

ENHANCED INFORMATION SYSTEMS CONTINUANCE MODEL FOR
MOBILE WELLNESS APPLICATIONS

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Specially dedicated to my families, lecturers and friends
Thank you and I really appreciate for the endless support and Doa'.

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ABSTRACT

Usage of Mobile Wellness Application (MWA) has been proven to be one of the ways to overcome obesity through the practice of self monitoring. However, based on the literature, users have difficulties in prolonging the usage of MWA. Study of MWA continuance use seems to be one of the less explored and examined topics in Information System (IS) domains. Also, most of the existing researches regarding MWA gave focus more on the effectiveness and approaches in developing MWA and were not guided by IS theories. Thus, this study aims to identify factors that influence continuance use of MWA in the context of Malaysia by adapting the Information System Continuance Model (ISCM) as a post adoption IS theory. A survey method was applied using the purposive sampling technique. Data were collected from 164 users of MWA from two different sources; MWA users whom undergone a wellness programme for 10 months and MWA users from online wellness groups on the internet. Partial Least Squares (PLS) method based on Structural Equation Modelling (SEM) was used for analysing the survey data. The outcome of this study offered a theoretical model for encouraging the continuance use of MWA. This research reveals that Perceived Interactivity and Social Norm also influence the continuance use of MWA, and Perceived Usefulness is found to be the strongest factor. Finally, the findings of this study can be useful to MWA users and mobile apps developers, and has the potential to be a guidance for marketing strategy to produce a sustainable MWA in the mobile apps market.

ABSTRAK

Aplikasi Kesihatan Mudah Alih (MWA) telah terbukti menjadi salah satu cara untuk menangani masalah obesiti melalui aktiviti pemantauan diri. Kini, berdasarkan kepada literatur, para pengguna mengalami kesukaran untuk melanjutkan penggunaan MWA. Kajian tentang penggunaan jangka masa panjang MWA merupakan salah satu topik yang kurang di kaji di dalam domain Sistem Maklumat (IS). Dalam pada itu, kebanyakan kajian yang sedia ada berkaitan MWA, lebih fokus kepada keberkesanan dan pendekatan di dalam membangunkan MWA serta tidak berpandukan dengan teori IS. Oleh itu, kajian ini bertujuan mengenal pasti faktor-faktor yang mempengaruhi penggunaan MWA secara berpanjangan di dalam konteks Malaysia dengan mengambil Model Sistem Maklumat Jangka Panjang (ISCM) sebagai teori IS selepas guna pakai. Kaedah kaji selidik telah dijalankan dengan menggunakan teknik sampel bertujuan. Data telah dikumpul daripada seramai 164 pengguna MWA dari dua sumber yang berbeza; pengguna MWA yang sedang menjalankan program kesihatan selama 10 bulan dan juga pengguna MWA daripada kumpulan kesihatan atas talian daripada internet. Kaedah Kuasa Dua Terkecil Separa (PLS) yang berdasarkan Model Persamaan Struktur (SEM) telah digunakan untuk menganalisis data kaji selidik. Hasil kajian ini menawarkan sebuah model teori bagi menggalakkan penggunaan MWA secara berpanjangan. Kajian ini menunjukkan Kepentingan Interaktiviti dan Norma Sosial mempengaruhi penggunaan jangka masa panjang MWA, dan Kepentingan Penggunaan merupakan faktor terkuat. Akhir sekali, model ini memberi faedah kepada pembangun dan pengguna MWA serta mempunyai potensi sebagai strategi pemasaran untuk menghasilkan MWA yang mampan di pasaran aplikasi mudah alih.

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LIST OF ABBREVIATION

MWA	-	Mobile Wellness Application
Apps	-	Applications
IS	-	Information System
WHO	-	World Health Organisation
MASO	-	Malaysia Association of Study for Obesity
mHealth	-	Mobile Health
eHealth	-	Electronic Health
ISCM	-	Information System Continuance Model
TAM	-	Technology Acceptance Model
TRA	-	Theory of Reasoned Action
TPB	-	Theory of Planned Behaviour
ECM	-	Expectation Confirmation Model
UTAUT	-	Unified Theory of Acceptance and Use of Technology
ACP	-	Average Congruency Percentage
PLS	-	Partial Least Square
SEM	-	Structural Equation Modelling
PI	-	Perceived Interactivity
PT	-	Perceived Trust
PU	-	Perceived Usefulness
CON	-	Confirmation
PSQ	-	Perceived Service Quality
SAT	-	Satisfaction
SN	-	Social Norm
CI	-	Continuance Intention
AVE	-	Average Variance Extracted

LIST OF SYMBOLS

R^2	-	Coefficient of Determinant
f^2	-	Effect Size
Q^2	-	Predictive Relevance
P	-	Estimated probability of rejecting the null hypothesis (H0) of a study question when that hypothesis is true

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CHAPTER 1

INTRODUCTION

1.1 Overview

Obesity is now classified as one of the most dangerous illnesses and the number of obese persons continues to increase. According to the World Health Organization (WHO), there are at least 2.6 million people who died each year because of obesity (February, 2010). In Malaysia, a National Health and Morbidity Survey conducted by the Ministry of Health in 2011, revealed that 15.1% of Malaysian were overweight compared to the 4.4% of the population in 1996. According to Saiful Adli Suhaimi, the Senior Assistant Director of the Health Education Division of Ministry of Health of Malaysia, 43% of adult Malaysian, 26% of primary school children, and 20% of teenagers, were obese.

According to WHO, obesity is defined as “abnormal or excessive fat accumulation that impairs health.” The Malaysia Association for the Study of Obesity (MASO) stated that obesity is the result of the energy acquire from the food being greater than the energy required.

Eating a healthy diet is one method for preventing obesity (Hesketh et al., 2005). Organizing a healthy diet requires discipline and guidelines in order to acquire healthy food and to control food intake. Daily food intake depends on individual caloric requirements. Seriously obese individuals require a high level of discipline in terms of their food intake to successfully loss weight. These individuals must be committed to following a plan for their daily food intake.

Yon et al. (2007) and Tsai et al. (2007) in their research, reported that the most effective method for managing diet is through self-monitoring. Self-monitoring is the recording of dietary intake and physical activity so that individuals are aware of their behaviors. Usually the recording process is in the form of a diary and the information that is usually recorded includes dietary intake, physical activity, and daily weight. Self-monitoring is one of the most important feature of behaviour therapy and it involves keeping a detailed record of specific behaviours that overcome obesity, particularly food intake and physical activity (Berkel et al., 2005).

In order to overcome the problem of obesity, researchers have studied obesity interventions using internet based tools. These tools normally include three primary components that combine dietary restrictions, physical activity, and behavior. Advances in Internet-based infrastructure and accessibility have produced effective web-based health behavior interventions that help users improve their behavior by practicing self-monitoring.

The next evolution of computerized health interventions is mobile technology and health or mHealth (Akter and P.ray, 2010; Hooker *et al.*, 2012; Littman-Quinn *et al.*, 2011). Currently, researchers are starting to use mobile phones as platforms for delivering of health interventions. There are several reasons why mobile phones provide a suitable platform for these types of interventions. Firstly, the adoption of phones equipped with sophisticated technical capabilities is a growing trend. Secondly, users always have their phones and they take them everywhere. Thirdly, context awareness features such as sensors, high speed Internet connections, diaries, and reminders are commonly available phone technologies. Finally, personal information can be delivered securely enabling mobile phone healthcare interventions (Klasnja and Pratt, 2012).

Today self-monitoring can be realized using mobile applications (apps). Mobile apps can be downloaded freely and some offer more sophisticated tools that a user can purchase before the app is downloaded. With the availability of these applications, many barriers to self-monitoring, such as privacy, mobility, and time can be overcome, thus increasing the effectiveness of diet management. The Mobile Wellness Applications (MWA) used in this study were defined as a mobile application that helped users monitor their dietary intake and physical activity while they worked to achieve their target weight or maintaining their ideal weight. In addition to the availability of various MWAs, and the usefulness of mobile phones in assisting self-monitoring, the continuous use of the MWA by the user is an additional and important characteristic that will allow a user to monitor their diet and activities and achieve their health goals. The use of an MWA to self-monitoring diet opens new opportunities for further research in diet management.

1.2 Problem Background

Obesity in Malaysia is serious. Information from the Ministry of Health Malaysia reported statistics through the National Health Morbidity Survey conducted in 2011 recorded that 15.1% of adult Malaysians were obese. This figure was greater than the reported 14% of obese adults in 2006. This means that 2.6 million adults in Malaysia are obese and this makes the obesity rate in Malaysia the highest of all South-Eastern Asia countries (MyHealth, 2014). According to Datuk Seri Rd. S. Subramaniam, the Minister of Health Malaysia, this increase was the result of Malaysian society's unhealthy nutritional culture and sedentary lifestyles (Utusan Malaysia, 2014).

Various initiatives have been developed to overcome the growing obesity rate including the use of intervention technologies such as the Internet. A review of the literature revealed that many studies have attempted to prove the effectiveness of

Internet interventions as tools to combat obesity. Most of the studies used experimental methods that commonly employed randomized controlled trials and focus groups. Many of these studies confirmed that Internet interventions were successful strategies for overcoming obesity (Goldstein, 2005; Harvey-Berino *et al.*, 2004; Saperstein *et al.*, 2007; Tate *et al.*, 2001). Although, these studies reported promising outcomes for Internet interventions, a few studies claimed that users had difficulties using these methods over the long term and they will return to their old eating habits (Patrick *et al.*, 2009; Sundar *et al.*, 2012). However, there are other studies that described a few factors for successful Internet interventions for weight loss such as online support, accountability, and personalized feedback (Hwang *et al.*, 2010; Tate *et al.*, 2001; Womble *et al.*, 2004).

MWAs are easily available and can be used to overcome obesity. Studies about MWA interventions, also known as mHealth studies, have been conducted (Arora *et al.*, 2014; Burke *et al.*, 2012; Hooker *et al.*, 2012). Despite the advantages of mobility and efficiency displayed by MWAs, Sundar, et al. (2012) suggested that there was no evidence for the sustained use of MWAs that would promote and monitor healthy behaviors. Even though an MWA is an advanced and improved version of a nutritional diary, users must still self-monitor and continue to enter their food consumption and physical activities. The arguments put forth by Sundar et al were supported by Sherry Pagoto, a licensed clinical psychologist and an Associate Professor of Medicine at the University of Massachusetts Medical School, who claimed that “this generation of apps is not advancing the science of behavioral weight loss when mobile technology is certainly advanced enough to be doing so” (Pagoto, 2012).

This study was based on the premise that prolong engagement of the user with the MWA is the key to its effectiveness. This claim is supported by Burke et al. (2011) who stated that frequent monitoring is associated with weight loss. Tate et al. (2001) mentioned that users involved in a greater variety of weight loss activities lost significantly more weight. Likewise, Tufano et al. (2005) found sustainable

persuasive and ubiquitous technologies were needed to overcome obesity. (Tufano and Karras, 2005a).

There is however, a lack of research regarding the continuous use of MWA. There is one related study conducted by Akter et al. (2013) that was concerned with mHealth telemedicine. Most of the studies regarding MWA were not guided by Information Systems (IS) theories. For instance, Riley et al. (2011) claimed that most of the mobile interventions related to treatment adherence did not report a theoretical basis for intervention development. Even though those studies provided a theoretical basis, very few attempted to evaluate any of the theoretical components hypothesized to be affected by the intervention. (Riley *et al.*, 2011)

The most common IS theories applied to studies on continuance use were Technology Acceptance Model (TAM), Theory of Planned Behaviour (TPB), IS Continuance Model (ISCM), IS Success Model, and Commitment- Based Model. ISCM is the most widely used theory and it is applied in many different contexts. ISCM has been tested in various contexts such as in micro-blogging (Zhao and Lu, 2012), online banking (Vatanasombut *et al.*, 2008), online auctions (Wang and Chiang, 2009) and online shopping (Al-Maghrabi *et al.*, 2011). In the context of online health, the most recent study that used ISCM was conducted by Akter et al. (2013) to explain the continuous use of mHealth services. Based on previous studies, ISCM is useful as a theoretical reference for explaining continuous use.

1.3 Problem Statement

This study agrees with the arguments made by (Burke *et al.*, 2012; Klasnja and Pratt, 2012; Tufano and Karras, 2005b) who claimed that a MWA can be an effective intervention for weight loss if used continuously. However, except for a

study by Akter (2013) that did examine the issue of continuous usage, previous studies on MWA mostly focused on the effectiveness of new mobile apps developed for their studies on obesity prevention or approaches for developing MWAs to combat obesity. For example, previous studies claimed that the existence of continuous interactions between users of an online wellness community resulted in long-term weight loss success. Continuous interactions also helped users to quickly adapt to the apps and become familiar with them (Klasnja and Pratt, 2012; Lieffers and Hanning, 2012).

In other studies (Klasnja and Pratt, 2012; Chen *et al.*, 2012; Liang & Yeh, 2011; Kim, 2010; Hwang *et al.*, 2009; Wang & Chiang, 2009; Hong *et al.*, 2008), the researchers claimed that social involvement allowed users to discover ideas and tips regarding a healthy diet. Users were also exposed to valuable information and this led to successful weight loss. Community support and social involvement were factors that led to the continuous use of a MWA. These two factors were proven to be effective when embedded in the development of a MWA. However, these factors have not been integrated with any continuance model, especially in the context of MWA. This opens the opportunity to further explore other potential factors that may be critical and encourage a user to continuously use MWA.

There is still a lack of studies related to the continuous use of MWAs, especially those guided by Information Systems theories. Currently the only study is one conducted by Akter (2013) who proposed a model for the continuous use of mHealth. However, the focus of Akter's study was mobile telemedicine services and not the specific MWA. Thus, the factors that influenced Akter's users to continue to use the MWA remain unknown. This current study was conducted to identify the factors that encourage users to continue using a MWA for self-monitoring and as a tool for overcoming obesity.

1.4 Research Questions

This study investigated the factors that influence the continuing use of MWA. The main research question for this study was:

How to encourage users to continue to use a MWA?

Subsequently the following three research questions were developed for this study:

- i) What are the factors that influence the intention to continue to use the MWA?
- ii) How to develop a model that would encourage the intention to continue to use the MWA?
- iii) What suggestions can be made to mobile apps developers and to ensure that users will continue to use the MWA?

1.5 Research Objectives

There were three main objectives of this study:

- i) To investigate the factors that influence the intention to continue to use the MWA
- ii) To develop a model for encouraging the intention to continue to use the MWA.
- iii) To provide suggestions to mobile apps developers and users to ensure that users will continue to use the MWA.

1.6 Scope of Study

The scope of this study was limited to the post-adoption of technology that focused on factors that contributed to the intention to continue to use a MWA by individuals in Malaysia. This study investigated various factors that involved behavioural aspects that had the potential to influence the intention to continue to use the MWA. This study was based on empirical research and the respondents had experience using MWAs. This study was based on calorie-based paradigms for overcoming obesity implemented by many established wellness practitioners and wellness companies such as SparkPeople and MyFitnessPal.

1.7 Significance of the Study

This study made the following contributions:

This study addressed an individual user's intention to continue using a MWA. The results should be of interest to mobile apps developers and users.

A developer can refer to the model developed in this study to focus on the factors that influence the user's intention to continue to use a MWA. This would allow developers to create features that would benefit their users.

As for users, they are at the receiving end of the apps development. They are provided with apps that can assist them to self-monitor their diet and keep their commitment to use the apps. As a result, a MWA can be used to its full potential and the user would enjoy the benefits of continuously using the app. Wellness consultants could provide their customers with apps that would help them keep track

their diet. Consequently, participants in wellness program would be more likely to realize their health goals.

1.8 The Organization of the Thesis

The remaining chapters are organized in the following manner. Chapter 2 outlines the literature review that looked at Information System (IS) Continuance use Model, mHealth Continuance Use Model, existing MWAs, and the identification of research gaps in MWA research. Chapter 3 presents the methodology used in this study. Chapter 4 discusses the development of the proposed model and pilot study. Chapter 5 describes data analysis and discussion in Chapter 6, and lastly, Chapter 7 provides a conclusion for this study.

REFERENCES

- Akter, S., and P. ray. (2010). mHealth - an Ultimate Platform to Serve the Unserved. International Medical Informatics Association (IMIA), 75-81.
- Akter, S., Ray, P., and D'Ambra, J. (2013). Continuance of mHealth services at the bottom of the pyramid: the roles of service quality and trust. *Electronic Markets*, 23(1), 29-47.
- Al-Maghrabi, T., and Dennis, C. (2011). What drives consumers' continuance intention to e-shopping?: Conceptual framework and managerial implications in the case of Saudi Arabia. *International Journal of Retail & Distribution Management*, 39(12), 899-926.
- Al-Maghrabi, T., Dennis, C., and Halliday, S. V. (2011). Antecedents of continuance intentions towards e-shopping: the case of Saudi Arabia. *Journal of Enterprise Information Management*, 24(1), 85-111.
- Aphramor, L. (2009). Weight management as a cardioprotective intervention raises issues for nutritional scientists regarding clinical ethics. Paper presented at the Proc Nut Soc, E401.
- Arora, S., Peters, A. L., Burner, E., Lam, C. N., and Menchine, M. (2014). Trial to Examine Text Message-Based mHealth in Emergency Department Patients With Diabetes (TEXT-MED): A Randomized Controlled Trial. *Annals of emergency medicine*, 63(6), 745-754. e746.
- Bacon, L., and Aphramor, L. (2011). Weight science: evaluating the evidence for a paradigm shift. *Nutr j*, 10(9).
- Baker, R. C., and Kirschenbaum, D. S. (1993). Self-monitoring may be necessary for successful weight control. *Behavior Therapy*, 24(3), 377-394.
- Bandura, A. (1989). Human agency in social cognitive theory. *American psychologist*, 44(9), 1175.

- Barnes, S. J. (2011). Understanding use continuance in virtual worlds: Empirical test of a research model. *Information & Management*, 48(8), 313-319.
- Bhattacharjee, A. (2001). Understanding information systems continuance: An expectation-confirmation model. *MIS quarterly*, 25(3), 351-370.
- Boutelle, K. N., and Kirschenbaum, D. S. (1998). Further Support for Consistent Self-Monitoring As A Vital Component Of Successful Weight Control. *Obes. Res*, 6, 219–222.
- Boutelle, K. N., and Kirschenbaum, D. S. (1999). How Can Obese Weight Controllers Minimize Weight Gain During The High Risk Holiday Season? By Self-Monitoring Very Consistently. . *Health Psychol*, 18, 364–368.
- Breton, E., Fuemmeler, B., and Abrams, L. (2011). Weight loss—there is an app for that! But does it adhere to evidence-informed practices? *Translational Behavioral Medicine*, 1(4), 523-529.
- Brug, J., Campbell, M., and van Assema, P. (1999). The application and impact of computer-generated personalized nutrition education: a review of the literature. *Patient education and counseling*, 36(2), 145-156.
- Bull, F. C., Holt, C. L., Kreuter, M. W., Clark, E. M., and Scharff, D. (2001). Understanding the Effects of Printed Health Education Materials: Which Features Lead to Which Outcomes? *Journal of Health Communication*, 6(3), 265-279.
- Burgoon, J. K., Bonito, J. A., Bengtsson, B., Ramirez Jr, A., Dunbar, N. E., and Miczo, N. (1999). Testing the interactivity model: Communication processes, partner assessments, and the quality of collaborative work. *Journal of Management Information Systems*, 33-56.
- Burke, L. E., Styn, M. A., Sereika, S. M., Conroy, M. B., Ye, L., Glanz, K., et al. (2012). Using mHealth technology to enhance self-monitoring for weight loss: a randomized trial. *American journal of preventive medicine*, 43(1), 20-26.
- Burke, L. E., Wang, J., and Sevick, M. A. (2011). Self-Monitoring in Weight Loss: A Systematic Review of the Literature. *Journal of the American Dietetic Association*, 111(1), 92-102.

- Chang, Y. P., and Zhu, D. H. (2012). The role of perceived social capital and flow experience in building users' continuance intention to social networking sites in China. *Computers in Human Behavior*, 28(3), 995-1001.
- Chen, S.-C., Yen, D. C., and Hwang, M. I. (2012). Factors influencing the continuance intention to the usage of Web 2.0: An empirical study. *Computers in Human Behavior*, 28(3), 933-941.
- Chin, W. W. (1998). The partial least squares approach to structural equation modeling. *Modern methods for business research*, 295(2), 295-336.
- Chiu, C.-M., and Wang, E. T. G. (2008). Understanding Web-based learning continuance intention: The role of subjective task value. *Information & Management*, 45(3), 194-201.
- Christakis, N. A., and Fowler, J. H. (2007). The spread of obesity in a large social network over 32 years. *New England journal of medicine*, 357(4), 370-379.
- Christakis, N. A., and Fowler, J. H. (2008). The collective dynamics of smoking in a large social network. *New England journal of medicine*, 358(21), 2249-2258.
- Consolvo, S., McDonald, D. W., Toscos, T., Chen, M. Y., Froehlich, J., Harrison, B., et al. (2008). Activity sensing in the wild: a field trial of ubifit garden. Paper presented at the Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 1797-1806.
- Coulson, N. S., Buchanan, H., and Aubeeluck, A. (2007). Social support in cyberspace: A content analysis of communication within a Huntington's disease online support group. *Patient Education & Counseling*, 68(2), 173-178.
- Cyr, D., Head, M., and Ivanov, A. (2009). Perceived interactivity leading to e-loyalty: Development of a model for cognitive-affective user responses. *International Journal of Human-Computer Studies*, 67(10), 850-869.
- da Silva, W. R., Dias, J. C. R., Maroco, J., and Campos, J. A. D. B. (2014). Confirmatory factor analysis of different versions of the Body Shape Questionnaire applied to Brazilian university students. *Body image*, 11(4), 384-390.

- Denning, T., Andrew, A., Chaudhri, R., Hartung, C., Lester, J., Borriello, G., et al. (2009). Balance: towards a usable pervasive wellness application with accurate activity inference. Paper presented at the Proceedings of the 10th workshop on Mobile Computing Systems and Applications, 5.
- Fogg, B., and Allen, E. (2009). 10 uses of texting to improve health. Paper presented at the Proceedings of the 4th International Conference on Persuasive Technology.
- Franklin, V. L., Waller, A., Pagliari, C., and Greene, S. A. (2006). A randomized controlled trial of Sweet Talk, a text-messaging system to support young people with diabetes. *Diabetic Medicine*, 23(12), 1332-1338.
- Free, C., Phillips, G., Felix, L., Galli, L., Patel, V., and Edwards, P. (2010). The effectiveness of M-health technologies for improving health and health services: a systematic review protocol. *BMC Research Notes*, 3(1), 250.
- Gallagher, K. I., Jakicic, J. M., Napolitano, M. A., and Marcus, B. H. (2006). Psychosocial factors related to physical activity and weight loss in overweight women. *Medicine and science in sports and exercise*, 38(5), 971-980.
- Gasser, R., Brodbeck, D., Degen, M., Luthiger, J., Wyss, R., and Reichlin, S. (2006). Persuasiveness of a Mobile Lifestyle Coaching Application Using Social Facilitation. In W. Ijsselsteijn, Y. W. Kort, C. Midden, B. Eggen and E. Hoven (Eds.), *Persuasive Technology* (Vol. 3962, pp. 27-38): Springer Berlin Heidelberg.
- Goldstein, D. J. (2005). The Internet and Obesity Treatment. In *The Management of Eating Disorders and Obesity* (pp. 367-374): Humana Press.
- Gudergan, S. P., Ringle, C. M., Wende, S., and Will, A. (2008). Confirmatory tetrad analysis in PLS path modeling. *Journal of Business Research*, 61(12), 1238-1249.
- Guo, X.-t., Yuan, J.-q., Cao, X.-f., and Chen, X.-d. (2012, 20-22 Sept. 2012). Understanding the acceptance of mobile health services: A service participants analysis. Paper presented at the Management Science and Engineering (ICMSE), 2012 International Conference on, 1868-1873.

- Hair, J. F., Tatham, R. L., Anderson, R. E., and Black, W. (2006). *Multivariate data analysis* (Vol. 6): Pearson Prentice Hall Upper Saddle River, NJ.
- Harvey-Berino, J., Pintauro, S., Buzzell, P., Elizabeth, and Gold, C. (2004). Effect of Internet Support on the Long-Term Maintenance of Weight Loss. *Obesity Research*, 12(2).
- Heron, K. E., and Smyth, J. M. (2010). Ecological momentary interventions: incorporating mobile technology into psychosocial and health behaviour treatments. *British journal of health psychology*, 15(1), 1-39.
- Hooker, D., Shen, N., and Ho, K. (2012). Leveraging Community for mHealth Research and Development. In *Technology Enabled Knowledge Translation for eHealth* (pp. 153-174): Springer.
- Hossain, M. D., Junghoon, M., Sun Me, C., and Tae Hyung, K. (2009, 24-26 Nov. 2009). The Effect of Social Embeddedness to the Information Systems Continuance: Context of E-government System Implementing in Rural Area. Paper presented at the Computer Sciences and Convergence Information Technology, 2009. ICCIT '09. Fourth International Conference on, 1487-1492.
- Hsieh, J. P.-A., Rai, A., and Keil, M. (2008). Understanding digital inequality: Comparing continued use behavioral models of the socio-economically advantaged and disadvantaged. *MIS quarterly*, 97-126.
- Hung, M.-C., Chang, I. C., and Hwang, H.-G. (2011). Exploring academic teachers' continuance toward the web-based learning system: The role of causal attributions. *Computers & Education*, 57(2), 1530-1543.
- Hwang, K. O., Ottenbacher, A. J., Green, A. P., Cannon-Diehl, M. R., Richardson, O., Bernstam, E. V., et al. (2010). Social support in an Internet weight loss community. *International Journal of Medical Informatics*, 79(1), 5-13.
- Idriss, S. Z., Kvedar, J. C., and Watson, A. J. (2009). The role of online support communities: benefits of expanded social networks to patients with psoriasis. *Archives of Dermatology*, 145(1), 46-51.
- Kang, Y. S., and Lee, H. (2010). Understanding the role of an IT artifact in online service continuance: An extended perspective of user satisfaction. *Computers in Human Behavior*, 26(3), 353-364.

- Kim, B. (2010). An empirical investigation of mobile data service continuance: Incorporating the theory of planned behavior into the expectation–confirmation model. *Expert Systems with Applications*, 37(10), 7033-7039.
- Kim, B., Choi, M., and Han, I. (2009). User behaviors toward mobile data services: The role of perceived fee and prior experience. *Expert Systems with Applications*, 36(4), 8528-8536.
- Klasnja, P., and Pratt, W. (2012). Healthcare in the pocket: Mapping the space of mobile-phone health interventions. *Journal of Biomedical Informatics*, 45(1), 184-198.
- Kollmann, A., Riedl, M., Kastner, P., Schreier, G., and Ludvik, B. (2007). Feasibility of a Mobile Phone–Based Data Service for Functional Insulin Treatment of Type 1 Diabetes Mellitus Patients. *Journal of medical Internet research*, 9(5).
- Kopp, J. (1988). Self-monitoring: A literature review of research and practice. Paper presented at the Social Work Research and Abstracts, 8-20.
- Kyriacou, E. C., Pattichis, C. S., and Pattichis, M. S. (2009, 3-6 Sept. 2009). An overview of recent health care support systems for eEmergency and mHealth applications. Paper presented at the Engineering in Medicine and Biology Society, 2009. EMBC 2009. Annual International Conference of the IEEE, 1246-1249.
- Latner, J. (2008). Self-help in the long-term treatment of obesity. *obesity reviews*, 2(2), 87-97.
- Lee, T. (2005). The impact of perceptions of interactivity on customer trust and transaction intentions in mobile commerce. *Journal of Electronic Commerce Research*, 6(3), 165-180.
- Lee, Y., and Kwon, O. (2011). Intimacy, familiarity and continuance intention: An extended expectation–confirmation model in web-based services. *Electronic Commerce Research and Applications*, 10(3), 342-357.
- Lieffers, J. R. L., and Hanning, R. M. (2012). Dietary assessment and self-monitoring with nutrition applications for mobile devices. *Canadian Journal of Dietetic Practice and Research*, 73(3), 253-260.

- Lievrouw, L. A., and Livingstone, S. (2002). *Handbook of new media: Social shaping and consequences of ICTs*: Sage.
- Lin, H. (2008). *Examining the Continued Usage of Electronic Knowledge Repositories: An Integrated Model*. Unpublished Ph.D., Virginia Polytechnic Institute and State University, Ann Arbor.
- Littman-Quinn, R., Chandra, A., Schwartz, A., Fadlemola, F. M., Ghose, S., Luberti, A. A., et al. (2011). mHealth applications for telemedicine and public health intervention in Botswana. Paper presented at the IST-Africa Conference Proceedings, 2011, 1-11.
- Mamykina, L., Mynatt, E., Davidson, P., and Greenblatt, D. (2008). MAHI: investigation of social scaffolding for reflective thinking in diabetes management. Paper presented at the Proceedings of the SIGCHI Conference on Human Factors in Computing Systems.
- Mansar, S. L., Jariwala, S., Shahzad, M., Anggraini, A., Behih, N., and AlZeyara, A. (2012). A Usability Testing Experiment For A Localized Weight Loss Mobile Application. *Procedia Technology*, 5(0), 839-848.
- Mantymaki, M., and Merikivi, J. (2010, 5-8 Jan. 2010). Investigating the Drivers of the Continuous Use of Social Virtual Worlds. Paper presented at the System Sciences (HICSS), 2010 43rd Hawaii International Conference on, 1-10.
- Mattila, E., Lappalainen, R., Pärkkä, J., Salminen, J., and Korhonen, I. (2010). Use of a mobile phone diary for observing weight management and related behaviours. *Journal of telemedicine and telecare*, 16(5), 260-264.
- McConnon, Á., Kirk, S. F. L., and Ransley, J. K. (2009). Process Evaluation of an Internet-based Resource for Weight Control: Use and Views of an Obese Sample. *Journal of Nutrition Education and Behavior*, 41(4), 261-267.
- Mo, P. K., and Coulson, N. S. (2008). Exploring the communication of social support within virtual communities: A content analysis of messages posted to an online HIV/AIDS support group. *Cyberpsychology & behavior*, 11(3), 371-374.
- Moore, S. M., Dolansky, M. A., Ruland, C. M., Pashkow, F. J., and Blackburn, G. G. (2003). Predictors of women's exercise maintenance after cardiac

- rehabilitation. *Journal of Cardiopulmonary Rehabilitation and Prevention*, 23(1), 40-49.
- Pagoto, S. (2012). Why Weight Loss Mobile Apps Aren't Really Changing the Game. An obesity expert's view of weight loss mobile apps Retrieved 3 January 2013, 2013
- Park, M.-J., Kim, H.-S., and Kim, K.-S. (2009). Cellular phone and Internet-based individual intervention on blood pressure and obesity in obese patients with hypertension. *International Journal of Medical Informatics*, 78(10), 704-710.
- Patrick, K., Griswold, W. G., Raab, F., and Intille, S. S. (2008). Health and the Mobile Phone. *American Journal of Preventive Medicine*, 35(2), 177-181.
- Patrick, K., Raab, F., Adams, M. A., Dillon, L., Zabinski, M., Rock, C. L., et al. (2009). A text message-based intervention for weight loss: randomized controlled trial. *Journal of Medical Internet Research*, 11(1).
- Pharow, P., Blobel, B., Ruotsalainen, P., Petersen, F., and Hovsto, A. (2009). Portable devices, sensors and networks: wireless personalized eHealth services. *Stud Health Technol Inform*, 150, 1012-1016.
- Phillips, G., Felix, L., Galli, L., Patel, V., and Edwards, P. (2010). The effectiveness of M-health technologies for improving health and health services: a systematic review protocol. *BMC research notes*, 3(1), 250.
- Riley, W., Rivera, D., Atienza, A., Nilsen, W., Allison, S., and Mermelstein, R. (2011). Health behavior models in the age of mobile interventions: are our theories up to the task? *Translational Behavioral Medicine*, 1(1), 53-71.
- Saffi, M. A. L., Macedo Junior, L. J. J. d., Trojahn, M. M., Polanczyk, C. A., and Rabelo-Silva, E. R. (2013). Validity and reliability of a questionnaire on knowledge of cardiovascular risk factors for use in Brazil. *Revista da Escola de Enfermagem da USP*, 47(5), 1083-1089.
- Saperstein, S. L., Atkinson, N. L., and Gold, R. S. (2007). The impact of Internet use for weight loss. *obesity reviews*, 8, 459-465.
- Sarasohn-Kahn, J. (2008). *The wisdom of patients: Health care meets online social media*: California HealthCare Foundation Oakland, CA.

- Sperduto, W. A., Thompson, H. S., and O'Brien, R. M. (1986). The effect of target behavior monitoring on weight loss and completion rate in a behavior modification program for weight reduction. *Addictive behaviors*, 11(3), 337-340.
- Sundar, S. S., Bellur, S., and Jia, H. (2012). Motivational Technologies: A Theoretical Framework for Designing Preventive Health Applications. In M. Bang and E. Ragnemalm (Eds.), *Persuasive Technology. Design for Health and Safety* (Vol. 7284, pp. 112-122): Springer Berlin Heidelberg.
- Tate, D. F., Wing, R. R., and Winett, R. A. (2001). Using Internet technology to deliver a behavioral weight loss program. *JAMA: the journal of the American Medical Association*, 285(9), 1172-1177.
- Thong, J. Y. L., Hong, S.-J., and Tam, K. Y. (2006). The effects of post-adoption beliefs on the expectation-confirmation model for information technology continuance. *International Journal of Human-Computer Studies*, 64(9), 799-810.
- Thorson, K. S., and Rodgers, S. (2006). Relationships between blogs as eWOM and interactivity, perceived interactivity, and parasocial interaction. *Journal of Interactive Advertising*, 6(2), 39-50.
- Tsai, C. C., Lee, G., Raab, F., Norman, G. J., Sohn, T., Griswold, W. G., et al. (2007). Usability and Feasibility of PmEB: A Mobile Phone Application for Monitoring Real Time Caloric Balance. *Mobile Netw Appl*, 12, 173-184.
- Tufano, J. T., and Karras, B. T. (2005a). Mobile eHealth interventions for obesity: a timely opportunity to leverage convergence trends. *Journal of medical Internet research*, 7(5).
- Tufano, J. T., and Karras, B. T. (2005b). Mobile eHealth Interventions for Obesity: A Timely Oppurtunity to Leverage Convergence Trends. *Journal of Medical Internet Research* 7 (5), 58.
- Vatanasombut, B., Igbaria, M., Stylianou, A. C., and Rodgers, W. (2008). Information systems continuance intention of web-based applications customers: The case of online banking. *Information & Management*, 45(7), 419-428.

- Verheijden, M., Bakx, J., Van Weel, C., Koelen, M., and Van Staveren, W. (2005). Role of social support in lifestyle-focused weight management interventions. *European Journal of Clinical Nutrition*, 59, S179-S186.
- Wang, J.-C., and Chiang, M.-J. (2009). Social interaction and continuance intention in online auctions: A social capital perspective. *Decision Support Systems*, 47(4), 466-476.
- Wang, T., Oh, L.-B., Wang, K., and Yuan, Y. (2012). User adoption and purchasing intention after free trial: an empirical study of mobile newspapers. *Information Systems and e-Business Management*, 1-22.
- White, M., and Dorman, S. M. (2001). Receiving social support online: implications for health education. *Health education research*, 16(6), 693-707.
- Whittaker, R., Maddison, R., McRobbie, H., Bullen, C., Denny, S., Dorey, E., et al. (2008). A multimedia mobile phone-based youth smoking cessation intervention: findings from content development and piloting studies. *Journal of Medical Internet Research*, 10(5).
- Williams, P., Barclay, L., and Schmied, V. (2004). Defining social support in context: a necessary step in improving research, intervention, and practice. *Qualitative health research*, 14(7), 942-960.
- Wilson, G. T. (1994). Behavioral treatment of obesity: Thirty years and counting. *Advances in Behaviour Research and Therapy*, 16(1), 31-75.
- Womble, L. G., Wadden, T. A., McGuckin, B. G., Sargent, S. L., Rothman, R. A., and Krauthamer-Ewing, E. S. (2004). A randomized controlled trial of a commercial internet weight loss program. *Obesity Research*, 12(6), 1011-1018.
- Wright, K. B., and Bell, S. B. (2003). Health-related support groups on the Internet: Linking empirical findings to social support and computer-mediated communication theory. *Journal of Health Psychology*, 8(1), 39-54.
- Zhao, L., and Lu, Y. (2012). Enhancing perceived interactivity through network externalities: An empirical study on micro-blogging service satisfaction and continuance intention. *Decision Support Systems*, 53(4), 825-834.

- Zhao, L., Lu, Y., Zhang, L., and Chau, P. Y. K. (2012). Assessing the effects of service quality and justice on customer satisfaction and the continuance intention of mobile value-added services: An empirical test of a multidimensional model. *Decision Support Systems*, 52(3), 645-656.
- Zhaoli, M., Meiyun, Z., and Jina, F. (2008, 13-15 Oct. 2008). Why Google Cannot Beat Baidu in China Search Engine Market. Paper presented at the Ubiquitous Multimedia Computing, 2008. UMC '08. International Symposium on, 190-194.
- Zheng, Y., Zhao, K., and Stylianou, A. (2013). The impacts of information quality and system quality on users' continuance intention in information-exchange virtual communities: An empirical investigation. *Decision Support Systems*, 56, 513-524.
- Zhou, T. (2013). An empirical examination of continuance intention of mobile payment services. *Decision Support Systems*, 54(2), 1085-1091.