



Sustaining Health Behaviors Through Empowerment: A Deductive Theoretical Model of Behavior Change Based on Information and Communication Technology (ICT)

Ala Alluhaidan^{1,2}, Samir Chatterjee², David Drew²,
and Agnis Stibe^{3,4}

¹ Princess Nourah bint Abdulrahman University, Riyadh 11671, Saudi Arabia
ala.alluhaidan@cgu.edu

² Claremont Graduate University, Claremont, CA 91711, USA
profsamirl@gmail.edu,

{ala.alluhaidan,david.drew}@cgu.edu

³ Paris ESLSCA Business School, 75007 Paris, France
a.stibe@eslsca.fr

⁴ MIT Media Lab, Cambridge, MA 02142, USA

Abstract. Theoretical and practical advances have been made within healthcare informatics. Yet, mainstream research has primarily focused on signs and consequences without consideration to causal factors. Likewise, there is an increase demand for better self-management interventions. This demand resulted from the growing elderly populations with chronic conditions that fail to adhere to self-care routine. Still, most of the Healthcare Informatics interventions have achieved short-term success; while the goal is to engage population towards long-term behavior change. This research aims to shed light on the topic of Information and Communication Technology (ICT) empowerment by building and testing a theoretical-model for building intentions to sustain a healthy behavior. With a trial of 174 responses, we found positive results and a promising approach for Empowerment based on this model.

Keywords: Empowerment · Information and Communication Technology (ICT)
Health behavior change · Persuasive wellbeing

1 Introduction

It is not surprising that a chronic disease can tremendously impact life expectancy. Across the world, there is a growing crisis of elderly populations suffering from chronic diseases (such as diabetes, heart failure, etc.); the cost of treating such patients is very high. Additionally, chronic diseases need to be managed and most people fail to adhere to self-management guidelines. In the face of this epidemic, the US healthcare system

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is struggling and trying to find solutions by improving access to timely, quality treatments, at the same time, US healthcare system faces a shortage of clinicians and care-givers [1]:

The global epidemic of chronic disease must, and can, be stopped. This invisible epidemic is an under-appreciated cause of poverty and hinders the economic development of many countries. Chronic disease is responsible for 60% of all deaths worldwide with almost half of chronic disease deaths occurring in people under the age of 70 [1].

Yet, the risk of deteriorating quality of life, readmission to the hospital, or death can be mitigated with proper disease management [2]. There is still a need for a model to detail a technology-enabled empowerment and encourage sustainable behavior change in order to improve self-care management. Home monitoring can transform current practices in chronic disease care to a more proactive approach that empowers patients to take control and improve their health outcomes. This new model in delivering healthcare at home seems convenient because it does not require patients to leave their home and it is more cost effective. While a number of chronic diseases demand daily monitoring, such as Diabetes, Congestive Heart Failure (CHF), Chronic Obstructive Pulmonary Disease (COPD), and Hypertension, research in remote patient monitoring has proven its effectiveness in managing and tracking progress or deterioration [1]. Yet, behavior modification through messages and instructions in the current approaches has only achieved short-term success.

In March 2014, our research team launched MyHeart, a system developed at university lab that has been implemented at Loma Linda hospital to monitor CHF patients' health. An integral part of the system is a smart phone app that displays patient vitals, asks for symptoms, shows motivational messages and reminders, and plots a chart representation of daily vitals and symptoms [3]. Despite MyHeart's effectiveness in tracking patients' health and providing motivational messages, there was an adherence gap for some users of this remote monitoring system. In other words, while some patients adhere to the guidelines, there were many patients that didn't adhere and there is a gap. Based on the feedback from those patients, it was clear that tailored messages could be an effective way of reducing the adherence gap. Thus, we assume empowerment through this approach increases the sustainability of a health behavior.

This has led us to assume we could better empower the patients to remain engaged, build intention to change, and ultimately achieve sustainable positive behavior through this approach. Knowing how to engage and motivate individuals is a complicated process with multiple coinciding elements. Yet, customized messages that matches personal goals can keep an individual active toward his/her plan [4].

Besides the importance of personal goals [3], we also looked at experientially rewarding content and several contextual variables that influence the sustainability of a behavior: social connection, self-efficacy, technology tools, and community support [5, 6]. Then, we built our ICT empowerment model using these latent constructs. This research attempts to find factors that support sustainable health behavior and investigates how empowerment can help people adhere to post-discharge guidelines. Positive behavior change is hard to maintain especially because of factors such as the enjoyment of negative behavior, addiction, or the lack of immediate benefits. About 50% of the population fails to sustain positive behavior changes [7]. Since there is more

than one factor that will empower the user to sustain the behavior, these factors may need to match internal feelings and stimulate internal commitment. Additionally, long-term management of chronic conditions is a critical factor in the cost of healthcare. In fact, \$3 trillion is spent annually in the US for healthcare. Around 30% of this can be avoided with positive health behavior. Moreover, more than \$100 billion is spent annually on poor medication adherence, some of which can be corrected [8]. Yet, empowering people to sustain their behavior changes is a complex process. Empowerment as defined by [9] is the discovery and development of one's inherent capacity to be responsible for one's own life. "Patients are thus empowered when they are in possession of the knowledge, skills, and self-awareness necessary to identify and attain their own goals." [10] Existing research shows that personal goals and customized tailored messages are better perceived by an audience [11]. Hence, we develop a theoretical model for empowerment that provides more insight on how to construct those messages for sustainability.

2 Literature Review

Persuasive design was introduced as one way to encourage adherence and to promote health and health-related behavior [12]. Yet, the concept of persuasive design holds a negative connotation, and therefore, empowerment was introduced to describe the continuous motivation process [13]. Several studies related to empowerment and to the factors related will be described below.

Dempsey and Foreman [14] describe empowerment in clinical literature as a desirable process and outcome of service. Yet, research on empowerment has remained mainly theoretical. In an attempt to operationalize and measure the concept, the Family Empowerment Scale (FES) was developed. This scale defines three constructs: knowledge, behavior, and attitudes on different levels such as family, service systems, and community/politics [15]. Previous research in empowerment was also mainly focused on sharing information and the involvement of parents in decision-making. "This approach refers to empowerment at an individual rather than at an organizational or community level, and will usually include a combination of self-acceptance and self-confidence" [16, 17].

Within healthcare domain, Jerofke's article [18], defines patient empowerment as "(1) helping patients to realize that they can and should participate in their care and treatment planning; (2) providing patients with access to information, support, resources and opportunities to learn and grow; (3) helping to facilitate collaboration with providers, family and friends; and (4) allowing patients autonomy in decision-making" [18]. The article aims to explore the nurses' impact on patient empowerment for a patient who required a self-care management following a surgery. The study used the Patient Perceptions of Patient-Empowering Nurse Behaviors Scale (PPPNBS). The measure of 45 items has seven subscales that cover the following areas: (1) initiation, (2) access to information, (3) access to support, (4) access to resources, (5) access to opportunities to learn and grow, (6) informal power, and (7) formal power" [18]. Jerofke's work [18] focused on nurse-patient relationship and the measurement was conducted after six-weeks on patients who recently underwent a surgical procedure for cancer or cardiac disease.

Within organization domain, Zeglat et al. [19], point to empowerment as “giving employees the possibility of taking necessary actions in modifying the current work processes or employing a new process in order to simplify job-related tasks and decisions.” Moreover, the paper defines the psychological/motivational empowerment as “a state of mind in which an employee experiences the feelings of control over how the job can be done, have enough aware to the work tasks that being performed, a great level of responsibility to both personal work outcome and overall organizational advancement, and the perceived justice in the rewards based on individual and collective performance.” [19] The study includes within its definition of empowerment: (1) meaning, (2) competence, (3) self-determination, and (4) impact [19]. The experiment is focused on business aspect and encourages implementing better managerial practices such as better job design, the use of up-to date technology, and the revision of job regulations and legislation. This again refers to empowerment as a means of maintaining control over decisions and resources at workspace.

It has been argued that empowerment can hold different meanings and can vary depending on past experiences across time, settings, and population [16, 17, 20]. The definitions of empowerment reveal both diversity and commonality. Still, most definitions focus on matters of gaining power and control over decisions and resources that determines the quality of one’s life [21]. In this paper, we look at Empowerment within healthcare, and we define it as having a positive attitude towards life and feeling more capable to achieve positive results. Accordingly, empowerment is looked as a mediating factor for developing intentions to sustain a health behavior. Finding a comprehensive model to evaluate empowerment considering different factors is yet to be found.

2.1 Studies Related to the Concept of Empowerment

An empowerment message, as defined in Chatterjee et al. [13] is a “message sent in good faith and containing no coercion.” The goal of empowerment is to direct the receiver without coercing action. Chatterjee et al. [13] suggested that empowerment should be designed after analyzing the momentary experience, which leads to use of a multilevel model and data collection. The study uses a three-layered model that includes: genetics, disease/health state, and social network to evaluate the effectiveness of empowerment technique. These three components are interrelated and essential in designing personalized messages. Persuasiveness is empowering when the message not only matches recipient’s long-term goals but also when it is motivating. Messages that make sense and make individuals feel good are believed to be empowering. Chatterjee et al. [13] detail a method of analyzing the outcome using the empowering system that includes constructs of the domain using factor analysis. This research inherits two components from this study - disease/health state and social network in evaluating the empowerment messages, thus factor analysis will be used to validate these domain constructs.

2.2 Experientially Rewarding Content

Messages can create good, happy, and enthusiastic feelings. The experienced feelings resulting from messages or instructions are valuable. “Analyses suggested that whereas experienced outcomes during the learning phase were objectively weighted in children’s and adolescents’ value estimates, adults biased the weighting of outcomes for

the instructed stimulus to be more consistent with the explicit instruction that they had received.” [22] This prior research indicates that the feedback is more effective with adults than children and adolescents [22]. Although Author is focused on how individuals would perceive instruction, which is not the primary focus of our research, it points to the importance of feelings embedded in the message and how an individual reacts to the content.

Although empowerment is used widely and referenced with different definitions, concepts, and operations, the hypothesis of employing goal-oriented messages and rewards to empower patients have not been tested. Thus, we hypothesize that goal-oriented messages and experientially rewarding content may enhance self-care management. In the following, we present the literature review of constructs that are strongly related to empowerment.

2.3 Social Connection

In a recent research project at Stanford, Walton [23] identifies that social belonging is an essential factor for human drive or motivation. It mentions the importance of identity belonging (a sense of self and how one gains the feeling of belonging to a family, group, place or community [24] and how social cues such as doing task with others can change behavior [25]. It also points to the lasting effect of interventions with social belonging aspect [23] meaning the higher chance of behavior sustainability with social support. These findings show that it is essential to include social context in the attempt of achieving behavior sustainability.

2.4 Technological Tools

The advantages of technology inventions such as internet, apps, mobile games, and social media include: wide spread reach, low cost, added interactivity, and the ability to quickly provide personalized messages [25]. Technology tools are empowering people with information and knowledge, “Overall, youth perceived computers and the Internet to be empowering tools, and they should be encouraged to use such technology to support them in community initiatives.” [9] Digital empowerment is defined as “the ability of an individual to use digital technologies effectively in order to develop life skills and strengthen his or her capacity within the information society” [27]. On the UNICEF website, there is a document indicating the impact of Information and Communication Technology (ICT) on enhancing the cognitive and capacity of individuals’ empowerment. The document emphasizes the effectiveness of ICT tools on elevating the society through learning an effective way of performing daily actions such as nutrition tracking and medication consumption [28]. More important, ICT tools can be utilized in supporting individual needs because they are pervasive and easy to customize.

2.5 General Self-efficacy

Another major factor to be considered in an ICT empowerment model, in particular, to perform and maintain a health behavior is self-efficacy, defined as an individual’s belief in his or her capacity to execute behaviors [29]. Self-efficacy is an essential factor for

feeling empowered and performing and sustaining a behavior. “Perceived self-efficacy has been found to be very important in causing people to form intentions to perform and maintain physical exercise for an extended time.” [29] Part of assessing or evaluating self-efficacy is through assessing an individual’s confidence and beliefs in their ability to achieve his/her health goals. In this experiment, we chose the self-efficacy measure currently used by the Health Trainer Service. “The Health Trainer Service is designed to train people with the skills they need to set their own health goals and manage and change their behavior.” [29] We selected seven items out of the eight questions listed in this measure as they fit the nature of this experiment; specifically, we used the items that address measuring the self-efficacy to achieve a health goal.

2.6 Community Support

“Community empowerment is said to offer the most promising approach for reducing health problems in communities.” [30] The need for empowerment approaches in motivating people and especially for patients in their transition to home is notable. “Expansion of empowerment programs in communities is a powerful tool to help improve peoples’ health”. Health promotions, workshops, drugs prevention programs, and safe community programs are different implementations for community empowerment [30].

The evidence is strong for intervention that is designed to promote individual behavior change, according to the Community Guide [31]. “The recommendation for individually adapted behavior change is based on 18 studies in which the median effect size was a 35% increase in time spent in physical activity and a 64% increase in energy expenditure.” [31] These intervention strategies are community-based for increased physical activity, such as the percentage of people starting exercise programs and the frequency of physical activity [31]. Another study states, “participation in school- and community-based sports increases the likelihood that students were active, practitioners should seek to enhance opportunities for participation in and access to these programs in order to increase the level of activity obtained by students” [32]. Therefore, community support is a valuable factor in changing and adopting a behavior.

2.7 Intentions to Sustain a Healthy Behavior

Maintaining a healthy behavior is the optimum goal of any healthcare intervention. The intervention may last a short time period, yet the effect should last longer or for life. In fact, after patients are discharged, self-care management is a main request, especially for the ones with chronic disease. Behavioral intentions, which are indications of how hard people are willing to try to perform a particular behavior, is a key concept in the psychology of behavior change [33]. We refer here to intentions instead of the actual behavior because 19% to 38% of variance in behavior (including health behaviors) can be explained by behavioral intention [34]. In order to build the intention for adherence and instill the behavior in those patients and individuals who seek a better health outcome, many contextual variables such as self-efficacy, social connection, and community support need to be considered. Notably, person-focused behavior change programs proved to be more effective than disease-focused ones [35]. These types of

programs appeared to have a lasting effect, because they involve social support, especially from peers, to sustain a behavior. This more focused approach requires customization and more comprehensive intervention considering impactful factors.

3 Objectives and Research Questions

We propose a theoretical model for ICT empowerment to address the adherence gap. We hypothesize that building an intention to sustain a behavior change can be improved with empowerment. The objectives are: To build and evaluate an ICT empowerment theory model using survey that includes the following items:

- A collection of goal oriented messages
- A pool of experientially rewarding types of messages
- Questions about how technology tools, self-efficacy, social connection, and community support can positively increase empowerment feeling which is hypothesized to positively affect the intention to sustain a healthy behavior

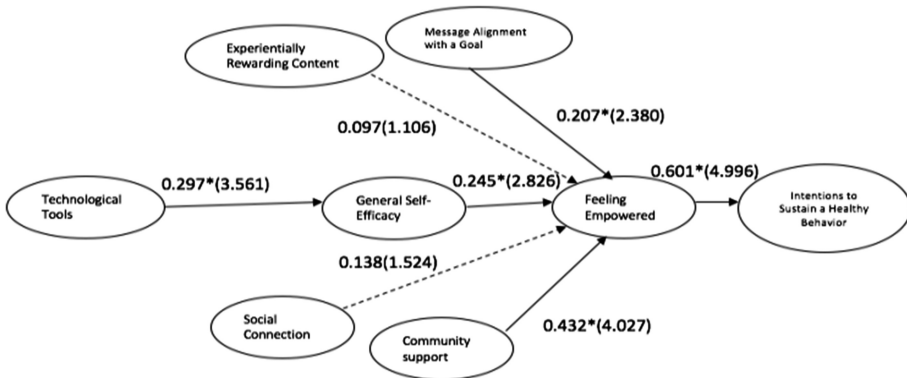
The research questions that will guide this research are:

RQ1: How do technology tools, self-efficacy, social connection, and community support positively affect empowerment feeling?

RQ2: Will an empowered individual have a higher probability of forming intention to sustain a behavior?

4 Methodology

This research uses a quantitative survey approach to answer the research questions and build an ICT empowerment theory model. The factors in this model are derived from previous trial results, brainstorming sessions, and a literature review. The theoretical model proposed is demonstrated in Fig. 1.



- Significant at .000 level
Path coefficients with t-values in parentheses

Fig. 1. The proposed theoretical model for ICT empowerment & results

Survey: To answer our research questions, we constructed a survey to measure different constructs and how they contribute to feeling empowered and eventually increase the intention to sustain a healthy behavior.

Prior research has proven that technology tools have an effect on self-efficacy [32, 36] thus, we identify the necessity to include technology tools construct in the ICT empowerment model. Prior research [37] has also proven the strong correlation between social connections and maintaining a behavior; therefore, we include this factor in the model. Community support has also been included in the model for its value in changing a behavior [30]. Lastly, we hypothesize in the model that feeling empowered can positively affects the intention to sustain a health behavior. The survey collects (1) demographic data, (2) current health portfolio, (3) the intervention signified by displaying the different messages, (4) questions on feeling empowered, (5) social connection, (6) general self-efficacy based on the Health Trainer Service Standards, and (7) intention to sustain a health behavior. Because it is hard to identify each individual's goal, we selected one generic commonly identified goal: do physical exercises in a regular manner. The survey was sent via email as an embedded hyperlink to individuals (survey elements are listed in Appendix A).

The survey, which was declared exempt from IRB supervision under the university policy and federal regulations on February 18, 2016, went through internal pilot testing before it was published to public. In two and a half months, we collected 174 completed responses from convenience sample of university students, and the responses were used in SPSS and Amos to perform factor analysis and SEM. The number of responses is sufficient for testing a structural equation model as Boomsma suggests a minimum sample size 100–150 [38, 39].

The result showed that the effects (MA \rightarrow FE, TT \rightarrow SE, SE \rightarrow FE, CS \rightarrow FE, FE \rightarrow ISHB) are all significant with $P < 0.05$, SC \rightarrow FE is abnormal at $P < 0.127$, and experiential rewards (ER) does not have significant effect on empowerment, so we removed this factor. Model fitness indicators are reported below:

The root mean square (RMR) of the model did not show a reasonable fit with the data. However, RMR is a sensitive scale of measurement and it is difficult to establish what a low value is. Thus, this study uses Standardized RMR (SRMR) with recommended values of less than 0.05 signifying a good fit with data. However, this model's SRMR index (0.1257) does not fall within this range. Root mean squared error of approximation (RMSEA) is 0.074, which is below 0.10—the indication of a good fit with the data. χ^2 and degree of freedom is 1.943, which does not fall within the good index boundary between 2 and 5.

5 Discussion and Conclusion

Empowerment, “respects the right to autonomy, as well as furthering autonomy as ability, it respects the person's dignity, and it reduces inequalities.” [40] Therefore, empowerment is preferred for behavior-change interventions [40]. In this study, we present a further step on how to implement such an intervention. Even though we have a small sample size to evaluate the model, we already found interesting results. The significant effects on empowerment from the factors (technology tools, self-efficacy,

social connection, and community support) were actually anticipated. Yet, the fact that experiential reward does not have that effect on empowerment was not expected. Since the experiment attempts to define the best way to engage audiences with regard to exercise, the survey was presented as if the messages and rewards were displayed as part of a regular exercise goal. For future trials, we will actually distribute the messages on a smart phone app. Most interventions fail to establish and maintain healthy habits for multiple reasons, such as lacking personalization and motivational perspective. This research brings new light on engaging audiences with meaningful messages and rewarding content and how it can help in forming intention to sustain a behavior. The ICT model proposed here is novel in incorporating personalized goal oriented messages and rewarding content into empowerment. This model also tests the relationship between technology tools, self-efficacy, social connection, community support, feeling empowered, and intention to sustain a healthy behavior in a new way. Ultimately, this model can help in revealing new ways of achieving better health outcomes.

With this research, we expect to contribute to the knowledgebase concerning how to effectively engage target audience using a goal-aligned content towards a better health outcome. Delivering tailored messages towards personal goals on a technology medium has not been established yet by previous research. This novel way of representing motivational content to encourage sustainable health behavior can be utilized to prevent health deterioration and increase the quality of life. This research also points to the importance of considering multiple factors while designing and implementing a changing behavior intervention. Currently, researchers are collecting more data in order to refine the model.

Appendix A: Survey Constructs, Definitions, Elements, Loadings, and Scale

Code	Construct: definition	Items	Loadings	Scale type
MA1	Message alignment with goal: all messages (text) are inline with the subject's goal towards certain behavior (regular exercise)	You should eat five or more servings of fruits and vegetables (combined) daily	.323	Aligned (1 2 3 4 5)
MA2		You should eat foods low in fat	.385	
MA3		Try getting 8 h of sleep a day to keep stress away	.228	
MA4		Drink at least 5 glasses of water a day which reduces the risk for heart attack and stroke by 41% in women and 54% in men	.348	

(continued)

(continued)

Code	Construct: definition	Items	Loadings	Scale type
ER1	Experientially rewarding: these events, when happened, make the subjects feel good and happy	Spending time with my family gives me motivation to exercise	.487	Important (1 2 3 4 5)
ER2		Getting recognized for my achievements	.869	
ER3		Receiving some award when I achieve my physical exercise goal	.824	
ER4		If you exercise, you will look more attractive	.439	
TT1	Technology tools: we use the term technology in general to refer to smart phones, Internet, computers, televisions, and wearable devices (such as Fitbit)	I am comfortable using technology	.523	Agree (1 2 3 4 5)
TT2		I feel more capable with my smart phone	.580	
TT3		I can accomplish most of my tasks using computers, internet, and technology	.602	
TT4		I often use the internet to look for solutions to problems	.208	
TT5		I feel powerless without technology	.231	
SE1	Self-efficacy: refers to an individual's belief in his or her capacity to execute behaviors	I will be able to achieve most of the goals I set for myself	.354	Agree (1 2 3 4 5)
SE2		When facing difficult tasks, I am certain I will succeed	.445	
SE3		I believe I can succeed at most tasks to which I set my mind	.548	
SE4		I will be able to successfully overcome many challenges	.522	
SE5		I am confident I can manage well many different tasks	.518	
SE6		Compared to other people, I can do most tasks very well	.449	

(continued)

(continued)

Code	Construct: definition	Items	Loadings	Scale type
SE7		Even when things are tough, I can manage quite well	.414	
SC1	Social connection: the number of family, friends, and social acquaintances that the subject connects to	I have a friend or family member who encourages me to accomplish my goal	.414	Agree (1 2 3 4 5)
SC2		My family members are always there to help and support me	.708	
SC3		In the past month it has been easy to relate to my friends and family	.319	
CS1	Community support: community support implies help from neighborhood, churches, and other social environment	My community helps me to be cheerful	.398	Agree (1 2 3 4 5)
CS2		In my community, I would find a source of satisfaction for myself	.707	
CS3		In my community, I would find someone to listen to me when I feel down	.544	
CS4		In my community, I could find people that would help me feel better	.761	
CS5		In my community, I would relax and easily forget my problems	.337	
CS6		In my community, I take part in activities	.563	
CS7		I respond to calls for support in my community	.467	
FE1	Feeling empowered: having a positive attitude towards life and feeling more capable to achieve positive results	I have a positive attitude towards life	.258	Agree (1 2 3 4 5)
FE2		Having access to information and resources enables me to take properly informed decisions	.344	
FE3		I go out of my way to help others	.238	

(continued)

(continued)

Code	Construct: definition	Items	Loadings	Scale type
FE4		I feel the ability to change other's perceptions by democratic means	.437	
FE5		I have a positive self-image and I can overcome stigma	.302	
ISHB1	Intention to sustain a health behavior: forming a plan to maintain the behavior for a long time	I intend to continue to exercise	.279	Agree (1 2 3 4 5)
ISHB2		I intend to eat healthy food from now on	.553	
ISHB3		I intend to keep a work-life balance going forward	.425	
ISHB4		I intend to sleep well and manage my stress from now on	.533	
ISHB5		From now on I will continue to remain healthy	.439	
ISHB6		Technology tools help me better manage my exercise routines	.185	
ISHB7		With or without support, I intend to stay physically fit	.466	

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