Persuasive Design in Mobile Applications for Mental Well-Being: Multidisciplinary Expert Review

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Abstract. Smartphones are a promising channel for health promotion interventions. Mobile applications can track behaviour and provide real-time guidance and support. Research on mobile interventions has mainly focused on physical health and disease management, whereas promotion of mental well-being has received less attention. This paper presents results of a multidisciplinary expert review of twelve currently available mobile applications for mental well-being. The aim of the study was to identify what kinds of engaging and persuasive features are used in the applications and to assess how well the features were implemented. The expert reviews were carried out from user acceptance, mobile intervention design, and persuasive design points of view. Current applications were assessed moderately good from all three perspectives but improvement needs were identified in more versatile utilisation of mobile technology, leveraging social support, and providing a wider range of personalized intervention features.

Keywords: Mobile Applications, Mental Well-being, Persuasive Design, Expert Reviews, TAMM, Technology Acceptance Model.

1 Introduction

Wide-reaching interventions that support and encourage healthy habits are essential to prevent diseases and improve life quality among general population. Mobile devices are considered especially promising tools for pervasive and unobtrusive well-being management, because mobile phones are usually personal and people carry them most of the time [1]. Thus, they are often present in daily situations when people make health related decisions, providing opportunities for timely interventions to support behaviour change [2]. Furthermore, the technical capabilities of smartphones enable not only collecting user data but also its real-time analysis and interpretation to support situational decision making [3].

Promotion of mental well-being is crucially important because subjective well-being influences overall health and longevity [4]. Mood problems and low self-efficacy can be significant barriers for behavioural changes. Many mobile applications have been developed for physical health monitoring and lifestyle interventions [5], such as weight management [6] and exercise [7, 8]. Recently, more research has started to emerge on applications that also address mental health and

B. Godara and K.S. Nikita (Eds.): MobiHealth 2012, LNICST 61, pp. 154–162, 2013.

well-being [5, 9]. Recently an abundance of mobile applications for mood monitoring or general well-being have become available. In order to develop or identify engaging and effective mobile interventions, it can be beneficial to learn from relevant existing mobile applications [10].

The purpose of this study was to identify engaging and persuasive features in a sample of existing mobile applications that target mental well-being. We screened relevant twelve applications out of the hundreds of available applications for an in-depth analysis. The selection process is described in section 2. Section 3 describes the expert review methodology to evaluate the applications from three different perspectives: user acceptance, mobile intervention design, and persuasive design. The results are presented in section 4. Finally in section 5 we analyse and conclude the results.

2 Application Selection Process

Search for relevant mobile applications in the stores of two main platforms, Android and iOS, was carried out during May-July 2011 by browsing through the following categories (Android Market): health & fitness, medical, lifestyle, social, productivity, education, entertainment, communication, and (iPhone App Store): the top 50 applications in all categories, as well as top 300 free and top 150 paid applications in health and fitness; and by entering keywords (Android market): mood, social, mental, behavio(u)r, and (App Store): mood, stress, happiness, training, monitor(ing), smoke, behavio(u)r, mental and awareness. 85 applications from App Store and 26 from Android market were selected based on their relevance and having an average rating of at least 3 in the scale 0-5 in the application store.

Applications were placed on a map with two axes: social-individual usage, and mental-physical focus. The aim was to identify applications that had a holistic approach to well-being. Finally, two researchers reviewed the map of applications and tagged promising applications based on the following criteria:

1. Including any kinds of social functions;
2. Connected to web services;
3. Purpose to track or improve mood;
4. Interactivity (user input and/or data interpretation);
5. Focus on mental well-being and lifestyle, not sports or specific diseases.

The final selection consisted of twelve applications (Table 1), nine from App Store and three from Android Market.

Table 1. Selected twelve mobile applications

	Application name	Description
iPhone	miMood (miM)	Mood tracking over time. Option to email mood history.
	Mood Runner (MoR)	For female users. Tracking emotional patterns with diet, exercise, sleep, stress, energy, sex drive and menstrual cycles.
	LiveHappy (LiH)	Surveys, therapeutic guides for happiness and mood, option to connect to Twitter and Facebook. Based on positive psychology.

Table 1. (*continued*)

	Healthy Habits (HeH)	Self-tracking new/old habits, reminders, high customizability.
	SeemyCity (SmC)	Recommends ways to explore a city based on user mood type.
	Anger Coach (AnC)	Survey input, therapeutic guide for anger management.
	Moodkit (Mok)	Survey input of social, sport, productivity, enjoyment & diet. Committing to actions. Based on Cognitive Behaviour Therapy.
	Awareness Lite (AwL)	Mood lifting by rehearsing mindfulness and reading aphorisms.
	My Balance (MyB)	Self-monitoring life balance with nutrition, fitness and lifestyle.
Android	Mood Meter (MoM)	Collects data automatically, presents mood scores and motivational messages based on time and social interaction.
Android	My CalmBeat (MCB)	Stress reduction through a guided breathing exercise.
Android	T2 Mood Tracker(T2M)	Self-monitoring anxiety, depression, general well-being, head injury, post-traumatic stress, or stress based on daily events.

3 Expert Review Methods

After the twelve applications were selected, we studied them further from three viewpoints: user acceptance, mobile intervention design, and persuasive design. Because multidisciplinary guidelines or heuristics that would cover all the three viewpoints do not exist, we decided to carry our three separate expert reviews with three different experts. The method was based on usage simulation as proposed by [11]. In usage simulation the reviewers who have wide experience of different applications aim to see the applications from an ordinary user's viewpoint. Each of our three experts had 5-15 years of research experience on their field (user acceptance of mobile services, mobile intervention design, and persuasive design).

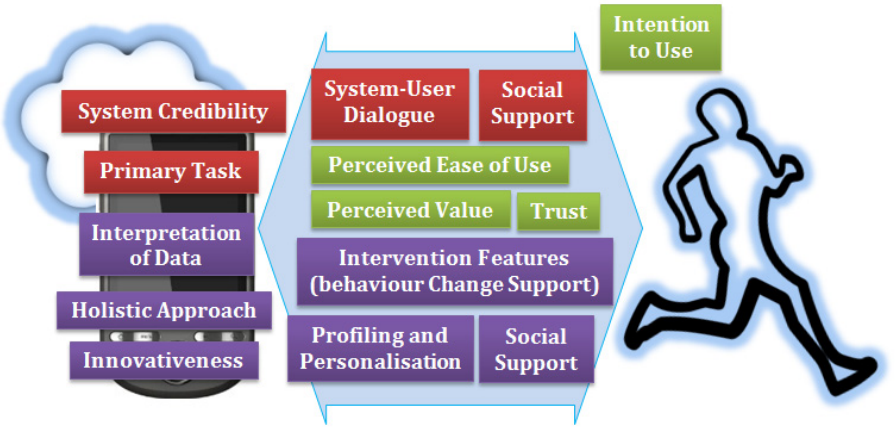

Fig. 1. A diagram combine three relevant theoretical models of user acceptance (green), mobile intervention (purple), and persuasive design (red)

With this expert group we studied whether the applications fulfilled basic user acceptance criteria for mobile services, whether the applications included features for effective attitude or behaviour change and whether the applications included persuasive features (Figure 1). Each expert defined individually their review criteria and carried out the review individually. The aim of the reviews was to assess the applications from user point of view and to identify applications that would be suitable for further evaluations with real-world users. Another aim of the reviews and the earlier selection process was to identify the strengths and shortcomings of current persuasive mental well-being applications. The reviewers are also co-authors of this paper. The review criteria and the expert review methods are described in the following sub sections.

3.1 User Acceptance of Mobile Services

Expert review on user acceptance was based on the Technology Acceptance Model for Mobile Services [12]. The model covers perceived value, ease of use, trust and ease of adoption. The model is intended for user evaluations but in here it was used as a framework to analyse the applications from potential users' points of view based on the evaluator's expertise on other mobile services. The model was interpreted as described in Table 2.

Table 2. User acceptance expert review criteria

Criterion	Description
Ease of use	How effortless it is to use the application? Are functions easy to identify, find and use? Is information provided to the user easy to understand?
Ease of start-to-use	How easy it is to get an overview of the functionality as a first time user? Any specific tricks to do before you can use application?
Value to user	What is the targeted value of the application to the user? Is the proposed value credible?
Trust	Does the information and feedback provided to the user seem reliable? Are there threats related to privacy or safety?
Overall	Overall grade, focusing especially on the persuasive features of the application and the suitability of the application to user evaluation.

3.2 Mobile Intervention Design

The criteria were formed based on various existing guidelines about mobile and technology-based intervention design for health behaviour change [13]. User engagement and effectiveness of mobile interventions can be optimized by using evidence-based intervention methods, profiling and personalization, data interpretation, holistic approach to well-being rather than a narrow focus, and overall expected novelty for the user. The review criteria from mobile intervention design perspective and the theoretical background are presented in Table 3.

Table 3. Mobile intervention expert review criteria

Criterion	Description
Profiling and personalization	Does application collect information to profile the user and tailor output based on user needs and characteristics? [14]
Interpretation of data	Does application interpret the data it collects? Is data abstraction rather than raw data used to display information? [15]
Intervention & behaviour change support	Are there features which actively support behaviour and/or attitude change with the aim of improving well-being of the user?
Holistic approach	Are all sides of well-being covered (mental, physical, social)? [16].
Social support	How much application leverages social support to improve psychosocial well-being [17] and/or increase user engagement? [18]
Novelty	How novel, innovative and interesting the application feels?

3.3 Persuasive Design in Mobile Applications

The criteria were built mainly based on Persuasive System Design model [19] but modified specifically for this review (Table 4). Twenty-nine principles of persuasive design were used as heuristics. The principles were in four categories: primary task support, system credibility, dialogue support, and social support [19]. In addition, goal setting was used as an additional principle [20]. Persuasiveness was defined as the set of attributes that bear on the ability of software to support change in its users' attitudes and/or behaviour. The applications were assessed based on the number of occurrences of the persuasive design principles. A similar but more detailed persuasive design evaluation of the applications is described by Langrial et al [21].

Table 4. Persuasive application design expert review criteria

Primary task	System credibility	Dialogue support	Social support
Reduction	Trustworthiness	Praise	Social facilitation
Tunnelling	Expertise	Rewards	Social comparison
Tailoring	Surface- credibility	Reminders	Normative influence
Personalisation	Real-world feel	Suggestion	Social learning
Self-monitoring	Authority	Similarity	Cooperation
Simulation	Third-party endorsements	Liking	Competition
Rehearsal	Verifiability	Social role	Recognition
Goal-setting			

4 Results of the Expert Reviews

The grades of **user acceptance** review are presented in Table 5. The ease of use of all the applications was at least moderate and crucial usability problems were not identified. Problems in starting to use were identified in two applications and the value to the user was doubtful with two applications. The overall grade was lower than 3 only with 2 applications, so from user acceptance point of view the selection was quite successful. Quite a few applications were basically life style books transferred to mobile applications, thus they did not utilize the measurement and monitoring possibilities of mobile technology.

Table 5. Ratings from user acceptance expert review (1-5)

App	miM	MoR	LiH	HeH	SmC	AnC	Mok	AwL	MyB	MoM	MCB	T2M
Ease of use	4	3	4	3	3	3	3	4	4	4	5	3
Ease of start-to-use	4	3	4	2	2	4	3	4	4	3	4	3
Value	3	4	3	4	2	3	4	3	3	2	3	5
Trustworthy	3	3	3	4	3	4	4	3	3	2	3	4
Overall	**3**	**3**	**4**	**4**	**2**	**3**	**3**	**3**	**3**	**2**	**4**	**4**

The grades of **mobile intervention design** review are presented in Table 6. Live Happy, Moodkit and Healthy Habits incorporated the widest variety of tools and exercises to encourage users to make actual changes in their lives, such as guided exercises or committing to actions. They addressed several life domains and provided explanations for the recommended actions, attempting also to profile users and personalize their output. Also MoodRunner, MyBalance and T2 Mood Tracker allowed tracking of several factors. However, they did not apply intervention techniques beyond reminders and graphical comparisons. The rest of the applications were either fairly simple mood trackers, or otherwise focused on one specific thing such as dealing with anger (Anger Coach) or practising breathing (MyCalmBeat).

The results of the **persuasiveness** review are presented in table 7. From the four categories of the PSD model, the principles in primary task support were the most popular ones whereas the principles in social support category were used the least. Generally, the applications did not use persuasive design principles very widely.

Table 6. Ratings from mobile intervention expert review (1-5)

App	miM	MoR	LiH	HeH	SmC	AnC	Mok	AwL	MyB	MoM	MCB	T2M
Profiling	2	2	4	3	2	2	3	1	1	2	2	2
Interpretation	2	3	3	2	2	2	3	2	2	2	2	3
Intervention	1	2	4	3	1	3	4	2	1	2	2	2
Holistic	2	4	4	4	1	2	4	1	3	1	1	3
Soc-support	2	1	3	2	1	2	2	1	1	2	1	1
Novelty	2	3	4	3	1	2	3	3	2	3	3	2
Overall	**2**	**2**	**4**	**3**	**1**	**2**	**4**	**2**	**2**	**2**	**2**	**2**

Table 7. Occurences of persuasive principles (maximum scores given in brackets)

App	miM	MoR	LiH	HeH	SmC	AnC	Mok	AwL	MyB	MoM	MCB	T2M
Primary task (8)	1	2	5	3	2	2	5	3	1	1	3	1
Credibility (7)	0	1	2	2	1	1	1	1	0	2	0	1
Dialogue (7)	0	0	5	0	0	4	5	2	0	0	0	0
Social support (7)	1	0	1	0	0	0	1	0	0	0	0	0
Total (29)	**2**	**3**	**13**	**5**	**3**	**7**	**12**	**6**	**1**	**3**	**3**	**2**

5 Conclusions

From user acceptance point of view, all the selected applications were at least moderately good. However, many applications were basically life style guide books transformed to mobile applications, and were not utilizing the monitoring capabilities of the mobile devices.

Our selection included both applications focused on a specific issue such as breathing correctly and applications with a more versatile focus. Applications with a sharp focus and simple functions can perform well in providing short-term support for immediate needs and improving self-awareness in small steps. Mood trackers may be sufficient for people who are just curious but for more permanent use, the applications need to include support for behaviour change. In general, the reviewed applications were not using persuasive design principles very widely. The two applications this utilised more than ten persuasive design principles (LiveHappy and Moodkit), were also identified as the most versatile applications in the intervention evaluation. However, it has to be kept in mind that the occurrence of the principles alone does not guarantee the success of the application, the persuasive features also need to be well implemented and the application as a whole needs to be acceptable.

Especially social support features were generally scarce in applications. Live Happy allowed users to send questions to the psychologist who had helped in the design, and Anger Coach offered access to online community resources. Mood-related data may be too sensitive to share in public, but emotional support from peers can have a great impact on well-being and motivation to make lifestyle changes [22].

We identified three major areas of improvement in the applications: 1) Utilising mobile technology more for measures and interactivity. Many of the applications were based on textual input and passive reading by the user instead of actual sensor measures and multimodal interactions. 2) Social support mechanisms that allow users connect and share with a selected group of friends or peers with similar goals. 3) Wider range of intervention features to promote actual behaviour change, tailored to the user. Most of the applications merely collected data without interpretation and suggestions, or provided static information without personalized approach.

When assessing the results of this study it has to be kept in mind that expert reviews do not replace user studies. Long term user studies will be needed e.g. to study how well the applications manage in changing user behaviour. Our future plans include gathering users' insights about their actual preferences and usage behaviour with the applications.

Acknowledgments. The study was supported by SalWe Research Program for Mind and Body (Tekes - the Finnish Funding Agency for Technology and Innovation grant 1104/10). The work of Ting-Ray Chang has been supported by VTT graduate school from 2010 to 2014. Special thanks to Marja Harjumaa for her contribution to persuasive design knowledge and expertise.

References

1. Atienza, A.A., Patrick, K.: Mobile Health: The Killer App for Cyber infrastructure and Consumer Health. American Journal of Preventive Medicine 40(5S2), S151–S153 (2011)
2. Fogg, B.J.: Persuasive Technology. Using Computers to Change What We Think and Do, p. 318. Morgan Kaufmann, San Francisco (2003)
3. Patrick, K., Griswold, W.G., Raab, F., Intille, S.S.: Health and the Mobile Phone. American Journal of Preventive Medicine 35(2), 177–181 (2008)
4. Diener, E., Chan, M.Y.: Happy people live longer: Subjective well-being contributes to health and longevity. Applied Psychology: Health and Well-Being 3(1), 1–43 (2011)
5. Harrison, V., Proudfoot, J., Wee, P.P., Parker, G., Pavlovic, D.H., Manicavasagar, V.: Mobile mental health: Review of the emerging field and proof of concept study. J. Ment. Health 20(6), 509–524 (2011)
6. Mattila, E., Lappalainen, R., Pärkkä, J., Salminen, J., Korhonen, I.: Use of a Mobile Phone Diary for Observing Weight Management and Related Behaviours. Journal of Telemedicine and Telecare 16, 260–264 (2010)
7. Consolvo, S.E., Everitt, K., Smith, I., Landay, J.A.: Design Requirements for Technologies that Encourage Physical Activity. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, vol. 1, pp. 457–466. ACM, Montreal (2006)
8. Toscos, T., Faber, A., An, S., Gandhi, M.P.: Chick Clique: Persuasive Technology to Motivate Teenage Girls to Exercise. In: CHI 2006 Extended Abstracts on Human Factors in Computing Systems, pp. 1873–1878. ACM (2006)
9. Morris, M.E., Kathawala, Q., Leen, T.K., Gorenstein, E.E., Guilak, F., Labhard, M., Deleeuw, W.: Mobile Therapy: Case Study Evaluations of a Cell Phone Application for Emotional Self-awareness. Journal of Medical Internet Research 12(2), e10 (2010)
10. Fogg, B.J.: Creating Persuasive Technologies: An Eight-Step Design Process. In: Proceedings of Persuasive 2009, Claremont, California, USA, April 26-29 (2009)
11. Preece, J., Rogers, Y., Sharp, H., Benyon, D., Holland, S., Carey, T.: Human-Computer Interaction. Addison Wesley (1994)
12. Kaasinen, E.: User Acceptance of Mobile Services. International Journal of Mobile Human Computer Interaction 1(1), 79–97 (2009)
13. Honka, A., Kaipainen, K., Hietala, H., Saranummi, N.: Rethinking Health: ICT-Enabled Services to Empower People to Manage Their Health. IEEE Reviews in Biomedical Engineering 4 (2011)
14. Noar, S.M., Harrington, N.G., Van Stee, S.K., Aldrich, R.S.: Tailored health communication to change lifestyle behaviors. Am. J. Lifestyle Med. 5, 112–122 (2011)
15. Consolvo, S., McDonald, D.W., Landay, J.A.: Theory-driven design strategies for technologies that support behavior change in everyday life. In: CHI 2009 Proceedings, pp. 405–414 (2009)
16. WHO. Constitution of the World Health Organization, Basic Documents, 45th edn., Supplement (October 2006)
17. Hogan, B.E., Linden, W., Najarian, B.: Social support interventions: do they work? Clinical Psych. Rev. 22, 381–440 (2002)
18. Schubart, J.R., Stuckey, H.L., Ganeshamoorthy, A., Sciamanna, C.N.: Chronic health conditions and Internet behavioral interventions: a review of factors to enhance user engagement. CIN 29(2), 81–92 (2011)
19. Oinas-Kukkonen, H., Harjumaa, M.: Persuasive Systems Design: Key Issues, Process Model, and System Features. Communications of the Association for Information Systems 24, Article 28, 485–500 (2009)

20. Nawyn, J., Intille, S.S., Larson, K.: Embedding behavior modification strategies into a consumer electronic device: A case study. In: Dourish, P., Friday, A. (eds.) UbiComp 2006. LNCS, vol. 4206, pp. 297–314. Springer, Heidelberg (2006)
21. Langrial, S., Lehto, T., Oinas-Kukkonen, H., Harjumaa, M., Karppinen, P.: Native mobile applications for personal well-being: a persuasive systems design evaluation. In: The 16th Pacific Asia Conference on Information Systems, PACIS 2012 (2012)
22. Munson, S.: Beyond the share button: Making social network sites for health and wellness. IEEE Potentials, 42–47 (September/October 2011)