Understanding the Roles and Influences of Mediators from Multiple Social Channels for Health Behavior Change

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ABSTRACT

People become increasingly influenced by others in changing and maintaining health behaviors. Along with the advancement of persuasive technology and social networking technologies, the place where social interaction occurs has expanded. As a result, mediators who influence an individual's behavior change can come from diverse social channels. However, little work exists on what roles the mediators have and how differently the mediators motivate and affect the maintenance of health behavior changes of users through various social channels. To investigate this, we conducted interviews with 13 participants who use a running exercise application for maintaining their health behavior changes. This study reveals the roles of mediators from three different social channels, which are the social feature in the application, general social media, and the agent feature in the application. Mediators from the application could influence participants' health behavior change either positively or negatively according to the level of intimacy and the similarity of the physical condition. Social media mediators influence participants' social face and support their health behavior changes by keeping participants in countenance. Lastly, the agent mediator of the application provides continuous reinforcement to participants for maintaining their health behavior changes.

Author Keywords

Health behavior change; maintenance; mediator; social reinforcement; social channels; social interaction

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms

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INTRODUCTION

Social reinforcement is based on the notion that rewarded behaviors are likely to be repeated. Social reinforcement has proven effective in maintaining various health behavior changes [18, 26]. Social reinforcement involves other social members who play a role as mediators and these include family members, friends, and colleagues. Such reinforcement improves the odds of sustaining healthy behavior changes because the mediators can assist the user with his or her behavior change [24] through providing advice, expressing empathy and concern, and providing direct aid from the mediator's social network [9].

According to a review of behavior change research by Hekler et al., papers that mention behavior change have significantly increased in the past five years in the HCI community [8]. This shows that the study of behavior change in interaction design is becoming more crucial nowadays. The means for promoting behavior changes have become easily accessible with technologies such as online videos and social networks [5]. The target behavior that needs to be changed can vary, and one of the areas being actively researched is an approach to promoting physical activities of the user through gamification [13]. This research encourages users to compete with each other [13], to join in collaboration [17], and to persuade users to act more with other users who also need to be physically active by using the system. However, it is hard to understand the roles and influences of mediators from diverse social channels (e.g., face-to-face, social networking services (SNSs) like Facebook, and health behavior changing applications) since current studies mainly focus on the system that they have developed.

As the use of social media, which provide different types of social channels, is woven into modern life, various social groups can interact with each other by using technology such as social networking services. While managing social media, a user tries to form self-impression on social media and makes various identities depending on his or her virtual social groups [4]. As a result, various social groups in social media can be mediators with different roles impacting reinforcement. Thus, it is necessary to explore what the roles, influences, challenges, and opportunities of mediators are in health behavior changes by understanding people's experience of using diverse social channels. To achieve this

research goal, we interviewed users of mobile health applications, specifically a running exercise application, and asked about different experiences depending on the mediators from diverse social channels. After we reveal the roles and influences of diverse mediators, we suggest design implications that need to be considered in designing socially meaningful computer-supported health systems.

BACKGROUND

Reinforcement Theory

According to Skinner [22], a human learns and eventually changes his behavior through experiencing reinforcement and punishment. *Reinforcement* is one of the core methods of behavior change that increases desirable behaviors, such as studying hard and cleaning one's own room. There are two main methods of reinforcement: positive and negative. Positive reinforcement implies giving or adding a response when an individual shows desirable behavior. Negative reinforcement implies rewarding an individual by removing unpleasant and undesirable consequences when the individual shows desirable behavior (Figure 1). Skinner found that reinforcement, especially positive reinforcement, is a more effective way to persuade people to change their behavior. He claimed that reinforcement encourages people to maintain their behavior change for a longer term without other side effects such as a relapse. Health related behaviors such as exercising and having a healthy eating habit are also mentioned as effective targets for applying reinforcement [18, 26].

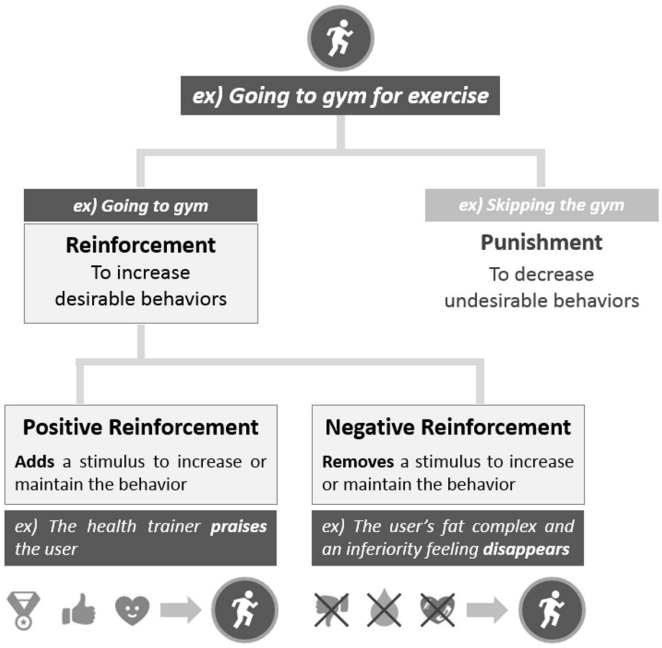

Figure 1. Two types of reinforcement and their examples in operant conditioning [22]

Social Reinforcement and Mediators

Reinforcement includes various stimuli, events, and situations that strengthen and increase a behavior. One of the representative types of reinforcement is called tangible reinforcement, with a tangible reinforcer being a tangible reward like a trophy, candy, or a toy. Other types of reinforcement, such as token reinforcement, involve awarding points, scores, or tokens for reinforcing the behavior [24] (Figure 2).

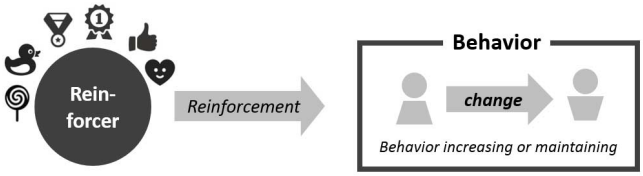

Figure 2. The process of reinforcement in behavior change

Social members, such as family members, friends, and colleagues, can provide a reinforcer to the person who tries to change his or her behavior [22]. This is called *social reinforcement*, in which rewards are delivered by another person's reaction, including social attention, affection, and reputation. These diverse rewards from another person are called social reinforcers. The person who gives a social reinforcer for behavior change is called a *mediator* [24] (Figure 3). A mediator is defined as "a social member who dispenses specific contingent consequences to a person who tries to change his or her behavior" [26, p. 242].

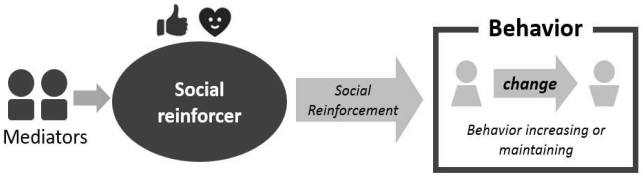

Figure 3. The process of social reinforcement

Although the effects of mediators and social reinforcement are displayed in various health issues, the roles and influences of mediators are not well defined. Existing literature mainly focuses on who the mediator is but does not distinguish which social channel through which the mediator interacts with the individual attempting to change behavior. For example, spouses appear to provide important emotional support in weight loss as mediators to each other [18]. However, we do not know how the influence pertains if the spouses were to interact with each other through the phone vs. Facebook. Thus, our goal is to explore how users perceive the influence of different mediators and the social channels through which the mediators interact.

RELATED WORKS

Persuasive Technology System for Health Behavior Change

Inducing users to change their health behaviors using persuasive technology [5] in the field of HCI has been developed rapidly in recent years [8]. Studies of health behavior changes have been conducted for various purposes from supporting patients with serious physical diseases (such as cancer [12] and mental illnesses like depression [3]) to health promotion for engaging in physical activities with people [13]. Many studies on health behavior changes

have developed new systems to help users realize their goals. A messaging application, VERA (Virtual Environment for Raised Awareness), assists users with weight loss and health promotion by allowing them to share messages [1]. An exer-game, iFitQuest [13], supports adolescents' physical activities by applying gamification based on the physical location of users. However, these studies do not consider how the diverse roles of mediators and social reinforcers influence those contexts. We live in the "Connected age" [21], and products and services are multifunctional, multilayered, and connected to a huge ecosystem. Thus, we can create a synergistic effect and add value if the developed system connects to the various mediators from other diverse products and service platforms. Naturally, it is important to know about diverse roles of different mediators who are connected in a health-related ecosystem and how they differently influence each user and his or her health behavior changes.

Using Social Media for Sensing Health Behavior Change

Several studies use social media as a sensing tool of users' health behavior changes. Murnane et al. [15] find that social media, such as Twitter, can be used as a tool for an intervention system for those who are trying to quit smoking by analyzing the smoker's posts that are related to signs of relapsing in smoking cessation. Xue et al. [27] also highlights the new role of Twitter as a sensing and measuring tool for psychological stress of adolescents by analyzing the Twitter posts of teenagers. Because social media is an access channel for big data, it is useful to use social media as a database of anticipation of certain progress. However, there is another possibility of using social media as a new place for social reinforcement by utilizing diverse human resources that are connected with each other. Moreover, many mobile applications are able to link with social media, even though they have different titles and purposes. In other words, users who use different applications are able to see each other's activities if the users are connected to social media and can influence each other as mediators. In this respect, it is important to define the roles and perceptions of mediators according to the users through these diverse social channels because social media connects diverse human resources and supports many activities in various ways.

In this "Connected age" [21], getting attention for enhancing running performance can be both positive and negative, depending on who the mediators are, according to previous research on social media. For instance, a user wants to show his improvement to his or her exercising group but does not want to share it with a boss who thinks the user does not have enough time for exercise because of the heavy workload. In this way, users of social media will be affected differently according to the mediators, and these different influences will drive the maintenance of behavior change. Therefore, revealing the different influences according to different mediators with different social channels is important.

INTERVIEW

Participants and Methods

We conducted 13 semi-structured interviews (7 male and 6 female) that lasted between 40 minutes to 1 hour per participant who uses a mobile application for running exercises. The average age of the participants was 25.9 (SD=2.4, MIN=21 & MAX=31), and the average duration of using the application was 8.6 months (SD=9.4, MIN=1 & MAX=24). We recruited participants by posting a recruitment advertisement on the Facebook wall of the university students' group. We recruited the participants who use a running application for their health behavior change maintenance. We also asked these Facebook group members to share the recruitment advertisement on their individual Facebook, Twitter, and any other social media accounts. During one week, we received responses from 33 people in total. We focused on a user group in the maintenance stage of behavior change [19] regarding exercise, rather than users who are already doing exercise as a habitual behavior because social reinforcement is most effective when users are in the behavior change stage of maintenance [26]. Thus, at the recruitment process, we used an online questionnaire to ask 33 respondents if they were trying to maintain a new healthy behavior and avoid temptation like skipping exercise so that we could verify that the participants were in the maintenance state of a behavior change [19]. We finally selected 13 participants who fit to our research purpose. Participants were selected if they used a running exercise application as an additional and external aid for maintaining running exercise and if they were in the maintenance stage of behavior change based on their answers on the questionnaire.

We conducted interviews with university students who use a running exercise application. Recruiting university students was appropriate for our research goal because most of them have just started to take care of their health by themselves. Our participants are all South Korean, and we think that this is a good starting region to research this subject because South Koreans and East Asians in general, tend to be susceptive to their social group's influences. We think that this cultural characteristic helps us identify various roles and influences of mediators from diverse social channels. However, we also believe that more research will be necessary that focuses on differing cultural influences on this phenomenon in various regions around the world as a future study.

We selected running exercise applications among various types of exercise applications as a representative case for examining the impact of social reinforcement between multiple mediators. In individual sports like running, a user has to accept the full blame for any failure, and there is no social support from teammates [11]. Social reinforcement becomes more important for better performance as well as for emotional support in individual sports. Moreover, most of the running exercise applications can connect to social media for exporting users' running records. People's

motivation and experience of exporting running records to social media is important in this study to see the various influences of different mediators from the application itself and social media.

Interviews were aimed at understanding each participant's experience of social reinforcement in using the application. To see the different influences of various mediators, our interviews were composed of three parts. Firstly, after a short icebreaking session, we examined the demographic information about the participants and asked them to introduce their running exercise application. We asked participants to describe the motivation of using the application, as well as the advantages and disadvantages of the application while they launched and operated the application. The first part took 10 to 15 minutes.

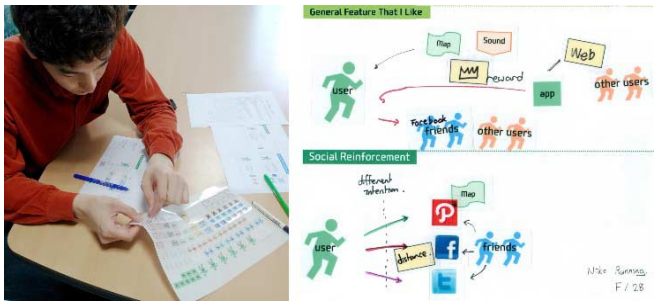

Figure 4. Creating social interaction map (left) and the map that user (P11-F-Nike + Running) created (right)

Secondly, we asked participants to create a map representing the interaction between the participant and mediators in using the application (Figure 4). The purpose of creating the map was to help participants to talk about their experiences easily [23]. We prepared a set of stickers representing a user, a mediator, and the running exercise application and other applications, including social applications, along with colored pencils and a format of the map. The format of the map had two parts: general features that users like in using the application regarding social interaction, and a social reinforcement part (Figure 5). The reason that we asked users to make two different maps is to remind users about their social interaction in the application use and to ask directly about the social reinforcement from different social channels.

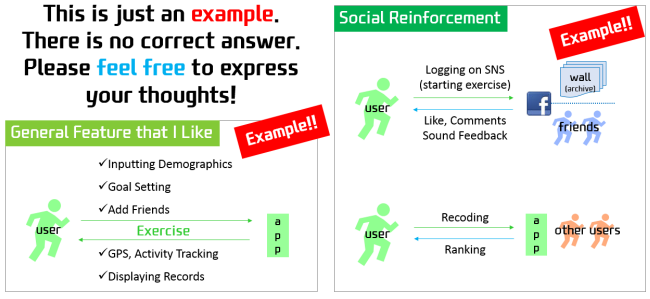

Figure 5. An example map for users that we build in advance

Thirdly, we asked participants to create a map of the interaction between them and mediators in social media (but the experience had to be relevant to the experience of using the running exercise application). Also, when participants felt difficulties in creating the map, we showed an example of the map that we made in advance to help users build their own (Figure 5). The second and third parts of the interview took 30 to 45 minutes in total.

Running Exercise Applications Used by the Participants

Eight out of the 13 participants had been using the Nike+ Running exercise application. The Nike+ Running exercise application provides all statistical results, the running history of users, and sharing through social media. Users of this application can get cheered on by a real-time crowd in social media if a user uploads the posting via social media. Two RunKeeper application users participated in this study. RunKeeper allows users to track running habits of runs, jogs, and even cycling. Similar to Nike+ Running, RunKeeper can export running data to social media. One participant had been using Endomondo, which basically allows users to track running duration, distance, and speed. Interestingly, Endomondo has several social features such as creating routes, challenging running times, and challenging friends who live in the neighborhood. Regarding the competition feature, there is the ability to see other users' times on routes and compete against users' records. One user had been using the Strava application, a riding and running support application that is similar to Endomondo. We recruited one Fitbit user. The application itself is similar to other running exercise applications, but with the Fitbit app and Fitbit wearable device, users' stats automatically sync to select smartphones wirelessly. However, the usage pattern regarding social reinforcement is not different from other running exercise applications, so we included the Fitbit case, too.

Data Analysis

Our interview data were iteratively analyzed more than five times in total with an interval of at least two days of spare time in-between the analysis sessions for enhancing validity. All interviews were audio recorded, producing 12+ hours of content. All recordings were transcribed. In this process, interesting relevant topics were noted and color-coded.

We identified 140 topics during this process, and those topics were subsequently classified with similar topics into 18 different themes. Each theme presents the positive or negative influence of mediators from different social channels for maintaining the participants' health behavior change. These themes were categorized into three different types of social channels where the participant and the mediators can interact with each other. Finally, after we classified them into these three different mediator groups from each social channels, we additionally conducted affinity diagramming to organize the topics from each mediator group based on their relationships and adjusted the level of findings. The entire process of data analysis, including interviewing, transcribing the audio recording,

and iteratively using coding and affinity diagramming for finding insights, took around 60+ hours. We refer to each participant by the participant number, sex, and the name of application used (e.g., P1-F-Nike + Running).

FINDINGS

We found that mediators from the different social channels influenced the participants' experiences on health behavior change maintenance in different ways (Table 1).

#	Themes/ Positive or Negative Influences	Social channel
1	Safe feeling of being connected/ +	In-app
2	All users' competition for the 1st rank/ +, -	
3	Defeating friends in application/ -	
4	Communication with intimate friends/ +	
5	Stats of unknown in-app users/ +, -	
6	Motivated by friend's social media posting/ +	Social media
7	Reaction and encouragement from friends/ +	
8	Fragmented using of multiple social media/ +, -	
9	Gaining reputation in social media/ +, -	
10	Representing user's healthy identity/ +, -	
11	Risk of losing face and feeling pressure/ -	
12	Providing easy and smart functions/ +	Agent of the system
13	Possible to archive user's running history/ +	
14	Functional feedback for pace checking/ +	
15	Emotional supports by giving badge icon/ +	
16	Emotional supports by encouragement/ +	
17	As a coach until user get used to running/ +	
18	Real-world mediators would make synergy/ +	Etc.

Table 1. Eighteen themes in three different social channels

The first mediators are in-app users who compete for scores and share running data with each other. The second mediator group is connected via social media such as Path, Facebook, and Twitter. Several people in the first and second mediator groups can overlap if they interact with participants in both groups. The last type of a mediator group is an embedded agent of the running exercise application systems. We found that each group influences the participants' health behavior change maintenance and the roles of the mediators and influence qualities are different. We highlighted important findings from those three different mediator groups' roles and influences by investigating the experience of the participants.

In-app Mediators: Intimacy Level and Similarity of Physical Condition Matter

Within the application, users can easily find and add their friends by using the contact list in their smartphones. Although there are many friends in the application, participants classified mediators into several groups according to their intimacy level due to frequent and thoughtful interaction. In addition to the intimacy level, we also found that the similarity in physical conditions among the connected people influenced people's motivation to maintain the behavior changes. The mediators who have similar physical condition with a participant reinforce participants to maintain their health behaviors through comparing the running stats and competing with each other. The intimacy level and the physical standard are not independent but our study showed that they can be potentially important for social reinforcement. We tried to highlight the influence of these factors on the participants' experiences in social reinforcement.

Running records show user's context or become a target to defeat depending on the intimacy level of mediators

The meaning of the running records of a participant is a conversation cue that shows the context between a participant and his intimate friends in the application, rather than the statistical records for competition. All of the participants have friends who have a high level of intimacy and high frequency of interaction within the application.

"Sometimes I want to see the detailed information of my best friend who was my roommate. Well, she doesn't live here anymore, but I can see her running records in the app. A week ago, I saw that she ran for three hours! I felt that it was a bad sign showing that she may have gotten too much stress in her work, and I called her." (P6-F-Nike + Running)

Participants who have a high intimacy with a mediator share the context of living, the situation of the work, and relationship status—not only about the emotional status, but the intimate mediator group also fully understands how busy the participant is and how hard the route is that the participant ran. Interestingly, we can find strong emotional support, but it is not directly related to health behavior change maintenance. Social reinforcement between a participant and an intimate mediator in an application occurs in neither a competitive way nor a collaborative way to facilitate a health behavior change, but it becomes more like a cue for real-world interaction between them.

"It's not as easy as people think to meet together with my best friends. So we use this app for running together. Although we individually did exercise, we can see each other's records on the feed-in application. When we see the running records of all of us are accumulated in the app, we know we are not so busy. Then, we contact each other and spend hours catching up." (P9-M-Nike + Running)

As seen from the interview, accumulated running records of members become a cue for real-world gathering. However, their initial reason for using the application is to promote their health rather than for social purposes. Thus, emotional bonds between intimate friends are reflected in the usage of the application, and the sense of togetherness indirectly helped the participants to sustain their running exercise. However, when they have a low intimacy level with their acquaintances, the participants describe the relationship with the mediators as competitors. All of the running exercise applications from the interview allow users to examine the leaderboard within the system and highlight winners. This competition motivates participants to enhance

their running stats, and it promotes health behavior change maintenance of participants as well.

"I was the first-ranked runner of the last month. I was a second one, but I dedicated my Friday nights for doing exercise. I was really happy to beat my friend's highest records, finally." (P8-F-Nike + Running)

Although competition may motivate a participant, competing with the explicit goal of beating other users may lead to a decrease in intrinsic motivation of users' health promotion.

"I do not say that I do it all the time, but several months ago, I wanted to really beat my friends when I was the second-ranked one with only a slightly slower running performance. So I once used cheap trick. I turned on my application and I rode my bicycle very slowly." (P7-M-Endomondo)

This shows that from time to time, participants' desire to beat their competitors is greater than the motivation of doing exercise for their health behavior change. As a result, sometimes participants forget about their initial goal of doing exercise. Although competition with the mediators who have a low intimacy level with participants can reinforce health behavior change maintenance of participants, it may lead to a change in their original motivation of using the application from maintaining health behavior changes to winning a competition.

The running stats of mediators who have similar physical conditions to those of the participants become a standard

The stats of the runners who have similar build, age, strength, and the same gender as the participants become a standard for reflecting the participants' physical ability by comparing records with them. This standard causes participants to reinforce and strive for maintaining the health-related behaviors. Also, the participants want to get better results among the runners with similar physical conditions.

"I do not know who these large numbers of people are, but I ranked a bit lower than the average for men in their 20s. So I try to change my habits a little every day." (P5-M-Fitbit)

"Actually, I feel superior when I see my running data. I am ranked higher than average among the girls in their 20s in here in my orange level (Nike+ Levels are assigned to distance-based achievements). The application does not provide this kind of comparison, so I access the website to check where I rank." (P8-F-Nike + Running)

In this case, seeing the records of other runners who have similar physical conditions to the participants can motivate the participants and help them maintain their health behavior changes. However, the competition with remarkably superior runners negatively affects participants' emotions. Eventually, it is impossible to reinforce the participants with the records of other runners who have very different physical conditions from the participants.

"He has an immovable position within the runners. At the beginning of the month, we are almost the same, but he always runs much longer and much faster. It is a bit frustrating. I just started to run, and I am female; so it is unfair to compare." (P11-F-Nike + Running)

Other runners' stats in the application become a frame for judgment of a health-related behavior. However, the influences are different, such as reinforcing participants to maintain their health behavior changes or to decrease their motivation to change, according to the similarity of the physical condition level. Interestingly, the negative influences of reinforcement that resulted in the sense of inferiority are mentioned when participants are not intimate enough with the mediators.

Social Media Mediators: Social Face Matter

All of the applications from this interview enable the sharing of participants' running data to social media. Participants are able to post route maps to social media and track their progress along them in real time. One of the interesting features in using social media is in the connection of participants' friends. It is possible for social media friends to monitor and provide encouragement in the form of virtual cheering. We found that social reinforcement from social media users affects participants, and eventually, it helps them to maintain the health behavior.

Timely and enthusiastic response to participants for gaining social face

In using most of the running exercise applications from the interview, participants can hear the sound feedback (such as a real cheering sound and just an alarm sound) when their social media friends add a "like" or comment on the participant's running data. Because of this feature, several users upload their posts through social media. The reaction of others becomes a positive social reinforcement to participants to persist in their health behavior. Participants feel proud of their running data and want to inform others about their efforts to achieve recognition.

"I feel really happy when I hear the cheering sound because someone recognizes me. Well, till high school I was a little bit chubby, and I had never ever done exercise. But I changed. Running represents the 'new me' so I want to show this to other people and want to receive cheers. When my friends 'like' my running stats, I get motivated and want to make better stats." (P4-M-Nike + Running)

"While I run, I can hear the push alarm of my friend's comments on my Facebook post. I do not know what the contents are, but I am happy with excitement and expectations." (P8-F- Nike + Running)

We can see that mediators from social media give positive influences to participants who try to maintain their behavior. From the mentioned running exercise application experiences of participants, feedback from social media friends about participants' running data at an appropriate

time made participants proud. Moreover, the size of social reinforcement is a vital driving factor that encourages health behavior changes. Since social media have many features that support social encouragement in virtual space, such as clicking a "like" or a "follow" button, leaving comments, sharing posts, and tagging or mentioning participants' names, mediators from social media easily provide social reinforcement. Eventually, virtual reactions from mediators in social media reinforce participants to exercise repeatedly, and this leads to health behavior change maintenance of participants.

Risk of losing social face becomes a source of reinforcement

Social media is a feature of an activity stream, which is a list of recent activities performed by an individual, and it contains recent actions by the user's friends. Since social media allows users to access other users' individual activity streams, it is easy to recognize the absence of running posts that used to be more common.

"Once, I had not worked out for two weeks in a row. One of my Facebook friends left a post on my wall and asked me why I was not exercising. I felt kind of embarrassed at that time, and I started my running again after I got that post." (P2-M-RunKeeper)

Participants are aware that other people are looking at them, and they feel responsible for their words as a public pledge. If participants use this characteristic of social pressure in social media properly, social pressure can be a means of social reinforcement.

"Sometimes I become too lazy to run. Then the first thing I do is post a message on my Facebook wall that I will start my run. Then I have to run because everyone will see my words." (P8-F- Nike + Running)

In this case, however, it is hard to define other people in social media as mediators since the participants reinforce themselves. The apprehension of the possibility of losing face makes participants act, so it is proper to say that other social media users may have the potential to be mediators. Participants from this study emphasized the importance of the frequency of uploading running posts. If participants post continuous running-related activity streams, the reactions of other friends in social media tend to decrease. For this reason, participants adjust the number of repetitions of running data on their social media.

"I try to exercise at least two times a week, but I cannot upload all of it. If I keep uploading my running, the number of friends who like my posts will decrease. It's the matter of the value of my post among others on the newsfeed. So if I made a really good record, or I ran on a special occasion, then I upload it." (P11-F-Nike + Running)

We found an interesting phenomenon related to the fragmentation of running data. Several participants use multiple social media for uploading running data.

"I usually use Foursquare before I start my run. Whenever I get a good stat, I upload it via Facebook." (P1-M-Strava)

"I used to share my running data using Facebook at the beginning, but I realized that some of my Facebook friends may not want to see it. So I use Twitter, where I share my result with a few friends with the purpose of personal data archiving. But for bragging, I use instant messaging applications with my brother and my friends." (P13-F-Nike + Running)

Participants have two different desires for receiving social reinforcement through using social media. First, they want to share their achievements for gaining social attention. But the social attention requires participants to upload their running stats on social media, and at this moment, the second desire appears to be maintaining their social face. As a second desire, participants are worried about getting little reaction from their social media friends, and they already know such perceived indifference will lead to disappointment. Their need to care about their health by themselves and their need to get attention from others conflict, so several participants seem to negotiate those conflicting desires by using social media dispersively.

Agent Mediators: Continuous Reinforcement Matter

We found another type of social reinforcement and mediator group: reinforcement from the agent of the application system. Participants perceived the application itself, and specifically the voice feedback from the application, as a social actor [5].

"This woman (voice of the application) keeps me exercising steadily. When I finish half of my route, she cheers me on by informing me of how long I have left rather than how long I have run." (P3-M-Nike + Running)

"Once I tried to change the voice of this application from female to male. When I use a female voice, it comforts me. And, yeah, it is just a feeling, but when I change it to the male voice, it's more professional. If I buy a voice pack, then I can choose from various voice types in various languages. It may help." (P7-M-Endomondo)

All of the applications provide voice feedback and vibration feedback continuously while the participants run. However, participants perceive voice feedback as a mediator since participants hear a human voice as a notification or alarm.

DISCUSSION AND DESIGN IMPLICATIONS

In-app Mediators: Sources of Emotional Support and Better Performance

In the study of psychology, it is known that the relationship between a mediator and a person who is trying to change his or her behavior is important, and the influences of social reinforcement vary depending on the relationship [18]. From our study, intimate friends within the application were not a particularly effective mediator group for enhancing the running performance directly, but they provide emotional support to the participants. With respect to health-related issues, it becomes evident that users who

share a common ground can understand each other's context and have a better chance of offering intrinsic motivation [10]. Thus, the intimate mediators can provide emotional support to participants.

However, in-app acquaintances could either positively or negatively reinforce participants' behavioral change, depending on the similarity of their physical conditions. The mediators with a similar physical condition level seem to enhance the running performance of participants and reinforce them to maintain the health behavior, although there is a risk of changed purpose due to excessive competition. Competition is defined as a situation where an individual's or a group's performance is being compared with a standard [11]. Competition and comparison are known to stimulate users to set and attain goals [11]. Since participants can access the running stats through the application without temporal and spatial limitation, it is possible to compete against users even though they may live far apart or with a time difference. However, competition has a positive impact when competitors have comparable conditions. Otherwise, competition with a no-win situation negatively affects users' emotions, with effects such as pressure, envy, and a sense of inferiority [11] when the participants were compared to remarkably superior users. Eventually, it is impossible to reinforce the participants with the records of other runners who have very different physical conditions from the participants. The running application from our study primarily focused on the competition with other competitors regardless the comparable physical conditions. However, the mediators with a similar physical ability can help in performing health-related behaviors better through practical aids.

It is necessary to redefine the concept of friends within the application by considering the different intimacy levels and similar physical conditions of the in-app users. An approach that separately provides the channels to interact with these two mediator groups, intimate friends and physically comparable friends, can be an important design implication. They are the sources of social reinforcement for health behavior change, but the balance between emotional support and practical aids is the key for providing effective health services depending on the target behavior and user's background.

Social Media Mediators: Politely Revealing the Achievement for More Effective Engagement

Timing, balance between deprivation and satiation, size, amount, type, and quality are known as factors of reinforcement, and those factors support the behavior change maintenance of users [24]. Specifically, we discovered that the timing and size of responses of reinforcement affect participants with mediators from social media. Moreover, we found that social face is importantly influence to participants' health behavior maintenance. According to Goffman [7], the face is a mask that changes depending on the audience and the variety of social interactions. Social faces are emotionally attached to people, so people try to maintain their social face and are afraid of losing it [7]. The theory is also applied in the use of social media, as people manage their reputation and disclosure process [25]. In this research, we found that social face influences users to maintain their health behavior change. Depending on the gain or loss of social face, the social reinforcement type becomes different to manage one's face.

From this study, we revealed an expanded concept of the mediator to the diverse social group in the virtual world. We found that mediators in social media positively influence participants when they provide compliments via comments and by clicking the "like" button, but the social concern about losing face hinders participants from maintaining their behavioral changes due to the lack of the social reinforcement from mediators. Interestingly, we saw that participants negotiated the ways of sharing their achievements and were careful with publicly-available information. They used a series of social media tools to avoid frequent exposure to others' activity streams. For this reason, the participants' running data became fragmented across the various social media platforms and social channels.

We found a similar phenomenon from the study of Newman et al. [16]. They found the importance of a balance between sharing health-related information and the desire to manage self-presentation by observing participants' use of an online health community for health-related information and Facebook for impression management. In Newman et al.'s study, they investigated users who tried to lose weight and/or manage Type II diabetes by using an online health community and SNS, and by sharing obese/diabetes information that may have a different level of privacy and seriousness compared to what we studied, i.e. running exercise. Although the backgrounds and situations of the participants are different from ours, the expression of a virtual identity with an ideal health state through SNS and the practical health-related behavior has a tension. For instance, if the impression management gives motivation to a participant, applying social reinforcement through social media can be effective. However, if a participant does not want to share his health-related data on social media due to privacy concerns or personal characteristics, the mediators from social media do not have a large impact on his or her health behavior change. The future research direction for this finding would be about how the tension differently affects users' health behavior changes across the diverse service platforms and backgrounds or according to the personal characteristics of users. It is difficult to demonstrate the effects of fragments of social reinforcement without further study, so such additional research is needed in order to design the feature of politely revealing participants' running data to gain social responses from social media friends. For example, by posting indirect and ambient information about improvements in running stats, shared stats via SNS can

expire after a certain amount of time or selecting a certain audience group can be a possible solution. However, according to the seriousness of health-related issues, the sensitivity of health-related data to users, and the participants' individual characteristics, the effectiveness of applying social media can differ. Thus, it is important to consider the most affective and effective mediator groups for an individual's health behavior change.

Agent Mediators: Potential Mediators of Coaches and Pacemakers

The definition of a mediator is a human who delivers social reinforcement including gaining social attention, feeling affection, and building a social reputation [24]. In this perspective, the direct and real mediator is human, but it seems possible to consider even non-human agents as potential mediators from this study. Persuasive technology [5] has the potential to change attitudes or behaviors of the users through persuasion and social influence in various ways, e.g., as a tool, a form of media, or a social actor. Moreover, experimental results from human-robot interaction show that people do display social and emotional behavior toward computers when users perceive human qualities in computers, even though the computers do not actually have them [20]. The social expressions from a computer agent draw positive reactions from users; furthermore, social expressions that are offered from a robotic product are desirable as a persuasive agent [2, 14]. As a persuasive agent, users tend to accept the computer agent as an interesting counterpart, and they perceive its human qualities.

From this study, we also found a computer agent that may have the potential to influence users' behavioral change by providing social reinforcement as a mediator, such as by giving compliments and stirring up energy by playing a power song. From our study, users perceived agents as potential social mediators because the agent mediator encourages users and provide information. In general, the diversification of feedback quality, types, and characteristics from an agent is important in order to maintain users' behavior changes. Although there is advancement in the computer agent, social reinforcement from agents and from human mediators affects the participants differently. From the interview, we discovered that the reinforcement from the agent enhances running performance but only by a small amount compared with a competitor who runs with the person. However, the agent is able to give continuous and constant responses to participants and provide information relevant to the running exercise, such as notifying user of the weather conditions and running routes. For these reasons, the agent of the system influence participants as a virtual coach and pacemaker. Thus, a possible direction of enhancing the influence of social reinforcement from the agent is to design ways to support human mediators.

With respect to the study of Fritz et al. [6], they found that designers can support users' long-term use of a fitness tracker by providing at the evolved displaying of tracked activities, data sharing, and rewards. One of their finding is that designing a system that supports and engages users by using various types of rewards is important in the fitness domain. In positive reinforcement, tangible, token, social, and other types of reinforcers influence a person's behavior change. Although Fritz et al. focused on the impact and influence of tracking devices, and our study focuses on the impact and influence of different mediators, they mentioned the possibility of rich and diverse qualities of reinforcement. We see that the resources of reinforcement can be from other mediators who are not using the tracking devices. Eventually, an agent in the system becomes a channel of reinforcement from users of diverse and different service systems and social channels. In the connected services, the agent may help human mediators to lead a dialogue relevant to the health behavior change, for instance, by suggesting new routes or sharing mutual goals of participants, which will support the conversation between mediators and participants.

CONCLUSION

In this study, we sought to disclose the different influences of social reinforcement on health behavior changes, depending on the various roles of mediators from diverse social channels, specifically in applications and among social media platforms. The key factors that drive social reinforcement for maintaining healthy behavior changes for each type of mediators are as follows. Balancing between helpful emotional support and challenging users' running performance will be a key to providing positive influences to runners to sustain the desired behavior change, especially by the mediators within the application. Prompt, enthusiastic, and continuous responses and feedback from social media friends will encourage users to maintain their healthy behavior change as well. We found that the concept of mediators expands from several real-world mediators to countless virtual-world mediators. Also, the synergy of the agent from the application in the virtual world and human mediators in the real world will help users to keep their healthy habits.

As we revealed in this study, diverse mediators in different social channels influence participants' health behavior change maintenance in different ways. Developing design strategies that invite users to synergize with various mediators in the virtual and real worlds is a possible future direction of this study. Moreover, it seems important to reveal how these different roles of various mediators can interplay with each other to reinforce the maintenance of healthy behavior. As we mentioned earlier, the cultural issues on this subject will also be a very important and interesting theme to be investigated for future studies.

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