system built on research of social networks for increased well-being. The mobile phone app aims at helping people become more aware of patterns of stressful events. It logs and displays basic information about self-perceived stress situations, such as location and time, and the user can add information about the situations and perceived stress levels. As the app constitutes a part of the web based stress management system, not only self-reflection but also reflection together with peers and stress experts is possible. The prototype of the mobile phone app has been qualitatively evaluated using stress management criteria, and the paper also exemplifies its utility in the context of the larger system.**

Keywords-mobile phone app; stress management; self-reflection; stress situation; web based stress management

I. INTRODUCTION

Stress and stress management have become important issues in today's society. High demands from work life constitute one of the factors that can make people experience unhealthy levels of stress. Also, it is difficult for many to achieve a balance between work and family. As for other health problems, the Internet offers various solutions for people who want to improve their situation and cope with stress exposure. Different kinds of applications for self-help are available on the Internet. There are health information resources of various kinds, intervention programs and forums for peers. More recently, a number of mobile tools have also emerged in the field of stress management, both to measure stress levels and to support people in stressful situations. However, there is still no system that takes a holistic approach, combining various forms of support, from different sources and stakeholders, and that links mobile apps with web based stress management systems. In this paper, we present the design of a newly developed mobile phone app that aims at supporting self-reflection on stressful everyday situations. The app is also prepared to become a complementary part of a holistic stress management system (see e.g., [1]-[2]). With this extension, the overall system integrates self-documentation, self-reflection, information sharing, communication and support among different actors to a working whole. It allows for both individual learning and group supported learning among different actors who contribute with knowledge and experiences about stress and how to cope with stress.

Next section presents theories of stress and stress management that have had implications for the design of the mobile phone app and the overall stress management system. Thereafter, the basic design of the web based part of the stress management system will be presented briefly. The sections that follow introduce the prototype of the mobile phone app for self-reflection and the way it is integrated in the overall stress management system. At the end, we reflect upon our results and present some future actions.

II. STRESS AND STRESS MANAGEMENT

A. Stress

Stress involves both physiological and psychological components, and is about how we perceive the demands placed on us as well as our ability to manage them. The term "stress" can either be used to relate to the cause and act as a stressor on the human body and mind, or be seen as an effect, a stress-reaction, of an event or thought [3]. Those who are exposed to high stress for a prolonged period of time are at increased risk for physical and mental health problems which can lead to sickness and high consumption of healthcare [4]-[5]. Stress factors related to the profession, such as a frustrating work situation, or imbalance in work-life, are important causes of psychological and physiological stress, mental illness and psychosomatic conditions [6]-[7]. Also high levels of engagement at work can lead to increased stress levels [8]-[9]; overcommitted employees tend to suffer from perceptual distortion of demands that prevent them from assessing cost-gain relations and to set limits [8].

B. Coping Strategies

Coping ability can help to manage a stressful situation. Work control, such as flexibility at work and control over

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work tasks can help people to cope with high levels of work stress. Coping strategies can be effective in helping people in stressful conditions, such as poor sleep quality and work-related stress experiences. Coping is classified as either problem-focused, which is when the individual confronts the problem directly, or emotion-focused, meaning that the individual focuses on controlling emotional reactions. The concept of coping has also been classified in terms of active coping, such as planning and pacing activities, and passive coping, which is resting and taking medications [10].

C. Self-Reflection

Aukes et al. (2007) declare that personal reflection is the examination of one's experiences to help clarify and create meaning of the experiences, and to promote learning [11]. They propose that personal reflection in care settings has three elements: self-reflection, empathetic reflection and reflective communication.

Keeping track of past experiences can also help someone with stress symptoms to recognize progression, i.e., positive results of changes made in life patterns, training, etc. [12]. This is regarded helpful for encouraging further changes.

Daily stress logs can be supportive in finding sources of stress and to look for effects from stress [13]. "Some scholars and practitioners distinguish between diaries, logs (a record of information that is a highly structured factual account maintained over time), and journals, which combine the objective aspect of a log with the personal aspect of the diary, but with a more reflective learning slant." [14, p 205]. The reflection in diaries or journals emphasizes the process of learning more than the product. The reflection activities itself helps to increase awareness.

In order to effectively document a situation, information about when and where the situation took place are needed, as well as situational context, level of stress experienced and emotions experienced as a result of the situation [15].

D. Self-Management and Social Support

Disease prevention and early interventions are essential in order to help groups of people from becoming patients of healthcare and from being forced to sick leave and long-term sickness absence. In order to achieve long-term and sustainable changes, interventions and support activities have to be continuous. Ongoing social support has shown to be crucial to develop a lifestyle that lasts [16]-[17]. It is in this context that e-health platforms can play an important role, since they can provide continuous interaction and information exchange between health professionals and also between people with lifestyle issues, who share a certain type of health concern.

Online support groups have shown to empower patients and citizens who suffer from different health problems. Through these online groups new relationships are developed, both strong tie relationships with friends and weak tie relationships with people who attend the online setting less often [18]. These groups support sharing of experiences and advice on particular health issues. The online groups enhance decision-making skills for people who are in distress, and they also foster well-being, a sense of control, self-confidence and overall help to increase abilities to handle specific conditions [19]. A crucial characteristic is their ability to foster social and empathical communication [20]-[21]. Previous studies have also shown that medical experts and peers contribute to knowledge sharing in different ways; while the experts offer detailed information and information on particularly rare issues, peers complement by giving practical advice and reflections based on experiences [22].

III. Social and Multiple Help Web Based Stress Management (Context)

It is not always an easy task to manage stressful life situations and to develop and maintain a healthy living. It involves learning how to balance perceived demands from working and personal life, and to question underlying thoughts and beliefs. E-health communities can assist in this process through continuous interactions between community members. Previous studies have shown that combining knowledge of health experts and the experiences of peers can create a good synergy. The use of question-response functions between citizens and experts and conversations among peers have seen to offer different and complementary support [22]-[23]. This section will shortly describe a web based system developed for stress management that considers social interaction and the integration of different actors and functions. It serves as background to the design of the mobile phone app to be presented in the coming sections.

The web based system for stress management is based on a holistic view of actors – both stress experts and peers - and the different types of support they can contribute with. The system offers the user information in the form of research and real life stories, practical exercises (both text- and video-based), and the opportunity to interact with stress experts and peers. Since different actors and functions are combined in one system, we call this a multiple help online system for stress management [1]-[2], [22] (see Fig. 1 for an illustration).

The web based system is also divided into four different stress intervention areas: sleep, work and studies, balance in life, and physical wellbeing [1]-[2], based on previous research [6]-[9]. This division makes it possible to organize conversations, counseling sessions, exercises and information around specific stressors and stress reactions. "Sleep" is a period of active recovery for the head and body; at the same time, it has been concluded that stress is strongly linked to disturbed sleep, insomnia and impaired awakening. "Work and studies" relates to exposure to stressful job conditions such as heavy workload, infrequent rest breaks, long work hours, shift work, and interpersonal relationships, as well as inappropriate perceptions of demands and fail in their coping ability. "Balance in life" refers to the challenges of coping with demands and to set limits to manage work, leisure time activities and time spend time with family and friends. "Physical wellbeing" is about individual interventions in the area of dysfunction due to negative stress exposure. Responses to stress are often manifested in body tension, and by using a combination of techniques; muscle relaxation and cognitive-

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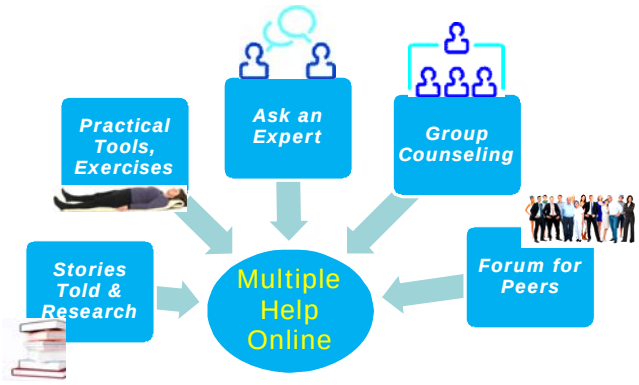

Figure 1. Web Based Social and Multiple Help Stress Management System.

behavioural skills, health promotion and prevention of stress-related disorders can be achieved.

A prototype of the web based stress management system is also available at: http://stress.dsv.su.se/.

IV. DESIGNING A MOBILE PHONE APP FOR SELF-REFLECTION

To continue the research work of the stress management system, and to extend it with a tool for self-reflection, a prototype of a mobile phone app was recently developed. This section will describe the artifact and the research process.

A. Design Science

Design science research is of importance to create successful artifacts [24], and it is a paradigm that looks to "extend the boundaries of human and organizational capabilities by creating new and innovative artifacts" [25, p 75]. Hevner et al. (2004) argue that effective design-science research is based on seven guidelines: design as an artifact, problem relevance, design as a search process, research rigor, research contributions, design evaluation and communication of research. Our work to create a mobile phone app for the stress management system was characterized by the ideas of design science. In the following sections, we introduce the developed prototype of the mobile phone app outgoing from the seven design science guidelines.

B. Design as an Artifact

In the area of information systems, design science is applied to come up with purposeful IT artifacts. The artifact can be a construct, a model, a method or an instantiation. In our research work, the purpose was to create an instantiation in the form of a prototype of a mobile phone app in the stress management area.

C. Problem Relevance

The problem domain that the mobile phone app is to be operating in is self-management and self-reflection for people with mild to medium stress symptoms. Since people with stressful lives can benefit from documenting real life situations and to reflect upon them, a mobile phone app developed for this purpose is regarded as a tool that could serve a purpose in stress management. The fact that the mobile phone is available in almost all situations during the day makes it easy to keep track of real-life stress situations while taking part in everyday life. The mobile phone app is also expected to be part of the larger stress management system that supports social interaction between different actors (described previously in section III). The overall stress management system therefore also serves as environment to the mobile phone app.

D. Design as a Search Process

The design science research is essentially a search process to find an effective solution to a problem. In search of an effective solution to the problem, the process needs to be iterative. Crucial to the design science research is abstraction and representation of appropriate ends, means and laws. During the iterative process, these things are refined. Design alternatives are generated and tested against requirements and constraints in The Generate/Test Cycle. In our search process, generation of new versions of the prototype were made regularly and tested against stress management requirements.

E. Research Rigor

Fundamental for design science research is to address two questions: "What utility does the new artifact provide?" and "What demonstrates that utility?" The artifact needs to solve the problem, map adequately to the real world, be unique in some sense and be demonstrated (evaluated) in a proper way. We will address these questions in the sections to come.

F. Research Contributions – the Prototype

As a 'stand alone system', the mobile phone app offers the user a tool for self-reflection. The features were designed in accordance with results from research in stress and stress management. The system design considers also the connection with the overall web based stress management system which brings possibility of having group reflection activities as a complement to the personal reflections.

The mobile phone app has two main parts (see Fig. 2 for screenshot in Swedish). The upper part is for registration and management of stress situations and the lower one for displaying statistical data about the situations. There are four functions related to the first part, i.e., to the registration and management of stress related situations: one function to *register a situation*, one for *listing all situations* in order to look at specific information and also to add information about

Figure 2. Prototype of mobile phone application for self-reflection (start menu).

situations, another one to *list situations per month* to be able to navigate in larger amounts of situations, and a fourth to *send information to the web system*, which means that stored information about situations are sent to the web based stress management system.

In order to document a stressful situation, the user only has to press the button *register a situation* and save the registration (see Fig. 3 for screenshot in Swedish). When this is done, the app will automatically log time and location of the situation (current location is determined by using GPS). More information about the situation, such as contextual data, photos of the scene, perceived level of stress and reflections of experienced emotions are manually put into the system. Perceived level of stress is defined on a scale from "low" to "high" (1-100). Photos are taken by using the phone camera and stored together with the other information about the situation. The manual information can be added at the same time as the registration of a situation, or it can be added later when the user is not in a stressful mode. The exception to this is the perceived level of stress that should be documented at once to avoid difficulties recalling it later.

There are four ways to present statistics of stress situations from the past: number of documented *situations per month*, number of *situations during the hours of a day*, *perceived stress levels* and *locations of stress situations* to be presented on a map (see Fig. 4 for two screenshots of statistics).

G. Design Evaluation

The app prototype has been evaluated qualitatively. The evaluations considered usability for the target group, i.e., people with mild to medium stress levels, and effectiveness regarding self-reflection and connectedness with the bigger stress management system. The design process leading to the prototype of mobile phone app was supported by recurrent evaluations, when the programmer demonstrated the app through simulations. The research group, including medical and stress expertise, evaluated the app from a stress management perspective. Through an iterative process of evaluation, feedback, improvements, new evaluations and new feedback the prototype was developed. Continuous technical testing was done to ensure that the mobile phone app was technically sound. The prototype was also demonstrated through a scenario, to illustrate its utility when connected to the overall stress management system.

Figure 3. Screen of the form for registration of stress situations.

Figure 4. Sample screens of displayed stress situations: locations (left) and distribution during the hours of a day (right).

1) Simulations

In the first version of the mobile phone app, the registration of situations prompted the user to add information about the situation. When simulating this function, the stress expert of the research project expressed that it might be difficult to get a person with ongoing stress symptoms to manage more information. This feedback led to a couple of new attributes in the app. First and foremost, it became clear that it must be easy to register a stress situation to increase the likelihood that the app is used. Automatic registration of time and location of a situation was introduced. It made it possible to record a stress situation with just a couple of buttons to press. In order to clarify the situation, additional functions made it possible to add manual information at a later time. Another iteration concerned the menu system, that it should be as simple as possible, with few hierarchies, to lessen the mental load. Simulations of new versions of the prototype were made regularly during the development process, approximately every 10 day.

2) Evaluation of Stress Management Properties

To ensure that features of the mobile phone app meet the goals, they were qualitatively evaluated against stress management criteria (see Table 1).

H. Communication of Research

To communicate research effectively, it is important to define the target audience. For the programmers who are supposed to implement a certain design, or improve existing implementation, technical details are necessary in the communication. For a broader research community that includes systems scientists and health practitioners as well, communication has to focus on the instantiation of a health management idea and the system utility in this health domain. In this paper, our intention has been to address this latter group.

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TABLE 1. EVALUATION USING STRESS MANAGEMENT CRITERIA

Stress Management Criteria	Mobile Phone App Feature
Information about experienced stress events over time helps the one with stress symptoms to reflect upon unhealthy patterns (e.g., [12], [14])	Statistical presentations of stress situations over a period of time
Information about stress reactions occurring at different times during the day constitutes valuable feedback on recurrent everyday activities	Statistical presentation per 2 hours during the day
Information should include when and where the situation took place, the level of stress, context and emotions that were experienced [15]	Automatic registration of time and place Additional information being manually registered: perception of stress level and description of the situation
Results of taken actions should be able to be measured, to motivate further actions [12]	Statistical data displaying changes in number of stress situations, levels, etc., over time
Continuous social support is important to change patterns [16]-[17]	Information can be sent to the web based system for ongoing conversations with peers
Personal reflection helps clarify and create meaning of the experiences to promote learning [11], [14]	Personal reflections on stressors and their impact can be described in the text field connected to the logged stress situation Information can be sent to the web based system for help from experts and peers in creating meaning of the experienced stress situations
Things that cause increased stress and mental load have to be avoided	Easy to register a stress situation: the system automatically logs time and place Hierarchy of menu system is low

V. RELATION TO THE WEB BASED STRESS MANAGEMENT SYSTEM

In this paper we have outlined the design and implementations of two interconnected prototypes: one web based stress management system and a newly developed mobile phone app for self-reflection. The mobile phone app will also be a complementary tool to the web based system (see Fig. 5). Technically, the mobile phone app uses Json objects to be able to send information from the app. This information can then be used in the web based system, after necessary adjustments in the web based system have been made.

The new mobile phone tool will contribute to the overall system in several ways; it will support the connection to the physical world and to everyday situations of the users, and bring support for personal self-reflection to the system. The overall system becomes extended due to this new tool. The strengths as a tool for reflection are enhanced through the connectedness with the overall stress management system.

Figure 5. Mobile phone app - a tool of the stress management system.

While the mobile phone app collects and presents information about the user stress image, the actors present in the web based system can contribute with reflections on the stress images. The user can therefore start to reflect upon the stress image on a personal basis, and then engage in learning activities and reflections together with others. The social aspect of learning will be handled by the web based system.

The overall web based stress management system enables different actors to contribute with their different knowledge and experiences. The users with stress symptoms are thereby enhanced as reflection peers and not only receivers of expert advice. Information and advice can be shared with other users of the web based system.

The mobile phone app provides user support in everyday situations and continuous feedback on stress situations. It keeps track of the number of stress situations, stress levels and descriptions/reflections allowing the user to learn about how stress characterizes one's life. Users' position history from the app can serve as a basis for ongoing conversations about registered problem situations, for example. The users can then become aware of their own learning processes through questions and conversations on practical situations, experienced and foreseen difficulties as well as motivational issues.

In general, the data from the mobile phone app could be used to initiate a variety of interventions. The mobile phone app in itself has no support for interventions, only for monitoring. Based on the picture of the documented stress situations, a stress expert in the web based stress management system can recommend relevant exercises and stress areas to work with.

There are individual differences due to diversity of personal stressors and reactions. This is reflected in the documented stress situations in the mobile phone app. This diversity needs also to be handled by the overall system. Information from the app could be processed through different stress intervention areas in the web based system based on the personal information sent.

The stress management system should include learning from the users. Users' logs of situations from the mobile phone

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app can be used as a basis for adjusting the overall system. For example, stress patterns can trigger new types of exercises or even new areas of stress interventions in the web based system.

By comparing changes in stress patterns with the actual usage of the stress management system, it is also possible to get valuable information for system evaluation as well. This could be a good complement to other types of measurements, such as self-reported health status in questionnaires and user evaluations.

VI. CONCLUSIONS AND FUTURE WORK

Today, mobile phones are available in daily life. The presented phone app serves as a bridge between the physical and digital world of the ones with stress symptoms. It conveys stressful situations digitally, as text-based information, location positions, photos, and visually through diagrams. On its own, the app lets the user log perceived stress situations, and to reflect upon patterns of stress situations.

Technically, the mobile phone app is prepared to send information to the web based stress management system. However, the web based system needs to be adjusted as to present this information in a suitable way. Future research will discover how information from the user's app can be displayed as to form the basis of web based conversations with experts and peers.

So far, the system development has resulted in prototypes evaluated by qualitative methods within the research project. Next, the prototypes will be evaluated by a user group, and both qualitative and quantitative analyses will be carried out.

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