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A STUDY ON COMPLIANCE GAINING STRATEGY IN MOBILE APPLICATION FOR PROMOTING PHYSICAL ACTIVITY

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임하진

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A STUDY ON COMPLIANCE GAINING STRATEGY IN MOBILE APPLICATION FOR PROMOTING PHYSICAL ACTIVITY

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ABSTRACT

The growing number of people who are a lack of physical activity has resulted in the necessity for appropriate physical activity interventions such as mobile health applications. To inform effective design of mobile health applications for physical activity, this paper utilized 'Marwell and Schmitt's compliance-gaining strategies' as a framework, which refers to interactions in which one individual attempts to induce another person to perform a desired behavior. Therefore, we first conducted a preliminary content analysis of 74 mobile applications and identified which compliance gaining strategy is frequently used and how each strategy is being represented. Based on the result of the content analysis, we conducted a survey study (N=203) using storyboards that depicted 11 compliance-gaining appeals. The results of the survey revealed that Positive self-feeling and Promise strategies were perceived most positively while Negative altercasting and Aversive stimulation strategies were evaluated most negatively. In addition, we investigated the relationship between the perceived effectiveness of strategies and individual characteristics variables. We found that individual's sex, age, perception in mobile health application and exercise goal content were the predictor variables of the likelihood of compliance. In conclusion, we discussed the design implication to improve the design of mobile health application to promote physical activity.

Key Words: Mobile Health Application, Physical Activity, Compliance Gaining Strategy, Persuasive Technology, Mobile Health Intervention

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CHAPTER 1. INTRODUCTION

Physical inactivity is now identified as the fourth leading risk factor for global mortality (WHO, 2010). Even though physical activity is a core determinant of energy expenditure, and thus is fundamental to energy balance and weight control (Guilbert, 2003; Tunstall-Pedoe, 2006; Who, 2010; World Health Organization, 2008), the majority of people worldwide fail to meet the recommended levels of physical activity to maintain good health (Lacroix, Saini, & Goris, 2009). The growing number of people who are a lack of physical activity and regular exercise has resulted in the necessity for appropriate physical activity interventions.

In an effort to engage individuals in the moderate level of physical activity, researchers and industry have utilized mobile technologies. Particularly, smart mobile devices are equipped with advanced technological features for the delivery of behavioral interventions in terms of physical activity allowing to: collect various activity data in real time throughout the day; provide feedback and support at the point of decision; provide interactive and individualized content that is automatically generated (Riley et al., 2011); facilitates the sharing of behavioral and health data with health professionals or peers (Morris & Aguilera, 2012). As a result, a number of smartphone applications and wearable devices (e.g. Fitbit, Nike Fuelband, Noom Coach) gain in popularity and become widespread.

Despite the great promise of mobile-based interventions for promoting physical activity, several limitations in the current mobile health application are pointed out. First, most of them are not based on theories although research has shown that interventions that are informed by theories tend to be more successful (Glanz &

Rimer, 2005; Orji, Mandryk, Vassileva, & Gerling, 2013). They are rather designed according to system developer and designer's intuition mostly. Furthermore, most health mobile technologies have been designed using a single technique and system component. With this *one-sizes-fit-all* approach, it is challenging to sustain user interest over time and to deliver an effective form of intervention (Halko & Kientz, 2010.; Orji, Vassileva, & Mandryk, 2013).

To provide design implications for personalized and theory-driven design of mobile health applications for promoting health, we utilize 'compliance-gaining strategies' as a framework, which has been developed and studied in the interpersonal communication domain. Compliance gaining refers to interactions in which one individual attempts to induce another person to perform a desired behavior that the target person otherwise might not have performed (Wheeless, Barraclough, & Stewart, 1983). Compliance gaining is a persuasive process, which is specifically concerned with behavior change (Fitch, 1994; Wheeless, Barraclough, & Stewart, 1983). Because behavior change should be accompanied with to increase one's physical activity, it seems reasonable to apply the concept of compliance gaining into the mobile health application context. In this research, we assume that a mobile application is an '*influencer'* or '*persuader'* who tries to promote users' physical activity.

The most widely used framework to classify the strategies and tactics to obtain compliance from a target is Marwell & Schmitt (1967)'s taxonomy. They uncovered a set of 16 strategies brought together techniques suggested by persuasion researchers and created a questionnaire to elicit people's tendencies to use particular power bases to gain compliance in interpersonal relationships (Villar,

2010). Marwell and Schmitt (Marwell & Schmitt, 1967b) identified 16 power-based compliance-gaining techniques: promise, threat, positive expertise, negative expertise, liking, pre-giving, aversive stimulation, debt, moral appeal, positive self-feeling, negative self-feeling, positive altercasting, negative altercasting, altruism, positive esteem, and negative esteem.

Compliance-gaining strategy has offered practical values for such professions as sales, management, and health care (Wilson, 2008). Especially, the compliance-gaining strategies have been adopted within the health domain focusing on the communication between physicians and patients. For example, Burgoon et al. looked at physician choice of compliance-gaining strategies as reported by patients (J. K. Burgoon et al., 1987a).

The purpose of this study is to examine which compliance-gaining strategy is perceived to be effective for users in the context of mobile health applications to promote physical activity (**Research Question 1**). The result of this research question would provide deeper understanding about what kind of appeal is effective and perceived positively to promote user's physical activity in general. Furthermore, we aim to investigate how individual characteristics relate to the likelihood of compliance to each compliance-gaining strategy (**Research Question 2**). The findings would inform the ways to tailor mobile applications to individual characteristics to gain users' compliances to help them more physically active.

To this end, we first run the preliminary study of 74 mobile health applications for physical activity to identify which compliance-gaining strategy is frequently used and how each strategy is being represented. Based on the result of preliminary

study, we formulate the survey study utilizing 11 storyboards, which depict the situations when each compliance-gaining strategy is applied to mobile health applications. Then, we conduct a survey study to evaluate the perceived effectiveness of each strategy. Lastly, after we collect the individual characteristics information from survey, we run the multiple regression analysis to explore participants' likelihood of compliance to each strategy based on their individual characteristics factors.

CHAPTER 2. LITERATURE REVIEW

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1. Mobile Health Application for Promoting Physical Activities

Physical inactivity is now identified as the fourth leading risk factor for global mortality (6% of deaths globally) (WHO, 2010). Participation in regular physical activity reduces the risk of coronary heart disease and stroke, diabetes, hypertension, colon cancer, breast cancer and depression (Who, 2010). Additionally, physical activity is a key determinant of energy expenditure, and thus is fundamental to energy balance and weight control (Guilbert, 2003; Tunstall-Pedoe, 2006; Who, 2010; World Health Organization, 2008). Unfortunately, participation rates have remained low despite significant scientific endeavors to enhance participation, reduce attrition, and increase maintenance of this important health behavior. In 2007, less than half of all adults in the United States achieved recommended levels of physical activity (FastStats - Exercise or Physical Activity, 2015).

In an effort to engage individuals who do not meet these guidelines, researchers have utilized popular emerging technologies, including mobile devices. Especially, smart mobile devices equipped with advanced technological features are expected to allow for the effective delivery of behavioral interventions. It is because smart mobile devices allow to collect various activity data in real time throughout the day, provide feedback and support at the point of decision, and provide interactive and individualized content that is automatically generated (Riley et al., 2011) and facilitates the sharing of behavioral and health data with health professionals or

peers (Morris & Aguilera, 2012).

In recent years, HCI researchers and commercial companies show growing interest in developing mobile health applications to promote physical activity. Generally, such systems consist of two main components: measurement of activity, and presentation of the measured data (Zuckerman & Gal-Oz, 2014). Personal informatics systems facilitate collection and storage of personal information and provide a means of exploring and reflecting on the information (Ploderer, Reitberger, Oinas-Kukkonen, & van Gemert-Pijnen, 2014).

The research model that has been frequently used for content analysis of the mobile health application is behavior change techniques (BCTs). Conroy et al. and Middlewerrd et al. characterized the behavior change techniques in top-ranked applications for physical activity (Conroy, Yang, & Maher, 2014; Middelweerd, Mollee, van der Wal, Brug, & Te Velde, 2014). Additionally, Yang et al. found that most common BCTs involved providing social support, information about others' approval, instructions on how to perform a behavior, demonstrations of the behavior, and feedback on the behavior (Yang, Maher, & Conroy, 2015).

2. Compliance-Gaining Strategy

Compliance gaining refers to interactions in which one individual attempts to induce another person to perform a desired behavior that the target person otherwise might not have performed (Wheeless, Barraclough, Stewart, & Bostrom, 1983). In other words, compliance gaining is a persuasive process, which is specifically concerned with behavior change (Fitch, 1994; Villar, 2010; Wheeless et al., 1983).

Although both compliance gaining and persuasion involve intentional attempts to influence others, they differ in several respects. Persuasion scholars typically focus on public or mass communication contexts, whereas compliance-gaining scholars investigate how friends, family members, and coworkers influence one another. (Wilson, 2008). In contrast to persuasion theories aimed at influencing psychological determinants such as people's beliefs and attitudes, compliance-gaining appeals are messages that target specific changes in behavior that may or may not be accompanied by changes in attitude (Villar, 2010).

A popular approach to the study of interpersonal control tactics is the compliance-gaining model of Marwell and Schmitt (Marwell & Schmitt, 1967b), which have been widely used to understand compliance gaining process by communication researchers (Villar, 2010). They uncovered a set of 16 strategies that are often employed after they brought together techniques suggested by persuasion researchers and created a questionnaire to elicit people's tendencies to use particular power bases to gain compliance in interpersonal relationships (Villar, 2010). Marwell and Schmitt's taxonomy (see Table 1) includes promise, threat, positive expertise, negative expertise, liking, pre-giving, aversive stimulation, debt, moral appeal, positive self-feeling, negative self-feeling, positive altercasting, negative altercasting, altruism, positive esteem, and negative esteem.

Table 1 Marwell and Schmitt's compliance-gaining strategy

(Marwell & Schmitt, 1967a)

	Strategy	Description
1	Promise	Offering a reward in exchange for compliance. Reward will be given to target by the speaker.
2	Threat	Threatening a punishment if there is no compliance. Threat will be given to target by the speaker.
3	Positive Expertise	Agent speaks as an authority on the subject. Speaker refers rewards that will occur if target comply, because of the nature of reality. (There is an assumption that the speaker knows this because of his/her expertise.)
4	Negative Expertise	Agent speaks as an authority on the subject. Speaker refers to punishments that will occur if target does not comply, because of the nature of reality. (There is an assumption that the speaker knows because of his/her expertise.)
5	Liking	Speaker seeks affinity with the target, getting them into a good frame of mind.
6	Pre-giving	Giving something as a gift, before requesting compliance. The idea is that the target will feel the need to reciprocate later.
7	Aversion Stimulation	Continuous punishment and the cessation of punishment is contingent on compliance.
8	Debt	Calling in past favors.
9	Moral Appeal	This tactic entails finding moral common ground and then using the moral commitments of a person to obtain compliance.
10	Positive Self-feeling	You will feel better about yourself if you comply.
11	Negative Self-feeling	You will feel bad about yourself if you do not comply.
12	Positive Altercasting	Only good people comply.
13	Negative Altercasting	Only bad people do not comply.
14	Altruism	Do-Me-A-Favor. Appeals to the generosity of the target.
15	Positive Esteem	Other people will think more highly of you if you comply.
16	Negative Esteem	Other people will think more highly of you if you do not comply.

Compliance-gaining strategies offers practical values into are important for such professions as sales, management, and health care (Wilson, 2008). Especially, the compliance-gaining strategies have been frequently utilized within the health domain. A large body of research focused on the communication between physicians and patients. For example, Burgoon et al. explored primary care physicians' reports of their compliance-gaining message strategy selection and found that physicians report use of expertise strategies more than other types of compliance-gaining strategies (M. Burgoon, Parrot, Burgoon, Birk, & Pfau, 1990). Additionally, Helme and Harrington identified diabetics' accounts for medical noncompliance, physicians' compliance-gaining strategies elicited in response to those accounts, and to examine the relationship between accounts and compliance-gaining strategies (Helme & Harrington, 2004).

While previous research paid their attention to physician-patient communication, we focus on the interaction between mobile health applications and users: mobile application aims to obtain compliance of users to make them physically active and healthy than before. Marwell and Schmitt's compliance-gaining strategy index is used as the framework of this paper. It is because it has been repeatedly elaborated, expanded, and condensed (Seibold, Cantrill, Meyers, Knapp, & Miller, 1985; Villar, 2010; Wheeless et al., 1983) In addition, Marwell and Schmitt's taxonomy has been widely utilized in the health communication domain as we addressed above. Lastly, a number of researchers studied and identified the dimensionalities of compliance-gaining strategy, which enables us to explore various aspects of compliance gaining in the mobile health application contexts.

To investigate which compliance-gaining strategy is generally perceived to be

effective to help users more physically active, the following research question is posed.

RQ1. Which Compliance-gaining strategy is perceived to be effective for users in the context of mobile health applications for promoting physical activity?

2.1 The Dimensions of Compliance-Gaining Strategy

In evaluating the perceived effectiveness of compliance-gaining strategy, several dimensions are used to analyze the survey data to explore **RQ1** from various perspectives.

Several researchers have grouped 16 compliance-gaining strategies of Marwell and Schmitt into larger dimensions, based on their style, approach and method used to obtain compliance (Villar, 2010). These dimensions were developed based on theoretical backgrounds or empirical studies.

The first dimension of compliance-gaining strategy that we adopt is the verbal aggressiveness, which is a personality trait that predisposes persons to attack the self-concepts of other people instead of, or in addition to, their positions on topics (Boster, Levine, & Kazoleas, 1993; Infante & Wigley, 1986). Research and theory suggest that verbal aggressiveness may underlie Marwell and Schmitt's (1967) compliance-gaining strategies (Boster et al., 1993) and found that strategies could be factored into three groups depending the degree of aggressiveness (M. Burgoon, Dillard, & Ooran, 1983; M. Burgoon, Parrot, Burgoon, Birk, & Pfau, 1990). (see Figure 1)

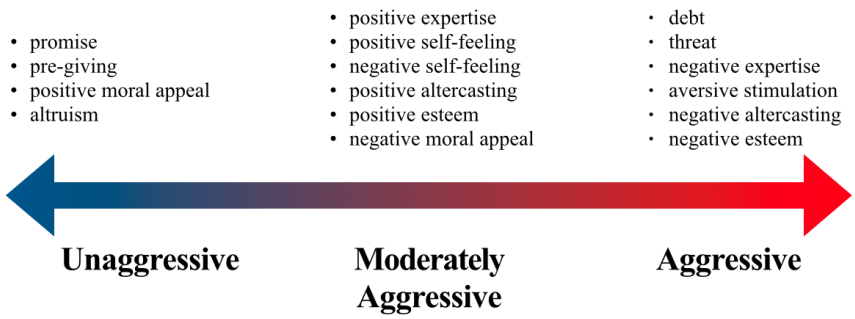

Figure 1 The verbal aggressiveness dimension of compliance-gaining strategy

Compliance gaining researchers utilized the verbal aggressive dimension in various ways. For example, Burgoon et al. reported that patients perceived their physicians to rely more on verbally unaggressive messages than on verbally aggressive ones. Also, patients' satisfaction was positively related to physicians' verbally unaggressive strategies, but verbally aggressive strategy use was not found to relate negatively to patients' satisfaction (M. Burgoon et al., 1990). In contrast, Lane (1983) found that a physician's use of verbally aggressive message strategies reduces the patient's ratings of satisfaction (Recited from J. K. Burgoon et al., 1987a; Lane, 1983) In addition, Dillard et al.'s study about situational influences on the selection of compliance-gaining messages showed that people tended to be more verbally aggressive when they felt it was legitimate to demand compliance (Dillard & Burgoon, 1985).

Because verbal aggressiveness dimension was used to highlight how people create and perceive different style of compliance-gaining strategy, we take advantage of it for better understanding of perceived effectiveness of each compliance-gaining

strategy.

RQ1a. Which style of compliance-gaining strategy is perceived to be effective in the context of mobile health applications for promoting physical activity?

In addition to verbal aggressiveness dimension, we use five factors dimension that Marwell and Schmitt identified based on people's activities to motivate a person people to take a particular action or adopt a new behavior (Marwell & Schmitt, 1967a; Villar, 2010) (see Table 2). There are rewarding activity, punishing activity, use of expertise, activation of impersonal commitments (such as moral values and beliefs), and activation of personal commitments (based on relationships with others).

Table 2 Five factors (activities) of compliance-gaining strategy

(Marwell & Schmitt, 1967a)

Activity Type	Strategies
Rewarding	Promise, Liking, Pre-giving
Punishing	Threat, Aversion Stimulation
Use of Expertise	Positive Expertise, Negative Expertise
Activation of Impersonal Commitment	Moral Appeal, Positive Self-feeling, Negative Self-feeling, Positive Esteem, Negative Esteem, Positive Altercasting, Negative Altercasting
Activation of Personal Commitment	Debt, Altruism

To be specific, reward and punishment compliance-gaining strategy are related to people's desire to obtain positive outcome or prevent a negative one. Moral and expertise appeals stimulate people's desire to behave appropriately. Personal and

impersonal commitments count on people's concern over their image, both their self-image and the image that others have of them (Villar, 2010). By using the five factors dimension of compliance gaining, we identify which kind of activity type will be effective in gaining people's compliance to become physically active.

RQ1b. Which type of activity is perceived to be effective in the context of mobile health applications for promoting physical activity?

3. Individual Characteristics in Responses to Compliance-gaining Strategies

Recently, health technology has turned towards personalized and adaptive manners because the effectiveness of strategies varies from one person to another (Kaptein, Lacroix, & Saini, 2010). Therefore, HCI researchers start to examine the effects of strategies focusing on possible individual differences in responses to these strategies (Kaptein, De Ruyter, Markopoulos, & Aarts, 2012).

The personality trait of individual or system was one of the individual factors that have been frequently examined. For example, Halko and Kientz (Halko & Kientz, 2010) explored the relationship between individual personality and persuasive strategies in the context of health-promoting mobile applications. They reported that the development of persuasive technologies that could cater to individual personalities could improve the likelihood of their success.

In the Bauman et al.'s systematic review (Bauman et al., 2012) about the relationships between physical activity and individual characteristics, it reported age, sex, health status, stages of behavioral change, self-efficacy, and motivation

are associated with physical activity. Lacroix et al. (Lacroix, 2009) considered three cognitive variables that have shown to be crucial for the adoption and maintenance of health behaviors: behavioral regulation, types of motives, and self-efficacy, for the effective tailoring of technology-based interventions.

In the realm of compliance-gaining studies, dogmatism, communication apprehension, locus of control, verbal aggressiveness and argumentativeness were frequently investigated, which have been considered as useful predictors of compliance-gaining message selection and generation (Boster et al., 1993).

In this paper, we aim to identify how individual characteristics related to the perceived effectiveness of compliance-gaining strategies. To be specific, we focus on diverse aspect of individual characteristics including: the demographic information (Age, Sex), physical activity status (Stage of change), psychological factors (Self-efficacy and Goal type), which has been noted as major predictors of one's physical activity and persuadability that refers one's tendency to comply with messages supported by persuasive arguments (Kaptein et al., 2010).

RQ2. What is the relationship between the perceived effectiveness of compliance-gaining strategy and individual characteristics factors?

Especially, 'stage of change' is based on the assumption that individuals move through a series of stages as they adopt and maintain a new habit (Prochaska & DiClemente, 1983). This model has been utilized widely in the studies about physical activity (B H Marcus & Lewis, 2003; Bess H Marcus et al., 1992). This framework includes five stages of change: Precontemplation, Contemplation, Preparation, Action, and Maintenance. Precontemplators are inactive and not

thinking about becoming active while Contemplators are inactive but are thinking about becoming active. Preparers are people who make small changes in behavior but still not meeting a criterion for physical activity. Individuals in the Action Stage are physically active at the recommended levels but have been active for less than six months. Individuals in the Maintenance Stage are physically active at the recommended levels and have been for six or more months (B H Marcus & Lewis, 2003). In this study we will utilize Physical Activity Stages of Change Questionnaire (Bess H Marcus & Forsyth, 2003) that is a four-item self-report questionnaire that categorizes individuals into one of the five stages of change (B H Marcus & Lewis, 2003).

Self-efficacy is the extent or strength of one's belief in one's own ability to complete tasks and reach goals (Bandura, 1998). Self-efficacy expectations are believed to influence types of activities engaged in, the amount of effort expended and length of persistence in the face of obstacles (Sallis, Pinski, Grossman, Patterson, & Nader, 1988). A number of research revealed that the stronger the perceived self-regulatory efficacy, the more successful people are in reducing health-impairing habits and adopting and integrating health-promoting habits into their regular lifestyle (Bandura, 1994). Especially, self-efficacy was consistently reported as a positive correlate and determinant of physical activity in children and adolescents (Bauman et al., 2012). In our research, we adopted the Sallist et al.'s self-efficacy scales for health related diet and exercise behaviors (Sallis et al., 1988), which was developed to study the mediating effects of self-efficacy in health-related behavior change studies.

Lastly, we focus on the goal content that is a critical predictor of the quality of an

individual's behavior and psychological well-being (Sebire, Standage, & Vansteenkiste, 2008). According to Self-determination theory (Ryan & Deci, 2000), the kind of goals that one pursues is said to yield implications for one's personal and relational functioning. Specifically, based on the content of goals, a distinction is made between *intrinsic* and *extrinsic* goals (Sebire et al., 2008). Sebire et al. (Sebire et al., 2008) found five exercise goals including health management, skill development, social affiliation, social recognition and image domains and developed a questionnaire (the Goal Content for Exercise Questionnaire :GCEQ) to define which goal type each individual has. In our study, we will use this GCEQ scales to identify which individual exercise goal relates to compliance-gaining strategy.

CHAPTER 3. PRELIMINARY CONTENT ANALYSIS STUDY

We conduct a preliminary content analysis of 74 mobile health applications for physical activity. It is for characterizing which compliance-gaining strategy has been utilized frequently and identifying how each strategy is now being represented. The result of the preliminary study provides the overview of the current health mobile applications designed to encourage physical activity. In addition, the findings are uilized to formulate the storyboards in the survey study.

1. Methodology

The study sample of the preliminary content analysis was the mobile applications that were categorized in the "Health and Fitness" section of two major mobile application markets. (i.e.Apple App store and Google Play store) The initial dataset was identified through the Health&Fitness app collection list of Google play store1 and 'Fitness&Health Popular apps' section of Apple app store2 on March to May 2015. As a result, total 283 mobile applications (240 from Apple Appstore and 43 from Google Play store) were collected and examined. Among collected applications, only applications if they (i) aimed to promote user's physical activity, and (ii) were primarily designed for general healthy adults were included in the content analysis. Duplicated applications between two stores and aligned applications with a same user interface (e.g. Ab Workout free, Cardio Workout free, Arm Workout free, etc.) were consolidated. Overall, total 74 mobile applications

[1] https://play.google.com/store/apps/collection/promotion_30007ff_health_fitness

[2] https://itunes.apple.com/us/genre/ios-health-fitness/id6013?mt=8

were selected for the content analysis. The full listing of mobile applications selected in the analysis is attached in Appendix A.

It is desirable to analyze every user interface (UI) and system dialogue of every application, but due to the accessibility and time constraints, we focused on analyzing the description pages of selected applications (see Figure 2). Application description page contains text description and a number of UI screenshots. It generally includes the main features and merits of each application, which is elaborated very carefully by application developers. They generally play a pivotal role to makes their application stand out and helps potential customers decide to buy it (Windows Dev Center, 2015). To be specific, text description in application description page includes its key features, merits and the testimonial of users and the media spotlights. Screenshots show how applications look like and illustrate its key features in situations that reflect the way people use it (Windows Dev Center, 2015).

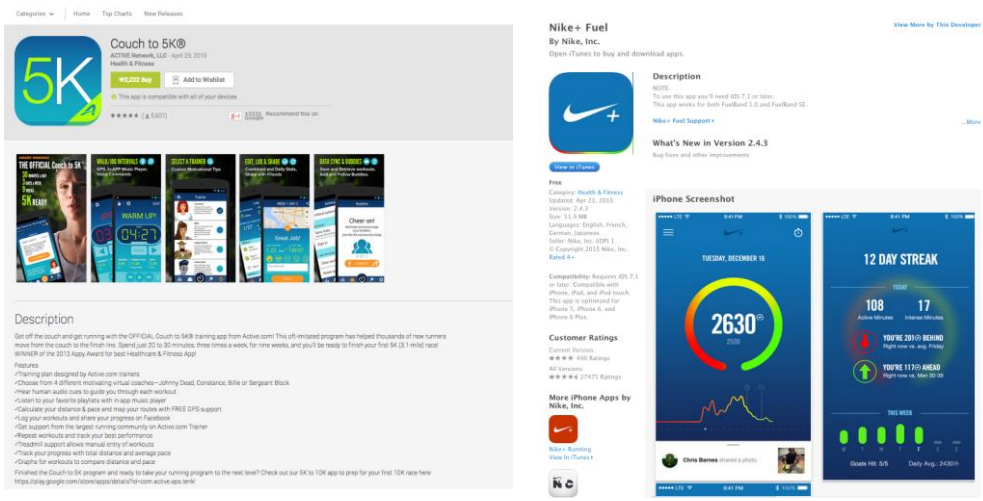

Figure 2 Examples of application description page
(Left: Google Play store, Right: Apple App store)

One coder reviewed every application description page several times (3+ times). First, the workout types, customer ratings, and prices of each application were examined. Then, the text and UI of each application were analyzed using Marwell and Schmitt's taxonomy of compliance-gaining strategies (see Table1). We coded which compliance-gaining appeals were utilized in each application description page. The coding scheme is presented in Appendix B.

2. Result

The retrieval of the mobile application markets from Fitness and Health categories yielded 283 potentially relevant applications, of which 74 apps met our selection criteria: 22.9% (17/74) of apps were available on Google Play store, and 77.0% (57/74) of apps were available on Apple App store. The average rating for selected applications was 4.17 out of 5.0. Over 80% of the applications (82.4%, 61/74) were free, and the average price of paid applications was $2.50.

After we had sorted out the study sample, we took a look at the workout types that each application supported (see Figure 3). 36.5% of the applications (27/74) tracked overall daily activities including steps, distance, calories burned, sleep, weight, etc. and provided activity logs on daily, weekly and monthly basis (e.g. Fitbit, Argues). Some of them gave users workout tutorials or feedbacks about their performances. Next, 27.0% of the selected applications (20/74) were designed for training muscles and bodybuilding (e.g. StrongLifts 5x5, Insta Abs Trainer). Most of these applications provided tutorial videos, images or text description and some of them enabled users to log circuit and interval training with a timer. 23% of dataset (23/74) were focused on the walking, running, jogging, and cycling

activities (e.g. iRunner, 5K Runner), whereas the 'activity' applications covered wide variety of daily physical activities. These applications generally were equipped with GPS tracking features for distance and route logging and real-time voice feedback for training. About 10% of the applications (8/74) (e.g. 7Minute Workout) were solely for 7mimutes workout training that is a serious of 12 exercises based on research in high-intensity interval training.

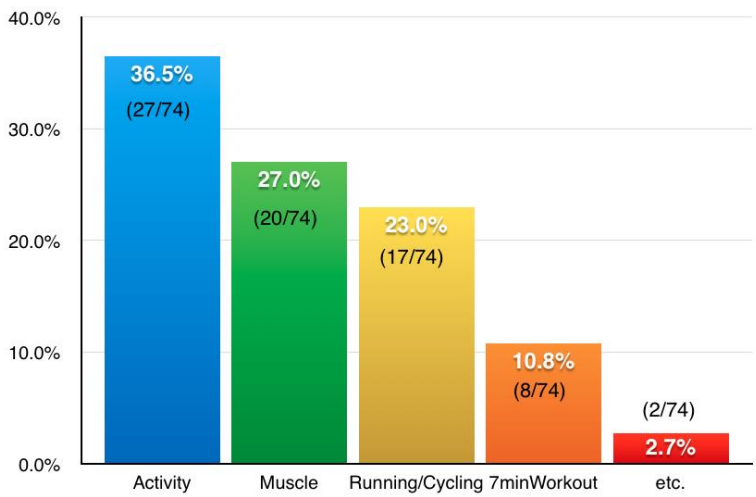

Figure 3 The frequency of workout types (N=74)

Of the 74 analyzed mobile applications, 69 of them (93.2%) were found to utilize at least one compliance-gaining strategy. On average, each mobile application utilized 2.35 compliance-gaining strategy (SD=1.41, Range=0-6, Mode=2).

The frequency of each compliance-gaining strategy is presented at Figure 4. Among 16 strategies, only 10 strategies were utilized at least once. Especially, 'Positive Esteem' strategy was the most frequently utilized one. More than half of the sample made use of positive esteem appeal. In addition, the majority of the

mobile health applications employed ‘Positive Expertise’, ‘Positive Self-feeling’ and ‘Promise’ strategies. Conversely, ‘Liking’, ‘Pre-giving’, ‘Debt’, ‘Altruism’, were not found, which were highly likely to happen in person-to-person interpersonal communication contexts. In addition, some of the negative-regard strategies such as ‘Negative Expertise’ and ‘Negative Moral Appeal’ were not found, either.

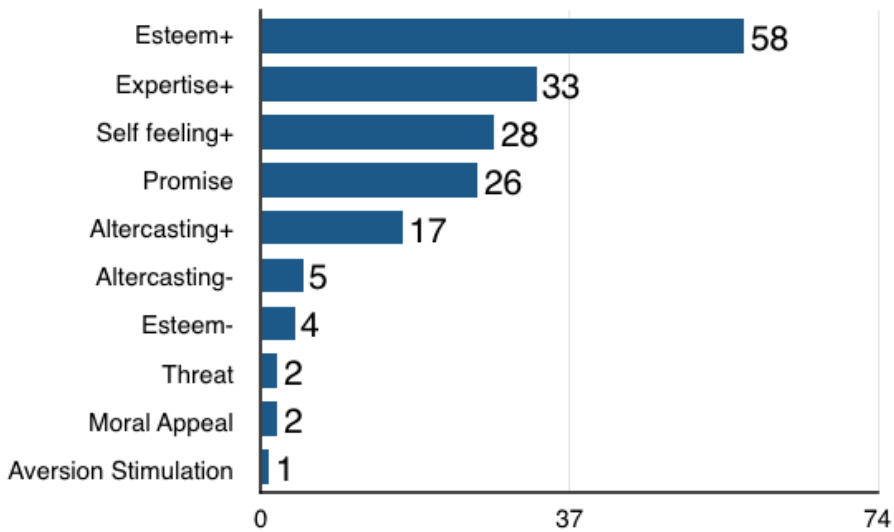

Figure 4 Frequency counts of compliance-gaining strategy used in the study sample

2.1 Representation of compliance-gaining strategies in mobile health applications for promoting physical activity

The most frequently used compliance-gaining strategy was “Positive Esteem” (N=55, 74.3%). Positive esteem is the strategy saying that people you value will think better of you if you comply. In representing positive esteem appeals, most of mobile health applications made use of diverse kinds of “Social feature”. The

social features found in the analysis varied: providing leaderboard to compete with each other, building online community to share information and encouragement, offering or social network features such as sharing, liking and commenting on other people's workout log (see Figure 5).

Your friends, family, trainer or coworkers help keep you motivated with the Sport Feed

· Compete for the top slot on your Friend leaderboard.

· Share sessions, photos and personal bests with your friends in the Sports Feed or on Instagram, Facebook, and Twitter.

(Text description from '*Nike + Fuel*')

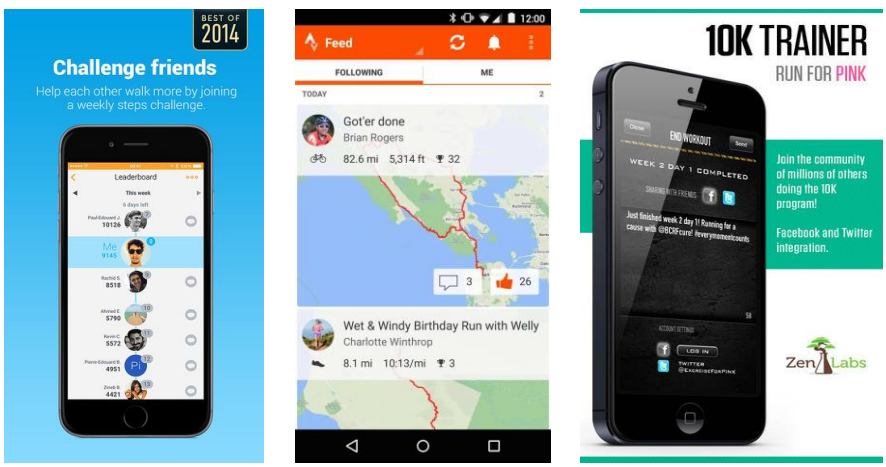

Figure 5 Examples of positive esteem appeal
(Screenshots from '*Health Mate*' (Left), '*Strava Running and Cycling GPS*' (Middle), '*10K Trainer FREE - Run for PINK - Couch to 10K*' (Right))

In most cases, the application screenshots usually showed the moment when a user successfully achieves their health goal, gets friend's support and encouragement, or wins the top spot in competition boards. However, in a rare case (N=4, 5.4%), some applications showed the situation when their friends beat users and when the system indicates that the user's record is far behind the average. As such, these

social features could elicit negative esteem appeals from users (People you value will think worse of you if you do not comply) as well as positive esteem, at the same time. If the users keep a steady record and do exercise regularly, these social features will be welcomed by users that make them proud of themselves and users would not hesitate to share their information. Conversely, if users cannot keep up with the record or skip exercise frequently, they probably do not feel great that their record and performance will be shared and shown by others. Consequently, it could make arouse the negative esteem appeals to users. To sum up, whether the social features are regarded as the positive or negative appeals depends on the user's performance and adherence.

The second most frequently used strategy was 'Positive Expertise' (N=33, 44.5%). In application descriptions, they frequently emphasized that their apps were "scientifically proven" or "recommended by doctors, health professionals and reputable media press". Furthermore, some of them even referred the academic publications related to their applications.

Choose from one of dozens of BodySpace programs built by PhD's, Professional Trainers and Athletes such as Jim Stoppani, Kris Gethin …. and many more.

(Text description from '*BodySpace - Social Fitness App*')

ACCURACY - Studies have shown that our heart rate measurements are within 3 bpm of a clinical pulse oximeter when performed at rest in a well-lit environment (Poh et al., Optics Express 2010, Poh et al., IEEE Trans Biomed Eng 2011).

(Text description from '*Cardiio - Heart Rate Monitor + 7 Minute Workout Exercise Routine for Cardio Health and Fitness*')

However, expertise appeals were rarely applied to the UI of applications. While the

various expertise strategies (especially the positive one) were frequently highlighted in application descriptions in words, it was not applied through the visual and interaction aspect of the applications.

The third and fourth most frequently used strategies were “Positive Self-Feeling” (N=28, 37.8%) and “Promise” (N=26, 35.1%). These two strategies are highly related to *gamification strategy,* which make use of external motivators such as points and badges. Gamification refers to the use of game design elements in non-game contexts (Deterding, Dixon, Khaled, & Nacke, 2011) and the underlying assumption is that gamification would make physical activity more enjoyable, thereby motivate users to become more active (Zuckerman & Gal-Oz, 2014).Virtual rewards such as points and rewards are offered in exchange for user’s great performances and adherences.

To be specific, the badge element in the health mobile applications plays the role of promoting users’ self-feeling, which enables users to feel the sense of accomplishment. Also, it functions in terms of goal-setting, instruction, reputation, status affirmation, and group identification (Antin & Churchill, 2011; Zuckerman & Gal-Oz, 2014). In addition, the point element is related with promise strategy because users recognize that they can earn virtual points if they keep working out or doing something healthy constantly. In some rare cases, virtual points can be exchanged for a tangible reward or real cash.

Use our workout tracker to earn points and level up. *Complete Quests for bonus points*. *Earn badges by reaching milestones*.

(Text description from ‘*Fitocracy Workout Fitness Log*’)

Fun achievements and rewards to keep you motivated

- *Unlock achievements from Novice to Athlete as you vary your routine*
- *Earn rewards and health-related giveaways*

(Text description from '*7 Minute Workout "Seven" with High Intensity Interval Training Challenge*')

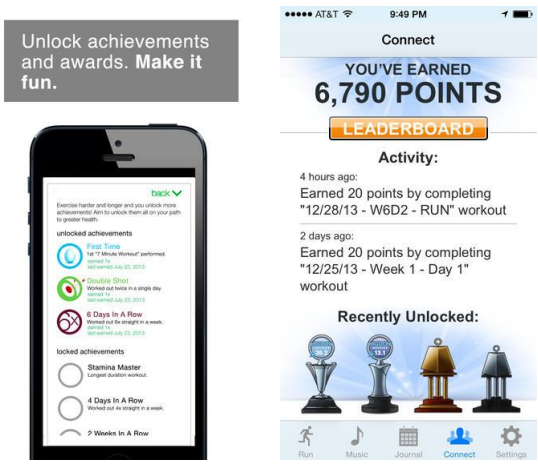

Figure 6 Examples of positive self-feeling and promise appeals
(Screenshots from '*Fitocracy Workout Fitness Log*' (Left), '*Ease into 5K: run walk interval training program*' (Right))

Like the social features found in the esteem appeals, these gamified elements can provoke both positive and negative impacts. Depending on users' performances, their self-feeling can be hurt if their progress does not go well or the expectation to gain points can become a threat that you will lose points if you do not work out.

Skip a day and lose a heart, but miss 3 workouts in a month and your progress resets to zero and it's game over!

(7 Minute Workout "Seven" with High Intensity Interval Training Challenge)

The fifth frequently used strategy was 'Positive altercasting' appeals (N=17, 22.9%) that a person with good qualities would comply with the request. This strategy is

represented implicitly by showing the images of the ideal-type body or healthy lifestyle rather text forms.

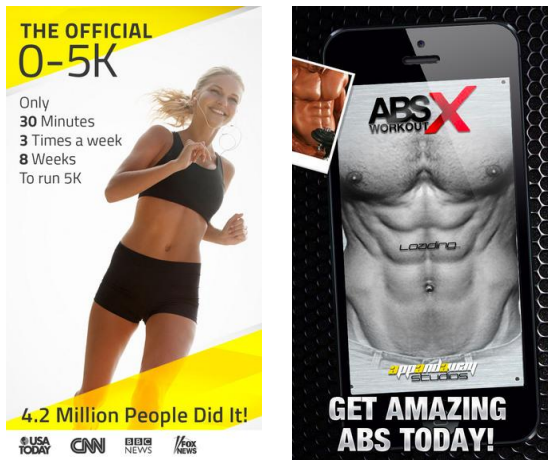

Figure 7 Examples of positive altercasting appeal
(Screenshots from '*5K Runner: 0 to 5K run training, Couch to 5K running, Pro*' (Left), '*Ab Workout X FREE - Six-Pack Core Exercises & Abdomen Trainer*' (Right))

Contrarily, the negative altercasting strategy (N=5, 6.7%) ("A person with bad qualities would not comply.") is represented through negative written words in the text descriptions. For example, they refer a person who do not exercise like "*couch potato*" (in 'C25K® - 5K Trainer FREE') and "*laziness dragon*" (in 'Fitocracy Workout Fitness Log') and they describe those kinds of qualities should be *slayed* and *got off*.

3. Design Storyboards

In the results of preliminary contents analysis of 74 mobile applications for physical activity, we could gain the understanding which compliance-gaining appeals were frequently utilized and how these strategies were being represented in

system dialog and UI. Based on these findings, we design 11 storyboards that depict the situation when each strategy is applied to the mobile health application for physical activity.

Each storyboard shows when a user gets the notification message, which intends to promote user's physical activity and presents the UI that displays the expected consequence when they comply or do not comply with the notification message. Especially, we refer the Burgoon et al.'s operationalization of compliance-gaining verbal message strategies (J. K. Burgoon et al., 1987b), which suggested the ways physician try to gain patient's compliance using strategies in formulating the system notification message.

Table 3 Storyboard Design

	Strategy	**Burgoon et al.'s verbal message strategies between physicians and patients** (J. K. Burgoon et al., 1987a)	**Notification Message (2nd part in the storyboard)**	**UI Representation (3rd part in the storyboard)**
1	**Promise**	The physician might promise something the patient would like, such as a free medication sample.	If you take exercise today, you will gain 25 health points.	Gaining health points
2	**Threat**	The physician might say, "I will not see you anymore if you are not going to do as I ask."	If you don't take exercise today, you will lose 25 health points.	Losing health points
3	**Expertise +**	The physician might say that she knows from experience that things will be best for the patient if the patient follows her recommendations.	If you take exercise today, you can meet the WHO physical activity recommendation.	WHO logo image and physical activity recommendation
4	**Expertise -**	The physician might point out that she knows from experience that the problem will only get worse if the patient does not do as asked.	If you don't take exercise today, you cannot meet the WHO physical activity recommendation.	WHO logo image and physical activity recommendation
5	**Esteem +**	The physician might say, "Your friends and family will think highly of you because you follow my recommendations."	If you take exercise today, your friends will think you are awesome.	Sharing the successful workout log to a user's social network sites

6	**Esteem -**	The physician might say, "Your family and friends will think less of you because you do not do as I ask."	If you don't take exercise today, your friends will think you are dispiriting.	Falling the workout ranking of a user
7	**Self - Feeling+**	The physician might say, "You will be taking care of your health by doing as I ask."	If you take exercise today, you will be awarded the "Weekend workout warrior" badge.	Being rewarded a badge
8	**Self- Feeling -**	The physician might say, "You will feel worse about yourself if you do not do as I ask, because you will not be taking care of your health."	If you don't take exercise today, you won't be awarded the "Weekend workout warrior" badge.	Not being rewarded a badge
9	**Alter- casting +**	The physician might say, "A responsible person concerned about health would follow these recommendations."	If you take exercise today, you will become more self-managed person.	Image of healthy and active man and woman + encouraging message ("You're getting healthier.")
10	**Alter- casting -**	The physician might say to the patient, "It shows your irresponsibility and lack of concern about your health to fail to do as I ask."	If you don't take exercise today, you become idler.	Image of unhealthy and cheerless man and woman + discouraging message ("You keep making excuses, again.")
11	**Aversion Stimul- ation**	The physician might insist that the patient come to the office frequently until the patient does what the physician wants.	The application will ring the loud alarm until you take exercise today.	A timer that shows the countdown to ring the alarm has kicked in

CHAPTER 4. PERCEIVED EFFECTIVENESS OF COMPLIANCE GAINING STRATEGY

In this section, we aimed to anwer the research question 1. We investigate which compliance-gaining strategy is generally perceived to be effective to help users more physically active. To this end, we design the survey study based on the preliminary content analysis.

1. Methodology

Because we intended to investigate the perceived effectiveness of compliance-gaining strategies as realistic as possible, we used 11 storyboards in our survey instead of providing scenarios in written words. Storyboarding is a common technique in HCI and design for demonstrating system interfaces and contexts of use (Truong, Hayes, & Abowd, 2006). The use of storyboard can be beneficial in understanding how technology reshapes human activity and experiencing, and its impacts before the system is built (Rosson & Carroll, 2002). Furthermore, the specific wording in text-based scenarios can influence the understanding of and reaction to a system. Thus, designers often use storyboards rather than scenarios as a less biased visual depiction of the same information (Truong et al., 2006).

Each storyboard that we provided to participants showed the probable situations when users interacted with fictional mobile health application called “Health Alarm.” “Health Alarm” was basically set to be an application that tracks user’s daily physical activity. The UIs and system dialogs were designed based on the result of the preliminary content analysis.

Among Maxwell’s 16 strategies, we decided not to include five strategies: Altruism,

Pre-giving, Debt, Positive and Negative Moral Appeal. It was because these strategies were rarely found in the preliminary content analysis study. Additionally, because some of them were likely to happen in highly interpersonal natures (e.g. Altruism, Pre-giving, Debt) or others seemed out of health scope (e.g. Positive and Negative Moral Appeals), those appeals were not included in the storyboard development process.

The storyboard (see Figure 8) consist of four parts:

1) The first part shows the common weekend situation: “Today’s weather is nice, and the character has nothing special to do.”

2) The second part displays the situation when the character gets the notification message from “Health Alarm”. Different notification messages according to applied compliance-gaining strategy are presented at this part.

3) The third part shows that the character thinks of the expected consequence when s/he complies or does not comply the notification message that “Do exercise today”. Different UI according to applied compliance-gaining strategy is represented at this part.

4) The fourth part shows that the character is indecisive over two options: do exercise or take a rest.

Figure 8 An example of storyboard

After participants were given 11 storyboards in a random order, they answer seven items (six 7-Likert scale statements and one open-ended question). Participants were requested to give score how much they agreed with the given statements on a 7-point Likert scale from “very unlikely” to “highly likely”. To be specific, they evaluated the effectiveness of each “Health alarm” storyboard in three perspectives: behavior, cognitive and affective aspects.

Table 4 Survey Items

Aspect	Item	Given Statement
Behavior	1) Likelihood of Compliance	"The Health Alarm will be helpful to promote my physical activity."
	2) Perceived Effectiveness	"The Health Alarm will be effective to promote my physical activity."
	3) Perceived Helpfulness	"The Health Alarm will be helpful to promote my physical activity."
	4) Intent to continue using	"I will use the Health Alarm, consistently."
Cognitive	5) Easiness to use	"Using the Health Alarm is easy for me."
Affective	6) Feel	"Using Health Alarm will make me feel good."

After they had completed to grade all six items above, we allowed participants to leave any comments about each storyboard, freely. However, it was not a mandatorily required question unlike six items above. The whole storyboards and survey contents that we used in the study are presented at Appendix C and Appendix E.

1.1 Participants

Participants were recruited through social network posting with the request to complete an online survey in May 2015 for one week. The recruitment posting that we used in the study is presented at Appendix D. In addition, we employed the 'snowball-sampling' strategy (Biernacki, Waldorf, & Methods, 1981) to recruit additional study participants.

Survey participation and data collection were done through Qualtrics[3], an online survey platform. Total 476 people initiated the survey, but only 203 of them were found to be appropriate for the data analysis (42.3%). The rest of them did not meet

[3] http://www.qualtrics.com/

the participation criteria (e.g. have no smartphone, younger than 18 years old or have some disease or injury) or did not complete the survey.

The frequency counts and percentages of the demographics of the sample are presented below in Table 5. The average age of the participants was 27.7 years (SD=8.2, range= 18-61 years old), and 139 were female (68.4%), and 64 (32.0%) were male. 32.5% and 22.2% of participants are undergraduate and graduate students. 32.0% are office workers. Some portion of the participants was compensated for their participation with a gift equivalent to $5. The average length to complete the survey was about 15 to 25 minutes.

Table 5 Demographic information of survey participants

	Variable	Frequency	Percentage
1. Gender	Male	64	32.6%
	Female	139	58.4%
2. Age	18-19	18	8.9%
	20-29	133	66.5%
	30-39	30	14.8%
	40-49	23	11.3%
	50-	10	4.9%
	Average Age: 27.8 (SD=8.2)		
3. Occupation	Undergrad Student	66	32.5%
	Grad Student	45	22.2%
	Office Worker	65	32.0%
	Self-Employed or Freelancer	5	2.5%
	Housewife or Stay-at-home dad	5	2.5%
	Etc.	17	8.4%

2. Result

We proceeded to the data analysis to determine if there was a statistically significant difference between the percieved effectiveness of compliance-gaining strategies, in terms of their likelihood of compliance, helpfulness, effectiveness, intent to continue using, easiness to use and feeling. The data gathered from the survey was used to run statistical analysis, including Kruskal-Wallis rank sum test and post hoc test (Tukey's HSD). Following standard practice, we tested the distributions of our data for normality to decide whether parametric or non-parametric statistical tests were appropriate. Therefore, we ran the Shapiro-Wilk test for each item and it showed that the items that participants scored were not likely normally distributed ($p<0.001$), so we used the non-parametric Kruskal-Wallis rank sum test to analyze the data.

As a result, in all six items, we could find the significant differences between strategies ($p<0.01$). Positive self-feeling and Promise strategies were in the upper ranks consistently. Conversely, Aversive stimulation and Negative altercasting strategies generally got the lowest score on all items (see Figure 9).

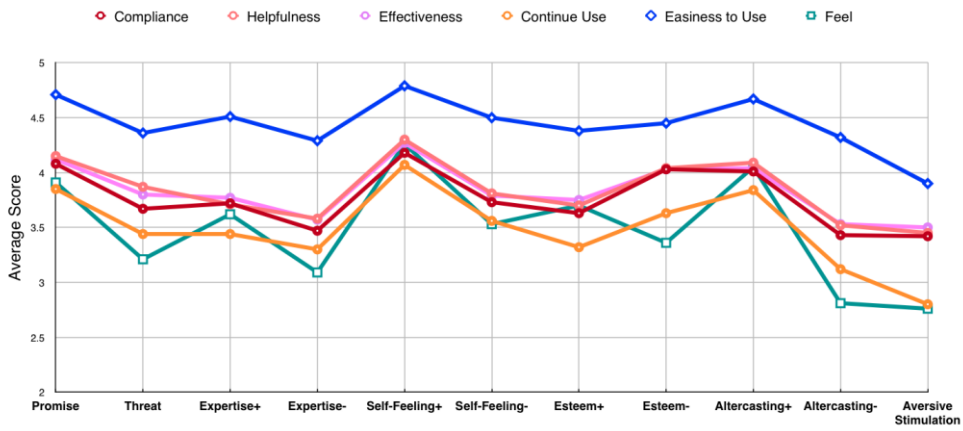

Figure 9 Average scores of six items in the survey

This result indicated that the health mobile applications with external motivators such as points (Promise) or virtual achievement badges (Positive Self-Feeling) were perceived positively in behavior, cognitive and affective aspects.

"It (Being rewarded a achievement badge) will make me do workout even though badges do not have any practical value or benefit." (Positive Self-feeling, 21)

"It sounds so fun. It is like playing a game." (Positive Self-feeling, 54)

"The motivation to gain more points will make me more physically active."(Promise, 82)

However, when the system dialog and UI is likely to provoke bad feelings such as "If you don't take exercise today, you become idler." (Negative altercasting) or "The application will ring the loud alarm until you take exercise today." (Aversive stimulation), people would tend to evaluate all aspects very negatively.

"This negative expression does not make me motivated. Rather, it discourages me and makes me feel very bad. I won't use "Health Alarm" application anymore." (Negative Altercasting, 80)

"It is too annoying and impulsive. It rouses a strong aversion." (Aversive Stimulation, 59)

Generally, when the gain-framed appeals (emphasize the benefits of taking action) were given to participants, it will be likely to be perceived more positively than when loss-framed appeals (emphasize the costs of failing to take action) were presented. Especially in the affective aspects, significant differences between gain-framed and loss-framed strategies were found, while there was no statistically significant difference in behavior and cognitive aspects. For example, when we conducted the post hoc test using Tukey's HSD, Promise was viewed as more pleasing than Threat ($t=-4.269$, $p<0.01$) and Positive self-feeling was perceived to make respondents feel better that Negative Self-feeling ($t=4.420$, $p<0.001$). Even though underlying source of appeals and given UI representation were identical, the ways to frame the system messages and UIs influnend how people evaluted the percieved effectiveness of mobile applications.

"The facts that I will gain points will make me feel so good." (Promise, 35)

"The expression emphasizing the loss will have a negatve effect on my feeling, especially when I am irresolute." (Threat, 20)

When we adopted the verbal aggressiveness dimension in the data analysis, we obtained the consistent results in all behavior, cognitive and affective aspects: Aggressive strategies such as Threat, -Expertise, Aversive Stimulation, were perceived more negatively than unaggressive and moderately aggressive strategies. However, we could not find the significant difference between aggressive and moderately aggressive strategies (see Figure 10).

It is not surprising that the health mobile application with verbally aggressive manners will exert adverse effects on people's behavior, cognitive and affective aspects. Meanwhile, it is noticeable that there was no significant difference between moderately aggressive such as +Expertise, ±Self-Feeling, +Altercasting, +Esteem, and the unaggressive strategies such as Promise. It indicated that the way that health mobile applications give directions or feedbacks to users should not have to be excessively polite or kind only if it is not too aggressive.

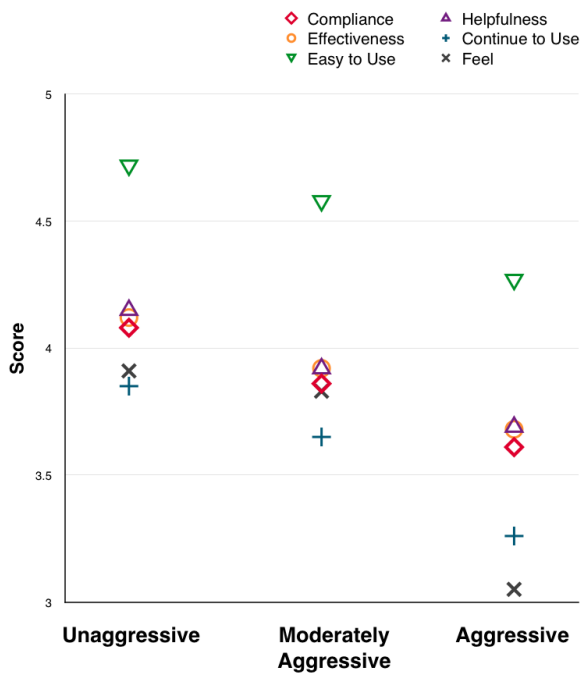

Figure 10 Average scores of six items according to the verbal aggressiveness dimension

When we applied the Marwell & Schmitt (1967)'s five-factor dimension, the overall result indicates that using rewarding activity is more likely to be positively

perceived than using punishing or expertise activity in all aspects. Additionally, punishing activities were generally perceived more negatively than the activation of impersonal commitments (such as moral values and beliefs. There was no significant difference between rewarding activity and activation of impersonal commitment (see Figure 11)

Interestingly, in the affective aspect ('feel' item), using expertise activity in mobile health application was especially perceived negatively. Even though it gained more scores than punishing activity (t=3.154, $p<0.01$), using expertise activity were regarded to be more offending than using reward activity (t=3.778, $p<0.001$) or activation of impersonal commitment (t=2.703, $p=0.03$). In the behavior or cognitive aspects, expertise strategies were perceived moderately positively. This result indicates that expertise strategies in mobile health applications have a moderate influence on the behavior or cognitive aspect, but people tend to feel not that good when expertise appeals are emphasized.

"I will feel pressure because it gives a too imperative message. I hate it." (Negative expertise, 50)

"It seems to give me a hypochondria." (Negative expertise, 86)

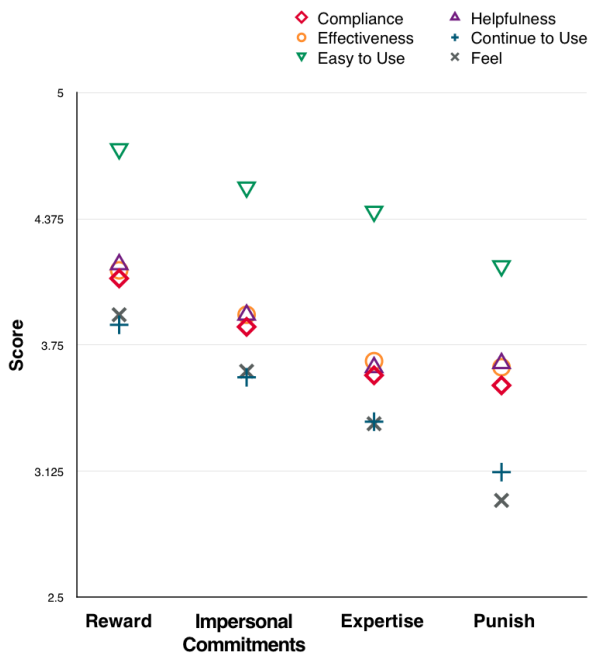

Figure 11 Average scores of six items according to five-factor dimension

CHAPTER 5. RELATIONSHIP BETWEEN INDIVIDUAL CHARACTERISTICS AND PERCEIVED EFFECTIVENESS OF COMPLIANCE GAINING STRATEGY

In the previous section (Chapter 4), we examined which compliance gaining strategy is generally perceived to be effective for users. In this section, we aimed to explore how individual characteristics factors affect individual's likelihood of compliance to the different compliance-gaining strategies, because the effectiveness of strategies varies from one person to another (Kaptein et al., 2010). The purpose of this study is to deepen the understanding about the relationship between individual characteristics and compliance to specific appeals. In addition, it would inform the design implications for mobile health applications tailored to individual characteristics to draw user's compliance more effectively.

1. Methodology

We conducted multiple linear regressions analysis using the individual characteristic measures as predictors. This analysis revealed how well the independent individual characteristics variables predict the self-reported likelihood of compliance scores. The individual characteristic variables that we took consideration into in this study were carefully selected after examining the previous literature concerned to health intervention studies. Consequently, one's demographic information (Sex, Age), previous experiences and perception in mobile health application, the current physical activity status (Stage of change), exercise self-efficacy, and exercise goal content (intrinsic vs. extrinsic) were chosen as a predictor individual characteristics. The dependent variable was the 7-

point Likert scale scores of the likelihood of compliance with 11 compliance-gaining strategies.

Especially, 'stage of change' variable has been reported to be associated with the effectiveness of physical activity interventions in a number of research (Bauman et al., 2012). In addition, previous studies revealed that the stronger the perceived self-efficacy, the more successful people are in reducing health-impairing habits and adopting and integrating health-promoting habits into their regular lifestyle (Bandura, 1994). Goal content (types of motives) also has been pointed out as a critical predictor of the quality of an individual's behavior and psychological well-being (Sebire et al., 2008).

To gather these individual characteristics data, we asked study participants provide their basic demographic information (i.e. gender, age, occupation and smartphone ownership). Next, 'RM 1–FM: Physical Activity Stages of Change—Questionnaire' (Bess H Marcus & Forsyth, 2003) was presented to the participants to elicit their current workout statuses. Then, we asked them whether they had ever used mobile health applications and how much they perceived these applications effective to promote their physical activities. Then, we presented the self-efficacy scales for health related diet and exercise behaviors (Sallis, Ph, & Grossman, 1987), which consisted of 12 items and the goal content for exercise questionnaire (Sebire et al., 2008), made up of 20 statements.

2. Data Analysis

Previous Experiences and Perception about Mobile Health Application

In the survey, we asked whether participants had ever downloaded and used the

mobile health application. We provided them with the explanation about the definition and examples of mobile health applications. In addition, all participants asked to grade the score for this given statement: 'How effective are mobile health applications to achieve your health goal?' basis on 7-point Likert scale to elicit the perceived effectiveness of the mobile health application.

Table 6 contains the data related to respondents' previous experiences and perception in mobile health applications. We found out that 60.1% (N=122) of participants had used at least one health mobile application. Among who had had experiences of mobile health application, 58.2% (N=71) of them answered that they had rarely used health mobile application. Only 14.9% (N=17) of them used mobile health application on a daily basis.

Table 6 Previous experiences about mobile health applications

	Item	Percentage	Number
1. Experience (N=203)	Yes	60.1%	122
	No	39.9%	81
2. Frequency (N=122)	Rarely	58.2%	71
	Once a Week	8.2%	10
	Twice or Three times a Week	14.8%	18
	Four and Five times a Week	5.0%	6
	Everyday	8.2%	10
	Multiple times Everyday	5.7%	7

The average score assessing the perceived effectiveness of mobile health application was 3.96 out of 7, and the standard deviation was 1.39.

Stage of Change

The transtheoretical model of behavior change (TTM) treats behavior change as

dynamic rather than an “all or nothing” phenomenon. Five stages have been proposed that differ according to an individual’s intention and behavior (Marshall & Biddle, 2001). Because we excluded who had problems and were not interested in doing physical activity during our screening procedure, our sample population only included three stages of people among five stages: Stage 3. *Preparation* (making small changes in behavior but still not meeting a criterion for physical activity), *Action* (meeting a criterion of physical activity, but only recently—usually within the past 6 months), and *Maintenance* (meeting a criterion for physical activity for 6 or longer months).

As a result, more than half of our sample (56.2%, N=114) was in preparation stage while 24.10% (N=49) of them are in their action stage. Roughly 20% of our sample population (19.7%, N=40) was in the Maintenance stage.

Self-Efficacy

Self-efficacy is the extent or strength of one's belief in one's own ability to complete tasks and reach goals (Bandura, 1998). Self-efficacy expectations are believed to influence types of activities engaged in, the amount of effort expended and length of persistence in the face of obstacles (Sallis et al., 1988).

To assess the individual self-efficacy especially in physical activity realm, we utilized ‘Exercise Confidence survey: Self-efficacy for Exercise Behaviors Scales’(Sallis et al., 1988), which consists of 12 questions, five point Likert questions. Individual’s self-efficacy score were calculated by adding up the 12 scores altogether. The average score was 34.4 out of 60, and the standard deviation was 7.93.

Goal Contents

To identify which goal type individuals had for their physical activity, we utilized 'the Goal Content for Exercise Questionnaire: GCEQ' (Sebire et al., 2008). This measure consists of 20-item consisting of 5 lower order factors (i.e., social affiliation, health management, skill development, image and social recognition) that could be subsumed within a 2-factor higher order structure (i.e., intrinsic and extrinsic). The average score of each goal content factor were summarized in Figure 12.

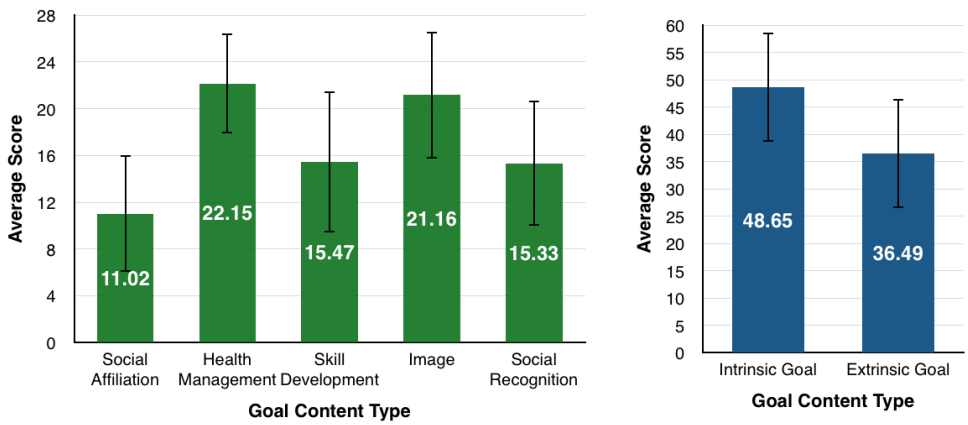

Figure 12 Average scores of goal content type

3. Result

Multiple linear regressions were tested to predict participants' likelihood of compliance to each strategy based on their individual difference factors. As a result, we could obtain statistically significant regression equations (10 linear regressions p<0.001***, one linear regression p<0.01**). The 11 regression equations yielded average 0.1511 (SD=0.032, Range: 0.1144 – 0.2346) R^2 score and 0.1161

(SD=0.034, Range: 0.0779 – 0.2030) adjusted R^2 score. The results are shown in Table 7.

Among eight individual difference variables that we took into consideration, five of them accounted for the variance in the likelihood of compliance. For individual's stage of change, prior experiences of using mobile health application and self-efficacy were not found to be the predictor of any strategy.

Especially, the perceived effectiveness of mobile health application consistently positively correlated with a respondent's reported likelihood of compliance. Conversely, the previous experience in using mobile health application was not related with any strategy.

Sex factor was shown to be a significant predictor of the likelihood of Positive esteem strategy (β=0.53, p=0.03*). As sex factor was coded Male=0 and Female=1, this indicates that female are more likely to increase their physical activity to Positive esteem strategies. This result informed that the female is likely to be more positive toward making use of social features in mobile health applications.

Age factor yielded negative association with the likelihood of compliance with five strategies: Threat (β=-0.35, p=0.02*), Aversive stimulation (β=-.30, p=0.08·), Positive expertise (β=-0.25, p=0.09·), Negative self-feeling (β=-0.39, p=0.01*) and Negative altercasting (β=-0.44, p=0.006**). This indicates that as the age of a respondent is younger, the likelihood of compliance with these five strategies gets higher. The interesting to note is that these five strategies (Threat, Aversive Stimulation, -Self-feeling, -Altercasting) have negative manners in the way of providing stimulations to users.

Intrinsic and extrinsic goal contents summated score showed significant correlation with the likelihood of compliance with some strategies. To be specific, as an individual possessed intrinsic goal for their physical activity such as developing skills and managing health, the likelihood of compliance to the positive expertise (β=0.036, p=0.002**) and negative expertise (β=0.027, p=0.03*) appeals would increase. It is natural that people with higher intrinsic motivation in promoting physical activity are likely to be more sensitive to the expertise based information and stimulation.

In addition, extrinsic goal content is found to be positively related with five strategies: Promise(β=.0039, p=0.002**), Threat(β=0.030, p=0.02*), Positive Self-Feeling(β=0.036, p=0.005**), Positive(β=.0041, p<.001***) and Negative Esteem(β=0.043, p=.002**). People who are willing to exercise for gaining social recognition or improving their image are likely to have extrinsic goals. Because people with higher extrinsic goal are likely to be sensitive to other's judgments, they are favorably inclined to Positive and Negative Esteem appeals. Additionally, people with the higher extrinsic goal content are likely to comply readily when they can get external rewards such as points (Promise, Threat) or achievement badge (Self-feeling) in return for their exercise.

Table 7 Multiple Regression Results

	Sex	Age	Stage of Change	MHA.Exp.	MHP.Per.	Self-efficacy	GC.Intrinsic	GC.Extrinsic	F-Statistic	R^2	Adjusted R^2
Promise	**0.40·**	-0.21	0.19	-0.34	**0.27*** **	-0.016	0.004	**0.039** **	**F(8, 194)=4.729, p<0.001*** **	0.1632	0.1287
Threat	0.277	**-0.35***	0.07	-0.38	**0.27** **	-0.002	-0.0008	**0.030***	**F(8, 194)=3.587, p<0.001*** **	0.1289	0.0929
Aversive Stimulation	0.44	**-0.30·**	0.017	-0.184	**0.26** **	**-0.036·**	0.015	**0.025·**	**F(8, 194)=3.132, p<0.01** **	0.1144	0.0779
+Expertise	0.23	**-0.25·**	-0.04	-0.36	**0.321*** **	-0.006	**0.036** **	-0.007	**F(8, 194)=4.335, p<0.001*** **	0.1517	0.1167
-Expertise	0.28	-0.25	-0.184	-0.025	**0.30*** **	0.001	**0.027***	-0.006	**F(8, 194)=3.362, p<0.001*** **	0.1217	0.0855
+Self-Feeling	0.33	-0.21	-0.01	-0.05	**0.41*** **	-0.012	**0.021·**	**0.036** **	**F(8, 194)=7.432, p<0.001*** **	0.2346	0.2030
-Self-Feeling	0.08	**-0.39***	-0.146	-0.31	**0.30*** **	-0.008	0.019	**0.025·**	**F(8, 194)=4.174, p<0.001*** **	0.1468	0.1117
+Esteem	**0.53***	-0.16	0.009	-0.27	**0.15·**	-0.017	**0.020·**	**0.041** **	**F(8, 194)=4.237, p<0.001*** **	0.1487	0.1136
-Esteem	0.087	-0.10	0.08	-0.23	**0.29** **	0.005	-0.0016	**0.043** **	**F(8, 194)=3.66, p<0.001*** **	0.1311	0.0953
+Altercasting	0.43	0.089	0.19	-0.14	**0.32*** **	-0.006	**0.019·**	0.016	**F(8, 194)=5.028, p<0.001*** **	0.1717	0.1376
-Altercasting	0.40	**-0.44** **	0.094	-0.44·	**0.31*** **	-0.015	0.014	0.018	**F(8, 194)=4.264, p<0.001*** **	0.1495	0.1145

Significance codes: '·' p< 0.1, '*' p< 0.05, '' p<0.01, '***' p< 0.001**

CHAPTER 6. STUDY IMPLICATIONS

Several important issues were raised in this research, and the findings informed the design implications to design the effective mobile health applications for physical activity.

The research findings from RQ1 indicated that mobile health applications with external motivators such as points (Promise) or virtual achievement badges (Positive Self-Feeling) are perceived to be generally positive in all behavior, cognitive and affective aspects. In addition, it revealed that gain-framed appeals have more positive influences on user's affective aspect than loss-framed appeals in using mobile health applications. Conversely, Negative altercasting and Aversive stimulation strategies were evaluated most negatively. In conclusion, when a mobile application for physical activity makes use of with gain-framed appeals and external virtual rewards to motivate users, users generally perceive the effectiveness of mobile application most positively.

In addition, we found that aggressive strategies were perceived more negatively than unaggressive and moderately aggressive strategies. . It revealed that strategies with extremely aggressive style would be perceived very negatively. However, we could not find the significant difference between aggressive and moderately aggressive strategies. It informs that system message and UI component to promote user's physical activity need to avoid using extremely aggressive strategy, but it does not mean that application needs to be always in extremely polite manners (Unaggressive strategies). We also found that using expertise activity in mobile health applications was likely to perceived negatively especially in affective

aspects. Even though expertise-based input is regarded as a crucial component of health interventions (Sparling, Owen, Lambert, & Haskell, 2000), some users could feel the expertise-based appeals as a 'threat' or 'compulsory burden' rather than 'trustworthy' recommendation or criteria. In conclusion, using expertise appeals in mobile health application requires careful consideration because using these appeals can give conflicting impressions to users.

The study results of RQ2 showed that the perceived effectiveness of mobile health application consistently positively correlated with the likelihood of compliance with all strategies. However, previous experiences in using health mobile applications were not related with the likelihood of compliance with any strategy. This result indicates that how strongly one believes the effectiveness of health mobile applications is more crucial than the previous uses of them in drawing users' compliances to increase user's physical activity.

In addition, we found that females are more likely to increase their physical activity to the social features of applications. It aligned well with the recent research result that women were significantly more likely than men to use social networking sites (Pew Research Center, 2013). The findings also revealed that the younger people are, the more likely they are to perceive negatively framed strategy such as Threat positively. It means that when a mobile application aims to motivate the older population's physical activity, it is recommended to avoid using negatively framed strategies.

Lastly, depending on the exercise goal types that each user possesses, the system design should utilize appropriate strategies. When a system targets people with

intrinsic goals, utilizing expertise-based appeals would be effective. Meanwhile, reward-based, and social-based appeals would be more satisfying to people with extrinsic goal types.

Meanwhile, this study has a number of limitations, which might lead to suggestions for future research. First, in regard to content analysis, some portion of interpretation and representation could be done a little arbitrarily. Especially, because only one coder participated in the content analysis process, the reliability and accountability of qualitative data coding could be a little misled even though one coder examined the data several times. In future work, a number of well-trained coders will be needed to ensure high levels of reliability.

Next, in designing the storyboard that depicted 11 compliance-gaining strategies, some portion of storyboard were not well understood by survey participants as intended. For example, in the storyboard that showed the situation when 'Negative esteem' strategy was applied, some people thought that this was about the competition board. In fact, we designed it to show the situation when one's workout ranking fell down, because s/he did not do exercise. Furthermore, some people could not tell the difference between positively and negatively framed appeals. In the comments from participants, some people complained about why identical storyboards were repeatedly presented without noticing the changes in the framing. In the further work, we should elaborate the study design to make people recognize the difference between appeals more clearly. In addition, we need to ensure that the storyboard or scenarios are well-designed fit to our intentions through sufficient pilot studies.

Lastly, in our survey study, we investigated the perceived effectiveness of each compliance-gaining strategy separately. While we found out that the existing mobile health application utilize 2.51 strategies on the average and there were a positive correlation between the number of strategies and the rating of applications, the current survey design could not accommodate the effects of multiple strategies, at once. Based on the present study findings, we need to explore how a combination of multiple strategies influences on the user's compliance and satisfaction in the future study. In addition, in the multiple regression study, we only could obtain relatively low R^2 scores because we focused on the individual characteristics variables only in this study. To elicit more comprehensive models, we need to consider situational contexts as well as individual characteristics in the future study.

The present study contributes in two ways.

First, this study provides practical design implications to those who design and develop mobile health applications to promote physical activity. While it should be noted that these design implications are not generalizable to all cases, it informs some important aspects that system designer should take into consideration. Furthermore, the findings of this study can guide the ways system messages are formulated and how system UI would be designed to promote user's physical activity effectively.

In addition, in terms of theoretical aspect, this study endeavored to broaden the deeper understanding and application of compliance-gaining strategy. While the concept and taxonomy of compliance gaining have been widely utilized in health

domains, to our knowledge, it is the first attempt to employ compliance gaining into the health mobile application contexts. This study could be a starting point to make use of compliance-gaining strategy not only for the exploration of human-to-human interpersonal communications, but also for investigation of the human-to-computer interactions.

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APPENDIX A. STUDY SAMPLE OF CONTENT ANALYSIS

	Market	Application Name	URL
1	Google Play Store	Google Fit	https://play.google.com/store/apps/details?id=com.google.android.apps.fitness&hl=en
2	Google Play Store	7 Minute Workout	https://play.google.com/store/apps/details?id=com.popularapp.sevenmins&hl=en
3	Google Play Store	Calorie Counter & Diet Tracker	https://play.google.com/store/apps/details?id=com.sparkpeople.androidtracker&hl=en
4	Google Play Store	Gorilla Workout: Strength Plan	https://play.google.com/store/apps/details?id=com.scopic.gorilla&hl=en
5	Google Play Store	Noom Coach: Weight Loss Plan	https://play.google.com/store/apps/details?id=com.wsl.noom&hl=en
6	Google Play Store	7 Minute Workout - Scientific	https://play.google.com/store/apps/details?id=icab.sevenminuteworkout.android
7	Google Play Store	Zombies, Run!	https://play.google.com/store/apps/details?id=com.sixtostart.zombiesrun&hl=en
8	Google Play Store	Strava Running and Cycling GPS	https://play.google.com/store/apps/details?id=com.strava
9	Google Play Store	Nike+ Running	https://play.google.com/store/apps/details?id=com.nike.plusgps
10	Google Play Store	Runtastic Running & Fitness	https://play.google.com/store/apps/details?id=com.runtastic.android
11	Google Play Store	Runtastic Push-Ups PRO Trainer	https://play.google.com/store/apps/details?id=com.runtastic.android.pushup.pro
12	Google Play Store	The Walk: Fitness Tracker Game	https://play.google.com/store/apps/details?id=com.sixtostart.thewalk
13	Google Play Store	Endomondo Running Cycling Walk	https://play.google.com/store/apps/details?id=com.endomondo.android
14	Google Play Store	Fitocracy Workout Fitness Log	https://play.google.com/store/apps/details?id=com.fitocracy.app
15	Google Play Store	30 Day Fitness Challenges	https://play.google.com/store/apps/details?id=com.fitness.challenges
16	Google Play Store	Couch to 5K®	https://play.google.com/store/apps/details?id=com.active.aps.c25k
17	Google Play Store	Sworkit Pro Personal Trainer	https://play.google.com/store/apps/details?id=sworkitproapp.sworkit.com
18	Apple Appstore	Fitbit	https://itunes.apple.com/us/app/fitbit/id462

			638897?mt=8
19	Apple Appstore	Fitness Buddy FREE : 400+ Exercise Workout Trainer and Workout Journal	https://itunes.apple.com/us/app/fitness-buddy-free-400+-exercise/id514780106?mt=8
20	Apple Appstore	Daily Ab Workout FREE - Personal Trainer for Quick Abs Workouts	https://itunes.apple.com/us/app/daily-ab-workout-free-personal/id388882339?mt=8
21	Apple Appstore	MyPlate Calorie Tracker - Your Diet and Fitness Calorie Counter for Better Health by LIVESTRONG.COM ...	https://itunes.apple.com/us/app/myplate-calorie-tracker-your/id502317923?mt=8
22	Apple Appstore	C25K® - 5K Trainer FREE - (Go from Couch Potato to Running the 5K)	https://itunes.apple.com/us/app/c25k-5k-trainer-free-go-from/id485971733?mt=8
23	Apple Appstore	Pacer - Pedometer plus Weight and BMI Management and Blood Pressure Tracker	https://itunes.apple.com/us/app/pacer-pedometer-plus-weight/id600446812?mt=8
24	Apple Appstore	UP - Tracker Required (UP/UP24/UP MOVE)	https://itunes.apple.com/us/app/up-tracker-required-up-up24/id461125277?mt=8
25	Apple Appstore	Nike+ Fuel	https://itunes.apple.com/us/app/nike+-fuel/id493325070?mt=8
26	Apple Appstore	5K Runner: 0 to 5K run training, Couch to 5K running, Pro	https://itunes.apple.com/us/app/5k-runner-0-to-5k-run-training/id439852091?mt=8
27	Apple Appstore	7 Minute Workout “Seven” with High Intensity Interval Training Challenge	https://itunes.apple.com/us/app/7-minute-workout-seven-high/id650276551?mt=8
28	Apple Appstore	Argus - Pedometer, Run, Cycle achieve your fitness and weight loss goals with the ultimate activity ...	https://itunes.apple.com/us/app/argus-pedometer-run-cycle/id624329444?mt=8
29	Apple Appstore	PumpUp - Health & Fitness Community	https://itunes.apple.com/us/app/pumpup-health-fitness-community/id573070442?mt=8
30	Apple Appstore	7 Minute Workout	https://itunes.apple.com/us/app/7-minute-workout/id650762525?mt=8
31	Apple Appstore	JEFIT Workout - Free personal exercise trainer & Gym Log	https://itunes.apple.com/us/app/jefit-workout-free-personal/id449810000?mt=8
32	Apple Appstore	Instant Abs Trainer : 100+ ab exercises and workouts for free, quick mobile personal trainer, on-th...	https://itunes.apple.com/us/app/instant-abs-trainer-100+-ab/id583620368?mt=8
33	Apple Appstore	FitStar Personal Trainer — Burn Calories & Lose Weight	https://itunes.apple.com/us/app/fitstar-personal-trainer-burn/id535640259?mt=8

		with Video Fitness Workouts Led by Football L...	
34	Apple Appstore	Health Mate - Steps tracker & Life coach by Withings	https://itunes.apple.com/us/app/health-mate-steps-tracker/id542701020?mt=8
35	Apple Appstore	BodySpace - Social Fitness App	https://itunes.apple.com/us/app/bodyspace-social-fitness-app/id687818146?mt=8
36	Apple Appstore	Garmin Connect™ Mobile	https://itunes.apple.com/us/app/garmin-connect-mobile/id583446403?mt=8
37	Apple Appstore	DailyBurn - Video Workouts	https://itunes.apple.com/us/app/dailyburn-video-workouts/id472322122?mt=8
38	Apple Appstore	Butt Workouts Free	https://itunes.apple.com/us/app/butt-workouts-free/id497564433?mt=8
39	Apple Appstore	Sports Tracker for Running, Cycling, Walking, Hiking, Fitness, Weight Loss and All Training	https://itunes.apple.com/us/app/sports-tracker-for-running/id426684873?mt=8
40	Apple Appstore	7 Minute Workout Challenge	https://itunes.apple.com/us/app/7-minute-workout-challenge/id680170305?mt=8
41	Apple Appstore	Steps Pedometer & Step Counter Activity Tracker	https://itunes.apple.com/us/app/steps-pedometer-step-counter/id708359518?mt=8
42	Apple Appstore	NexTrack – The mPoints exercise and weight loss tracker for motivation improve your health & fitness...	https://itunes.apple.com/us/app/nextrack-mpoints-exercise/id417348701?mt=8
43	Apple Appstore	Pact: Earn Cash for Exercise, Healthy Living, and Eating Right	https://itunes.apple.com/us/app/pact-earn-cash-for-exercise/id456068701?mt=8
44	Apple Appstore	Coach.me - Accountability, Tracking and Coaching for Any Goal or Habit (Formerly Called Lift)	https://itunes.apple.com/us/app/coach.me-accountability-tracking/id530911645?mt=8
45	Apple Appstore	Cardiio - Heart Rate Monitor + 7 Minute Workout Exercise Routine for Cardio Health and Fitness	https://itunes.apple.com/us/app/cardiio-heart-rate-monitor/id542891434?mt=8
46	Apple Appstore	Ab Workout X FREE - Six-Pack Core Exercises & Abdomen Trainer	https://itunes.apple.com/us/app/ab-workout-x-free-six-pack/id596678863?mt=8
47	Apple Appstore	Full Fitness : Exercise Workout Trainer	https://itunes.apple.com/us/app/full-fitness-exercise-workout/id536049508?mt=8
48	Apple Appstore	Walkmeter GPS Pedometer - Walking Running Hiking for Weight Loss Walk Tracker	https://itunes.apple.com/us/app/walkmeter-gps-pedometer-walking/id330594424?mt=8

49	Apple Appstore	The Johnson & Johnson Official 7 Minute Workout App	https://itunes.apple.com/us/app/johnson-johnson-official-7/id784797900?mt=8
50	Apple Appstore	Target WEIGHT for Adults (Personal Daily Weight Tracker & BMI)	https://itunes.apple.com/us/app/target-weight-for-adults-personal/id338889966?mt=8
51	Apple Appstore	Nike+ Move	https://itunes.apple.com/us/app/nike+-move/id712498492?mt=8
52	Apple Appstore	The 7 Minute Workout - Get fit quick with high intensity interval training	https://itunes.apple.com/us/app/7-minute-workout-get-fit-quick/id653407949?mt=8
53	Apple Appstore	P90X	https://itunes.apple.com/us/app/p90x/id425192079?mt=8
54	Apple Appstore	Fitness Point - Workout Exercise Journal & Personal Trainer + Body Tracker	https://itunes.apple.com/us/app/fitness-point-workout-exercise/id525094310?mt=8
55	Apple Appstore	Charity Miles	https://itunes.apple.com/us/app/charity-miles/id505253234?mt=8
56	Apple Appstore	Pocket WOD - CrossFit Enthusiasts Trainer, Exercise & Fitness App	https://itunes.apple.com/us/app/pocket-wod-crossfit-enthusiasts/id492100601?mt=8
57	Apple Appstore	Human - Activity & Calorie Tracker: track walking, running, biking and indoor activity	https://itunes.apple.com/us/app/human-activity-calorie-tracker/id692721875?mt=8
58	Apple Appstore	iRunner | Runners & Walkers Fitness | Heart Rate Training | Run, Jog, Walk & Hike Workout Route Trac...	https://itunes.apple.com/us/app/irunner-runners-walkers-fitness/id304074554?mt=8
59	Apple Appstore	Footsteps - Pedometer Free	https://itunes.apple.com/us/app/footsteps-pedometer-free/id364911801?mt=8
60	Apple Appstore	Pedometer++	https://itunes.apple.com/us/app/pedometer++/id712286167?mt=8
61	Apple Appstore	FitnessBuilder	https://itunes.apple.com/us/app/fitnessbuilder/id306287984?mt=8
62	Apple Appstore	StrongLifts 5x5: The Simplest, Most Effective Workout to Get Stronger, Build Muscle and Burn Fat Fas...	https://itunes.apple.com/us/app/stronglifts-5x5-simplest-most/id488580022?mt=8
63	Apple Appstore	Under Armour Record - Fitness Training, Activity & Sleep Tracking, Weight Loss Community	https://itunes.apple.com/us/app/under-armour-record-fitness/id895425891?mt=8
64	Apple Appstore	Breeze - Pedometer, walk tracker, activity log and	https://itunes.apple.com/us/app/breeze-pedometer-walk-

		movement coach made simple	tracker/id826697005?mt=8
65	Apple Appstore	Misfit	https://itunes.apple.com/us/app/misfit/id564157241?mt=8
66	Apple Appstore	Blogilates Official App	https://itunes.apple.com/us/app/blogilates-official-app/id677023207?mt=8
67	Apple Appstore	GAIN Self-Guided Workout Apps - custom training programs for strength, cardio & functional fitness.	https://itunes.apple.com/us/app/gain-self-guided-workout-apps/id441646808?mt=8
68	Apple Appstore	10K Trainer FREE - Run for PINK - Couch to 10K	https://itunes.apple.com/us/app/10k-trainer-free-run-for-pink/id511600311?mt=8
69	Apple Appstore	POPSUGAR Active	https://itunes.apple.com/us/app/popsugar-active/id684484023?mt=8
70	Apple Appstore	Run with Map My Run+ - GPS Running, Jog, Walk, Workout, Heart Rate, Sleep, Weight, Step Tracking, Co...	https://itunes.apple.com/us/app/run-map-my-run+-gps-running/id306468004?mt=8
71	Apple Appstore	30 Day Squat Challenge Free	https://itunes.apple.com/us/app/30-day-squat-challenge-free/id680296784?mt=8
72	Apple Appstore	miCoach train & run	https://itunes.apple.com/us/app/micoach-train-run/id383809424?mt=8
73	Apple Appstore	Ease into 5K: run walk interval training program	https://itunes.apple.com/us/app/ease-into-5k-run-walk-interval/id301233668?mt=8
74	Apple Appstore	MyFit Fitness - Workout Logger and Weight Loss Exercise Tracker Free	https://itunes.apple.com/us/app/myfit-fitness-workout-logger/id475628210?mt=8

APPENDIX B. CONTENT ANALYSIS CODING SCHEME

	Name	Price	Rating	Market	Workout	+Expertise			+Esteem			....	Promise			Num. of Strategies
							Text	UI		Text	UI			Text	UI	
1	Google Fit	0	4.0	Google PlayStore	Activity	0			0				0			0
2	7 Minute Workout	0	4.4	Google PlayStore	7minWorkout	1	Over 3,000,000 Users love 7 minutes workout, Scientifically proven to aid weight loss & improve cardiovascular function.	https://lh6.ggpht.com/lAHv3BIMhAaJe12GIXUhQ1gp9VwkQ6txgvu98aTLKi7YSXbdLg0M6VWj28fNu6QrB_s=h900-rw https://lh6.ggpht.com/H3PinVLNXo9CdKT1A7nJ_LeM7eT-NPz1hkTECkTlzxGNFxZKmmLlVjyMM-zOUN1x5Q=h900-rw https://lh5.ggpht.com/eFJMI5Te4gQeT0IAV4xH-QybqklvyWhnsdQglt4bFyU-VppFKDZKsAHC6Wfij8IAFUE=h900-rw	0				0			2
3	Gorilla Workout: Strength Plan	1	4.2	Google PlayStore	Muscle	0			1	Once completing a workout you can share on sites like Facebook or Twitter to get encouragement and motivation, or for bragging rights if you're competing amongst friends.	https://lh4.ggpht.com/7ZOzTR7tAy7UXV727lzvN8Xo7ipMaBfDOekW1WfQnQUzZwe0UWUq2FpLR3cY9-lZkp4=h900-rw		0			1
4	Noom Coach: Weight Loss Plan	0	4.3	Google PlayStore	Activity	1	Unlike a calorie counter, Noom Coach provides support -- backed by science -- to help you make lasting lifestyle changes.		1	User support forums to connect with others, ask questions, & share tips UNLOCK EVEN MORE WITH NOOM PRO • Noom Groups: virtual weight loss support groups led by a trained facilitator. Share your health and fitness journey & get support	https://lh6.ggpht.com/icrYkssQDyLFFsq64wSYV0TwbTjcwY_TEVgKmC0LZitK17D5tMFB6KhZj_hhlursdbJn=h900-rw		1		https://lh3.ggpht.com/heaaFYb_vuBDe2xbTxFCeymaOZHeg6i7JdNDp7q-jmNGqd6kx6qs14k0_U6VwfcrOUI=h900-rw	3
5	7 Minute Workout - Scientific	0	3.7	Google PlayStore	7minWorkout	1	The seven minute workout is a 7min full workout that has been featured all around the world. It was originally published in American College of Sports Medicine's Health & Fitness Journal		0				0			1
6	Zombies, Run!	0	4.5	Google PlayStore	Walking/ Running	0			1	VIEW YOUR RUNS ONLINE WITH ZOMBIELINK Register with our free ZombieLink service to view and share your runs online, complete with maps and full run history. Plus you can sync your runs with Runkeeper, export them as GPX files, and share them with friends!	https://lh5.ggpht.com/XvvkCVByZvbOrm0iQOp10_Sw52heoBU9rfUEOenfEzelz0_uEo0bzO0cD0Y4isaMug=h900-rw		1	YOU ARE RUNNER 5 Hundreds of lives are counting on you. You've got to rebuild your base from a few shivering survivors into a fortified beacon of civilization by collecting critical supplies and avoiding roving zombie hordes. Can you save them and learn the truth about the zombie apocalypse?	https://lh6.ggpht.com/hj-7cC9RCKzhA4DKMcZB_N9IVkngIt5kJR5BhCDv3ODpqnhFh6DZwVIUINQ03jibubE=h900-rw https://lh3.ggpht.com/vTnHQVkOHQAqzMOiOQ4QdQd-KcErgHoMKSkbVSpGvRIWWuhvFHI3I013bxSerpUVKMsk=h900-rw https://lh3.ggpht.com/J62iN_Hus9qxywUghkzoLGK6cdmm89fueetc0ne7CXViu_GI6jMLcmH7ajxv_LREVMpT=h900-rw	2

APPENDIX C. STORYBOARD DESIGNS

N.O	Strategy	Storyboard
1	Promise	
2	Threat	

3	Positive Expertise	
4	Negative Expertise	

5	Positive Self-feeling	
6	Negative Self-feeling	

7	Positive Esteem	
8	Negative Esteem	

9	Positive Altercasting	
10	Negative Altercasting	

11	Aversive Stimulation	

APPENDIX D. SURVEY STUDY PARTICIPANT RECRUITMENT POSTING

게시물 제목 : 설문조사 참여하시고 커피받아가세요 ! (**15분-20분 /스타벅스 커피**) - SNU HCC Lab.

본문 :

이제 완연한 봄이네요. 서울대학교 융합과학기술대학원 인간중심컴퓨팅 연구실 (Human-centered Computing Lab)에서 진행하는 설문조사에 참여하시고 봄날, 커피 한잔의 여유를 누리세요 :)

- 연구기관 : 서울대학교 융합과학기술대학원 인간중심컴퓨팅 연구실 (Human-centered Computing Lab)
- 연구주제 : 신체 활동 증진을 위한 모바일 헬스 어플리케이션 개발 및 디자인 관련 연구
- 대상자 : 스마트폰을 소지하고 있는 현재 질병이나 부상이 없는 건강한 성인 (모바일 헬스 어플리케이션을 사용한 적이 없어도 참여 가능합니다!)
- 설문하러 가기 : Link (← 다음의 링크를 누르시면 바로 설문조사 참여 가능합니다 !)
- 응답 예상 시간 : 15~20분
- **소정의 상품 : 설문에 응답해주신 분들을 대상으로 추첨을 통해 스타벅스커피 아이스 아메리카노 기프티콘을 드립니다.**

국문 초록

본 연구의 목적은 Marwell과 Schmitt (1967)이 제시한 16개의 대인설득전략을 바탕으로, 신체 활동 증진을 위한 모바일 어플리케이션의 효율적인 디자인 방안에 대해 연구하는 데 있다. 이를 위해 먼저 어플리케이션 마켓에서 유통되고 있는 신체활동 증진을 위한 모바일 어플리케이션에 대한 내용분석을 실시하여, 현재 널리 사용되고 있는 대인설득전략이 무엇인지, 또한, 각각의 전략들이 어떤 방식으로 시스템 메시지 및 인터페이스 상에 표현되고 있는지 살펴보았다. 다음으로, 11개의 대인설득전략을 표현한 스토리보드를 구성하고 이를 활용한 설문조사 (N=203)을 실시하여 어떤 대인 설득 전략이 사용자의 신체활동 증진에 있어 효과적으로 인식되는지 살펴보았다. 연구 결과 긍정적 Self-feeling 전략과 Promise 전략이 사용자에게 가장 긍정적으로 인식되고 있음을 발견할 수 있었다. 또한, 사용자의 성별, 나이, 모바일 헬스 어플리케이션에 대한 인식, 운동 목표 등이 모바일 헬스 어플리케이션을 통한 대인설득전략의 평가와 유의미한 관계를 맺고 있는 것으로 나타났다.

주요어: 모바일 어플리케이션, 신체활동증진, 대인설득 선략, 모바일 신체활동 및 운동 중재

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