

Chapter 2

Use of Persuasion Strategies in Mobile Health Applications



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2.1 Introduction

Health-related behaviors have been traditionally influenced through different channels such as television, radio, and newspaper (Michael and Cheuvront 1998). Today, with the advances in the computing technologies, the Internet, e-mail, and mobile applications have become the tools for influencing health-related behaviors. According to Fogg (2007), mobile phones are as powerful as personal computers due to their advantages of providing easy access to the internet and having GPS sensors and other useful instruments such as accelerometers. Therefore, mobile applications present modern opportunities to promote healthy behavior by offering real-time monitoring and detection of a change in health status. The challenge here is to efficiently integrate mobile technologies into daily life to motivate individuals to adopt specific health-related behavior. This could be accomplished by using persuasive technologies.

In the context of social sciences, persuasion refers to changing human behaviors toward a system, an idea, or other people. Simons et al. (2001) defined persuasion as “human communication designed to influence the autonomous judgments and actions of others.” Individuals have been trying to influence each other’s behaviors

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and attitudes unintentionally or intentionally; thus, impact of persuasion can be observed in every part of our lives. For example, marketers use persuasion techniques to increase awareness, charities use for fundraising, and health service providers for healthy behavior. The term persuasion has been introduced to the information systems domain to explain the behavior changes of humans toward computing systems (Fogg 2002). Computing products have been considered as social actor that could trigger behavior change.

In the literature, different persuasion strategies and behavior change theories are employed for mobile health applications. In this study, a literature survey was conducted to identify the theories of behavior change that have been used in mobile health applications. The most common behavior change theories or persuasion approaches were determined as the elaboration likelihood model (ELM), social cognitive theory (SCT), theory of planned behavior (TPB), cognitive behavioral therapy (CBT), transtheoretical model of behavior change, and Cialdini's six principles of persuasion and motivation. Furthermore, the study identified that personalization of applications improves the effectiveness of the applications and increases the success rates of the target behavior. In addition, mobile phone use, e-mail, short message service (SMS) and multimedia message service (MMS) interventions, mobile diaries, mobile phone applications, and mobile games were found to be the commonly used tools to change individuals' health-related behavior in the mobile health domain.

2.2 Review Procedure

A search procedure was defined for a systematic literature review. First of all, English was selected as the only language since the most of the studies in this context were written in English. *Mobile health, mobile health applications, persuasive technology, behavior change, behavior change theories, behavior change in health, persuasion principles, and persuasion theories* keywords and their combination were used. The papers were searched using scholar.google.com and the institutional online libraries (i.e., lib.metu.edu.tr and lib.baskent.edu.tr which have access to international databases, such as Scopus, Sciencedirect, and Web of science). In order to reach relevant studies, references of the papers were followed. A total of 76 studies were reached that consisted of journal papers and conference proceedings. The studies that were not focusing on persuasion or behavior change theory and not covering mobile applications were excluded. Finally, 22 of the studies were included for analysis. The next section presented our findings about the theories and mobile applications.

2.3 Persuasion and Behavior Change Theories and Use in Mobile Health Applications

2.3.1 *Elaboration Likelihood Model of Persuasion (ELM)*

ELM is an attitude change theory. It explains decision-making and persuasion with two parallel processes, of a central and a peripheral route (Cacioppo and Petty 1984; Oinas-Kukkonen and Harjuma 2008; Petty and Cacioppo 1986). The main idea behind ELM is to decide whether a person will be persuaded from the central or the peripheral route. Central route to persuasion refers to processes, in which elaboration likelihood is high, while peripheral route involves processes with low elaboration likelihood.

ELM has been applied in physical activity interventions in the mobile health domain. In one of the studies, Hurling et al. (2007) proposed a system including the use of the internet, mobile phone, and e-mail to promote physical activity based on the social comparison, decisional balance, elaboration likelihood, and goals. The system used a Bluetooth-connected wrist accelerometer to measure physical activity. In addition, the users were asked to enter their weekly physical exercises, and feedback and a comparison of their performance with other users were provided. The system also provided a schedule for the following week trainings and e-mail or mobile message reminders. Hurling et al. (2007) reported that the system was effective in increasing the physical activity of the users.

Zuercher (2009) integrated ELM into an SMS intervention to increase the physical activity performance of young women. Using this application, the participants sent information about their daily physical activities to a central database via SMS, and they received personal feedback about the exercises and their target goals. The study measured the elaboration likelihood using a scale on the users' motivation, ability, and favorable thoughts. Although a significant correlation was not reported between these constructs and behavior change, the author concluded that SMS was found acceptable intervention method for young women.

2.3.2 *Social Cognitive Theory (SCT)*

Social cognitive theory (SCT) is a widely accepted and empirically validated model of individual behavior (Compeau et al. 1995). SCT is based on the reciprocally determined factors consisting of environmental influences, cognitive, and other personal factors and behavior. Environmental influences refer to people selecting the environment in which they exist and being influenced by those environments. Furthermore, environmental factors, situational characteristics, cognitive, and other personal factors affect the behavior of individuals. The relations between these three factors, environment, and behavior have been related as "triadic reciprocity" by Bandura (1977). In addition, Bandura (1986) considered self-efficacy to be a

cognitive factor in his theory and defined it as “people’s judgments of their capabilities to organize and execute courses of action required to attain designated types of performances. It is concerned not with the skills one has but with judgments of what one can do with whatever skills one possesses.” Based on Bandura’s theory, Compeau et al. (1999) focused on information systems and developed a model concerning computer usage. The SCT model was used to examine the relations among factors including computer self-efficacy, outcome expectations (performance), outcome expectations (personal), affect, anxiety, and usage. The model shows that self-efficacy directly influences affect, anxiety, and usage, and also it impacts the usage over outcome expectations and effect.

In the literature, it was observed that SCT has been used in the design of health applications, such as using the constructs of SCT on mobile phone intervention (Yoganathan and Kajanan 2013). Zuercher (2009) also used the self-efficacy construct of SCT, alongside with ELM, to assess the positive health behavior change in young women. The author concluded that significant behavior improvement in self-efficacy was not observed.

In another SMS intervention study, Fjeldsoe et al. (2010) implemented SCT in an application called MobileMums to promote physical activity. In this intervention, the researchers developed the content of the SMS considering the constructs of SCT that are effective in changing individual behavior (self-efficacy, goal setting skills, outcome expectancy, social support, and perceived environmental opportunity for physical activity).

2.3.3 Theory of Planned Behavior (TPB)

TPB extended the theory of reasoned action (Ajzen and Fishbein 1975) in order to understand the complexities of human social behavior. The key factor in TPB is the individual’s intention to perform a behavior, which means that an individual’s behavior is determined by his/her intention to perform that behavior (Ajzen and Fishbein 1975; Chang 1998). Ajzen and Fishbein (1975) theorized that behavioral intention is a function of two conceptually distinct sets of attitude towards behavior and subjective norms of behavior. Attitude is considered a collection of behavioral beliefs, and thus attitude toward behavior refers to the “degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question” (Ajzen 1991). Subjective norm indicates the normative belief and is defined as “the perceived social pressure to perform or not to perform the behavior” (Ajzen 1991). TPB introduced a third independent expositive factor of intention, perceived behavior control, which refers to beliefs that underlie the level of control over behavior and “people’s perception of ease or difficulty of performing the behavior of interest” (Ajzen 1991).

Sirriyeh et al. (2010) proposed that the effective components of attitude (such as finding the behavior enjoyable and pleasant) influence engaging in physical activity. They conducted an SMS intervention with adolescents and found that the SMS

content was successful in increasing the physical activity of inactive participants. This study demonstrated enjoyment as an influencing factor in promoting physical activity by taking the attitude construct of TPB as the theoretical base.

2.3.4 Cognitive Behavioral Therapy (CBT)

CBT is a kind of psychotherapy involving processes cognitive restructuring, stress inoculation training, problem-solving, skills training and relaxation training (Butler et al. 2006). CBT targets groups to solve their problems and change their behaviors. Self-monitoring is one of the key methods in CBT (Mattila et al. 2008). With this approach, the subjects can be taught the ways that they could observe their actions, emotional reactions, thoughts, and other health-related variables. Through these observations, individuals can identify their behavioral lifestyle changes (Mattila et al. 2008). In the literature, CBT has been implemented in a number of studies as clinical trials and cognitive-behavioral interventions (Butler et al. 2006).

In this context, a mobile phone application, The Patient-Centered Assessment and Counseling Mobile Energy Balance (PmEB), was developed to monitor caloric balance in real time for weight management (Lee et al. 2006; Tsai et al. 2007). The application aimed to increase self-efficacy of self-monitoring in dietary and exercise behavior and helped people to change their nutrition habits. PmEB was developed with a four-phase iterative approach. The first three phases were designed using human-computer interaction methodologies. The users enter their daily consumption of food and the physical activities they undertake into the system, which then calculates the caloric balance. The system also sends reminder SMS messages to motivate the users to update their caloric and exercise information. In the last phase, the researchers assessed the feasibility of the application with 15 clinically overweight and obese participants using two key methods, ubiquitous computing evaluation (attention, trust, conceptual degree, interaction, invisibility, and impact) and feasibility evaluation (compliance and satisfaction). The results of the study demonstrated that self-monitoring increased the level of awareness in all participants. Paper diaries were found to be inconvenient leading to bias and lower compliance, whereas PmEB was easy to use and effective in motivating users in a variety of ways. This application helped users to develop emergent weight management practices. However, the researchers added that PmEB users found food entry challenging and disliked the prompts.

Mattila et al. (2008) developed the wellness diary (WD) for the management of personal wellness and weight based on the philosophy of CBT. WD was used for self-monitoring and embedded in an existing calendar application for life and time management. The focus of the research was on the usage, usability, and acceptance of the concept and its implementations. The study showed that WD was well accepted and actively used by the participants.

Wylie and Coulton (2008) presented a health-monitoring software, Heart Angel, which was developed for mobile phones to monitor, record, and improve individuals'

level of fitness. The software included built-in cardiorespiratory tests, a tracking software to provide information about heart rate exertion over time and location. It also provided mobile game called Health Defender, which measures the players' real-time heart rate and informs them about heart rate exertion during game play that triggers bonus points. These bonuses are used to encourage users to undertake a physical exercise to increase their heart rate.

Denning et al. (2009) introduced a wellness management system, BALANCE, which automatically detects the user's caloric expenditure via a sensor from a Mobile Sensing Platform unit worn on the hip for long-term health monitoring. The researchers conducted initial validation experiments to measure oxygen consumption during treadmill walking and jogging. The results showed that the system estimates caloric output within 87% of the actual value. The researchers concluded that this system would facilitate behavioral change for weight loss and weight control.

Morris et al. (2010) aimed to investigate the potentials of mobile phone technologies to increase access using CBT techniques and provide instant support. The researchers developed a mobile phone application, Mood Map, which allowed users to report their moods and the therapeutic exercises they undertook for cognitive reappraisal and physical relaxation. A one-month field study was conducted with eight participants who were prompted to report their moods several times a day using the Mood Map by selecting from mood scales. In addition, the participants were able to activate mobile therapies when needed. The researchers emphasized that use of Mood Map was successful in increasing self-awareness and coping with stress.

Lathia (2012) stated that people use their mobile phones in the lavatory to pass the time; therefore, this is an ideal idle moment to use health applications. The researchers introduced the design of The Poo mobile phone application to examine user feedback about their gastrointestinal health in an idle moment. This application allows users to input data to monitor and review their current bowel movement.

2.3.5 Transtheoretical Model of Behavior Change

The transtheoretical model was derived from theories of psychotherapy and behavior change. This model proposed that health behavior change depends on the progress that occurs in six stages: precontemplation, contemplation, preparation, action, maintenance, and termination (Prochaska and Velicer 1997). In the precontemplation stage, people do not intend to take action in the near future (for 6 months) (Prochaska and Velicer 1997). Persuasive technology should target precontemplators to focus on education (Consolvo et al. 2009). In the contemplation stage, people intend to change their behaviors in the next 6 months (Prochaska and Velicer 1997). For contemplators, persuasive technology should be designed in a way to provide techniques for overcoming barriers and rewards for encouraging desired behaviors (Consolvo et al. 2009). In the preparation stage, people are anticipated to take action in the immediate future (next month) (Prochaska and Velicer 1997). In this case, persuasion technology should focus on rewarding behaviors even if the behavior is

not consistent (Consolvo et al. 2009). In the action stage, people have made specific explicit modification in their lifestyles usually within the past 6 months (Prochaska and Velicer 1997). For the people in this stage, the best strategy is to focus on keeping track of progress and consider the elements of social influence (Consolvo et al. 2009). In the maintenance stage, people try to prevent relapse; however, they cannot undergo the change process as frequently as people who are in the action stage (Prochaska and Velicer 1997). For maintainers, persuasion technology should provide strategies for problems encountered previously and help them to realize how they become “the kind of person one wanted to be” (Consolvo et al. 2009; Prochaska et al. 1992, p. 12). In the termination stage, individuals do not have any temptation and have 100% self-efficacy (Prochaska and Velicer 1997). The researchers identified ten processes of change to achieve decisional balance, self-efficacy, and temptations: Consciousness raising, dramatic relief, self-reevaluation, environmental reevaluation, self-liberation, social liberation, counterconditioning, stimulus control, contingency management, and helping relationships (Prochaska and Velicer 1997).

Grimes et al. (2010) created a casual nutrition game called OrderUP!, in which players learn how to make healthier meal choices. The researchers used the trans-theoretical model of behavior change to characterize four processes of change, namely, consciousness raising, self-reevaluation, engaging in helping relationships, and counter-conditioning. The researchers assessed the experiences of 12 participants with the game, and they observed that playing OrderUP! helped people to demonstrate behavior change and encouraged them to adopt a healthier lifestyle.

2.3.6 *Cialdini's Six Principles of Persuasion*

To understand how people influence others' attitudes and actions, Cialdini proposed six principles of influence that triggers the behavior of people (Cialdini 1993, 2001, 2004). According to Cialdini, these basic principles can be taught, learned, and applied to change human behavior in different contexts. These principles were defined as followings:

- The principle of reciprocity: According to this principle, “People repay in kind.” This strategy can be applied by giving gifts, doing favors, and making concessions (Cialdini 2003).
- The principle of scarcity: This is based on the assumption that “People want more what they have less.” When something is scarce, people have a tendency to value it more. This principle can be applied by explaining the unique benefits of the target behavior, opportunities, and using deadlines. For example, Kaptein and Eckles (2012) applied this strategy in their online bookstore by mentioning that there were only limited copies of the books on sale.
- The principle of authority: People are inclined to follow those who have power. This principle is based on the idea that “people defer to authorities.” When a

request is made by a legitimate authority, people have a tendency to follow/believe the request. This principle can be applied by referring to expert opinions in applications.

- The principle of commitment and consistency: “People align with their clear commitments.” People do what they are told to do. This strategy can be applied encouraging target users to make public commitments since they will be consistent with their previous commitments.
- The principle of social proof (consensus): This principle depends on people’s tendency to follow other people that are similar to them when making a decision. In other words, “People follow the lead of similar others”. To apply this principle, examples from similar individuals’ behaviors can be given.
- The principle of liking: According to this principle, people are influenced more easily from those they like. This principle can be applied by considering similarity and praise since people like who likes them and behave similarly to those. Groves et al. (1992) identified the factors that increased liking as the similarity of attitude, background, dress, praise, cooperation, and physical attractiveness.

Cialdini’s persuasion principles are implemented in different domains to change human behavior. In the mobile health domain, these principles have mostly been used in e-mail and SMS interventions and mobile phone applications. Kaptein et al. (2010) conducted two experiments, in which the participants were asked to join a lunch walk exercise and consume fruit. The researchers employed Cialdini’s following persuasion strategies in e-mail messages: authority, scarcity, and consensus. Authority was employed by giving recommendations from the physicians, general practitioners, and the World Health Organization. Scarcity was employed by mentioning the limited slots to join the activity, and consensus was employed by giving examples from similar individuals. The results of the study showed that these strategies increased people’s compliance to health-related activities.

Kaptein et al. (2012) used personalized short SMS to reduce snacking. The researchers developed and validated the Susceptibility to Persuasive Strategies scale (STPS) based on the six principles of Cialdini (1993). The researchers performed an experiment with 73 participants. The test group received personalized text messages, and the control group received non-tailored messages. It was observed that, based on the participants’ score on STPS, the personalized messages resulted in a higher decrease in the consumption of snacks.

Van Dantzig et al. (2013) aimed to reduce sedentary behavior with the SitCoach application, which encourages office workers to have regular breaks from sitting. This application monitors physical activity and sedentary behavior, and it sends timely persuasive messages suggesting active breaks. The messages were based on the social influence strategies of Cialdini (1993). To evaluate the effectiveness of persuasive text messages, the researchers conducted an experiment with 86 participants from different health companies in the Netherlands. The study showed that there were significant differences between the control group, not receiving any persuasive messages, and the intervention group, receiving advising messages to take a

break. However, no significant change was observed in the physical activity of the participants.

Alkiş and Temizel (2015) investigated the relationship between Big Five Personality (BFP) traits and six influence strategies of Cialdini and found that different types of personalities are influenced differently from persuasion strategies which will guide the use of persuasion strategies according to personality type. The study showed that data related to personality is crucial for implementing effective influence strategies for a given personality type. As suggested by Hirsh et al. (2012), persuasive messages are more effective when they are framed according to the personality traits of people. In addition, Halko and Kientz (2010) investigated the relationship between BFP traits and persuasive technologies in the context of health-mobile applications. They found correlations between these traits and cooperative, competitive, positive reinforcement, negative reinforcement, intrinsic, extrinsic, authoritative, and non-authoritative persuasion instruction styles. The results of the study contributed to the personalization of health applications according to the personality types.

2.3.7 Fogg's Behavioral Model (FGM)

FGM was proposed by Fogg (2009) to understand the drivers of human behaviors. There are three factors in this model to determine behavior: motivation, ability, and trigger. According to this model, to achieve a target behavior, the person should be motivated enough, have the ability to accomplish the target behavior, and be triggered to perform the behavior. Therefore, a persuasive design should focus on increasing the motivation for the target behavior, consider the ability of audience, and use effective triggers.

Gasser et al. (2006) compared the usage and acceptance of a mobile lifestyle coaching application with that of an equivalent traditional web application. In the study, the researchers administered a set of health questionnaires that incorporated social facilitation features to enhance motivation. The implications of the study provided a guideline to strengthen the persuasiveness of health applications on mobile devices. The researchers emphasized the importance of using social facilitation features, such as aliases and avatars or functionalities, as instant messaging, for strengthening the persuasive effect of the system.

When the mobile health applications were examined, it was seen that some of these applications aimed to improve users' motivation to reach the target behavior, which is a dimension in FBM. For example, Patrick (2009) performed an SMS and MMS intervention by assessing the motivation progress in order to help individuals improving their dietary behaviors (to lose or maintain their weight over 4 months). The experiment was conducted with age- and a gender-adjusted sample of 65 participants, and it was found that the intervention group that received personalized SMS and MMS messages two to five times a day lost more weight than the control group.

Ahtinen et al. (2009) evaluated user experiences in three mobile wellness applications, namely, Wellness Diary (WD), Mobile Coach (MC), and SelfRelax (SR). In their study, the researchers concentrated on motivational factors. The results indicated that the participants positively responded to the applications. In the study, the participants used the applications to find the solution for given problems. The rate of using the applications increased once the participants understood the purpose of the functions and perceived them as being personally relevant. WD was perceived being easy to use, which means that its purpose and functionalities were understandable. On the other hand, MC was more challenging to understand and to learn. However, it provided persuasive and motivating solutions that can be adaptable for training programs, goals, and coaching. MC triggered curiosity, challenge, and control factors of intrinsic motivation. SR was perceived as being intuitive to use, and it was considered beneficial for helping participants to fall asleep and relax.

Pollak et al. (2010) created the Time to Eat mobile game to motivate children to develop healthy eating habits. The researcher examined the role of the motivational feature of a mobile phone in supporting and encouraging healthy eating habits in seventh and eighth graders. The game allows participants to care for a virtual pet by sending photos of the food they consume. The researcher evaluated the experience of 53 seventh and eighth graders. According to the results, the children who played the game consumed a healthy breakfast more frequently than those who did not play the game.

Buttussi and Chittaro (2010) created a fitness game called Monster & Gold to increase physical exercise. In the game, users gain or lose points according to their level of exercise. This study showed that games have motivational effects on people, which is a dimension of persuasion in FBM.

2.4 Discussion and Implications

With the improvements in technology, health-related behaviors have been promoted in using mobile systems and applications. The extensive use of mobile phones is an evidence of their acceptance as well as an advantage in supporting the adoption of a healthy lifestyle. In the reviewed studies, ten mobile phone applications, six SMS-MMS interventions, four games, and two e-mail interventions cases were investigated. This showed that mobile phone applications are becoming a common medium to promote health behavior. These applications were effective in managing weight, encouraging physical activities and exercises, preventing and managing chronic diseases, self-monitoring, and self-awareness for long-term wellness. Furthermore, promoting physical activities and wellness management were the common target behaviors for the applications.

In order to increase the effectiveness of these applications, behavior change, and persuasion theories were employed. In this study, the following theories and models were identified from the literature review: traditional behavioral theories, specifically ELM, SCT, TPB, CBT, the transtheoretical model of behavior change,

Cialdini's six principles of persuasion, and FBM. Among these theories CBT and motivation are frequently implemented.

In addition, the mobile applications that were reported in the studies were revealed that the personalization feature was effective to promote health-related behaviors. For example, Halko and Kientz (2010) listed the persuasive health technology design strategies (authoritative, non-authoritative, cooperative, competitive, extrinsic, intrinsic, negative reinforcement, and positive reinforcement) and suggested that different types of personalities required different strategies to be considered in designing effective personalized applications. Similarly, the personalized feature of mobile game increases its effectiveness as a persuasive application.

For example, a mobile game called *MoviPill* was designed to increase medication adherence for elder people in that regard (De Oliveira et al. 2010). In the game, users gain points when they take their bills on time and at the right amount, and they compete against other users.

This study revealed that health behavior change was difficult to measure and quantify. Therefore, it was not always possible to determine whether the applications were successful solutions in achieving the intended behavior (Klasnja et al. 2011). Thus, regardless of the platform (mobile phones, web applications, or social networking tools), health-related applications should be carefully designed and implemented to reach the target behavior.

2.5 Conclusion

In this chapter, the studies on mobile health applications, behavior change, and persuasion theories were investigated. ELM, SCT, TPB, CBT, transtheoretical model of behavior change, Cialdini's six principles of persuasion, and FBM were the theories employed in mobile health applications. Persuasive technology, including SMS-MMS intervention, e-mail intervention, mobile health applications, and games, encourages individuals to adopt a healthy lifestyle by helping them track their physical activities, moderate their diet, reduce the consumption of snack food, learn how to make healthier meal choices, and prevent and manage chronic diseases. This chapter provides an overview for (1) researchers to guide their future research and (2) persuasive technology designers to develop effective mobile health systems to promote behavior change.

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