

Designing Social Interaction for Health Behavior Change throughout the Before, During, and After Phases in Health IT Services

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Abstract

Background Social interaction crucially impacts health-related behaviors not only in the context of the physical world but also when using a health IT service. In each temporal phase of before, during, and after health-related behaviors, different social interactions are needed. Therefore, way to provide appropriate social interactions in each phase should be explored, and such interactions should be systematically framed to induce effective health behavior changes among the users of health IT services. As an explanation of how to apply different social interactions for diverse people according to the temporal phase, this study suggests a design principle of social interactions for each temporal phase of health-related behaviors when using health IT services based on survey and user interview data.

Methods First, an online survey was conducted to ask users about the features of current health IT services that support their social interactions in each temporal phase. Second, user interviews were conducted to understand what users experience and what they need from their social interactions in current health IT services.

Results We found that current health IT services do not support proper social interactions in the before, during, and after phases. Triggers are needed to promote action in the before phase, and a balance between social and individual features is needed to focus on health-related behaviors in the during phase. Sharing pride in their small achievements was important for users in the after phase. Based on these insights, we extracted design principles for the social interaction quality of health IT services throughout the user journey. In the before phase, providing careful and sequential warm-up features is important; in the during phase, utilizing agents as mediators can be a good design principle; and in the after phase, taking advantage of the effect of social reinforcement benefits the users by supporting rich social interaction.

Conclusions Addressing the temporal dimension of health behaviors is a pervasive strategy in health IT services, yet it has not been extensively researched in the context of social interaction. The type and quality of social interactions between users and mediators vary according to the temporal phase. The diverse features of social interactions along the user journey through a health IT service are crucial driving factors of user experience because these features interact with, influence, and synergize with each other to support health behavior changes.

Keywords Service Design, User Journey, Health IT Service, Social Interaction, Social Reinforcement

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1. Introduction

Individuals' behaviors can be influenced by other people, such as family members, friends, and colleagues. As a result of these social interactions, people can learn from others and modify their behaviors, which leads to behavior change (Bandura, 1991; Skinner, 1953). The advancement of social networking systems enables users to interact with others through diverse social platforms, such as social media and instant messaging applications. Various social interaction features, such as comparing, sharing, and competing with others, are embedded in health IT services to promote social interaction among users. Many health IT services, such as activity trackers and physical activity applications, can help users initiate new health behaviors. Health behavior change is not a singular event; it is a complicated process that requires long-term intervention. For this reason, behavior change strategies attempt to induce and intervene in users' behaviors by applying a temporal dimension: they provide a systematic description of the behavior change *before*, *during*, and *after* the occurrence of the target health-related behavior (Sussman, 2000). These methods have been widely applied to human behavior change using three different temporal orientations: an antecedent-oriented approach, a behavior-oriented approach, and a consequences-oriented approach (Scutchfield & Keck, 2003; Sussman, 2000). An antecedent-oriented approach focuses on the period before the health-related behavior and plays a role in motivating desirable health-related behaviors, such as exercising, and in recognizing the risks of future health-related behaviors, such as smoking. A behavior-oriented approach targets the moment of health-related behavior, and a consequences-oriented approach is based on what occurs after the health-related behavior is performed. Every temporal approach that represents before, during and after health-related behaviors has emphasized the importance of intervention at the right time, and to successfully implement a health behavior change, proper support – tailored to the temporal phase of the health behavior change – is crucial.

Using current health IT services, users can easily find and add their friends using the contact lists in their smartphones, and their friend lists from social media such as Facebook and other online communities. They can easily export their health-related data to others via diverse types of social media. However, the social interaction features supported by current health IT services are not only lacking in diversity and quality, they are also limited in that they do not support social interactions with users at the appropriate time. For instance, with current health IT services, users can share their health-related data with others through social media after the health-related behavior; but sharing goals before the health-related behavior could help users to stay motivated about such behavior. Thus, the sharing features of health IT services can be differently and specifically targeted to users according to the different contents of their shared data and the temporal phase of their health behavior change. Providing appropriate social interactions before, during, and after health-related behavior is important to induce effective health behavior changes among users. To design health IT services that enable appropriate social interactions, it is necessary to understand the types of social interaction features currently used in health IT services at different temporal phases: before, during, and after health-related behavior. Additionally, identifying

how these social interactions enhance users' experiences in each phase is crucial. To help designers understand and create health IT services with social interactions tailored to the temporal phase, the necessary design knowledge should be established; therefore, we focus on the design principles. To establish a design principle that maximizes the effects of social interaction on health behavior change in each temporal phase, this study first conducted an online survey that asked users about the features of current health IT services that support their social interactions in each temporal phase of health behavior change. Second, user interviews were conducted in an effort to understand the user experience and what users need from their social interactions in current health IT services.

2. Related Works

Recently, in the field of human–computer interaction (HCI), there have been many attempts to design rich social interactions that can motivate users to improve their health-related behaviors. Competition features in a system support users' motivation and active participation in health-related behaviors, especially physical activities (Macvean & Robertson, 2013; Saksono et al., 2015). Support features lead users to encourage and cooperate with others' health-related behaviors (Adams, Baumer, & Gay, 2014; Lin, Mamykina, Lindtner, Delajoux, & Strub, 2006), and certain social features, such as mixed collaboration and competition using social relatedness (Rooksby, Rost, Morrison, & Chalmers, 2015), influence users' health behavior maintenance. Particular aspects of social influence, such as identification, can influence people's health behaviors through the involvement of role models because of the tendency to be influenced by someone who is liked and respected (Turchaninova, Khatri, Uyanik, & Pavlidis, 2015). However, these social features focus on supporting a certain phase of the health behavior change, mainly the time during the health-related behavior, rather than considering the different characteristics of each temporal phase and the changes of these characteristics over the course of the user journey. The features of social interaction become more diverse when a health IT system connects various users from multiple social channels. To provide proper and effective social interaction that promotes the maintenance of health-related behaviors by the users of a health IT service, it is important to consider the user journey throughout the process of health-related behavior change. To understand each phase of the user journey, we conducted an online survey and interviews with users of health-related behavior applications to determine how the social interaction attributes of health IT services should be designed. We investigated the social channels used as touchpoints of social interaction, the mediators (i.e., the stakeholders who influence health behavior change), and the consequent user experience according to the different phases of the user journey.

3. Method

3. 1. Online Survey

The aim of the online survey was to determine how current health IT services support users'

social interaction in each temporal phase. We conducted an online survey of users who were using or had experience using at least one health IT service such as an activity tracker or an application related to bicycle riding, running or other types of physical activity. We created an online survey questionnaire using Google forms and shared an online survey link on the Facebook wall of a university students' group and a university's online community board, where potential respondents could access it. During one week, we gathered responses from 45 respondents. Because there were several unfinished responses to the survey, we had to exclude those results. Ultimately, 40 respondents' responses were reflected in our online survey (18 females and 22 males).

The online survey used two main questions to understand current health IT services' social interaction support during each phase of users' health-related behaviors (before, during, and after). First, we asked respondents to state which features of a health IT service support their health-related behavior in each of the three phases (before, during, and after) and how each feature helped them. Next, respondents filled out a 7-point Likert scale reporting how satisfied they were with the current features of a health IT service in the three phases (before, during, and after). In the online survey question, we did not ask social interaction-related questions because we wanted to assess how much social interaction is necessary in the overall service experience. It took approximately 10 to 20 minutes to answer all of the questions in the online survey. The average age of the participants was 27.2 years (SD=3.2, MIN=21, and MAX=35). We performed quantitative analysis using SPSS statistics software.

3. 2. User Interviews

The purposes of the user interviews were to understand users' social interaction experiences with current health IT services in each phase (before, during and after) and to explore users' needs with regard to the social interaction experiences of future health IT services during each temporal phase of health-related behavior (before, during, and after). We conducted 13 semi-structured interviews with participants who were using or had used more than one health IT service (6 females and 7 males); interviews lasted about one hour per participant. The average age of the participants was 25.2 years (SD=3.5, MIN=20, and MAX=30). Participants were asked to share their social interaction experiences using a health IT service. Participants detailed their social interaction experiences in terms of which social channel they used and with whom they interacted, and they also described their emotions during social interactions. Our participants were all South Korean, and we believe this is a good starting region in which to research this subject because participants from Eastern cultures tend to be susceptible to social interactions and social influences (Huang & Deng, 2008). This cultural aspect helped us investigate rich social interaction experiences in the health behavior change context. However, we also believe that more research – focusing on different cultural influences on this phenomenon in various cultures – will be necessary as a future study.

Our interview data were iteratively analyzed five times, with four different coders, to enhance validity. The process of comparing agreements between two coders and making mutual codes was conducted iteratively. Cohen's κ was run to determine if there was an agreement between two coders' judgments of the interview data. There was moderate agreement among all of the coders (Coder1 – Coder2 had $\kappa=0.583$, codes by Coder1 and Coder2 – Coder3 had

$\kappa=0.308$, and codes by Coder1, Coder2, and Coder3 – Coder 4 had $\kappa=0.463$; 95% CI, 0.300 to 0.886, $p<0.0005$). All of the coders gathered, reached a final consensus on the codes, and classified all of the codes according to the temporal phase: before, during, or after. However, other temporal phases, such as ‘not specified’ and ‘always,’ were added. Within each temporal phase, all of the coders performed affinity diagramming to investigate the relationships of users’ social interactions. We identified 200 topics, and those topics were subsequently classified with similar user experiences into 40 different themes.

These user experience themes were categorized into three different temporal phases: before, during, and after. We refer to each participant by gender, participant number, and the name of the application used (e.g., M1-Fitbit). In cases where additional social media were used, the name of the social media is shown (e.g., M1-Fitbit, Facebook).

4. Results

Part 1. Online Survey

Respondents were using or had used more than one application ($M = 1.7$), and the average duration of use was 8.8 months ($SD=8.9$, $MIN = 1$ & $MAX = 36$). The five most popular applications that respondents used were Fitbit (10 respondents), Strava (8 respondents), Samsung health (7 respondents), Apple health (5 respondents), and Nike + Run Club (4 respondents). We conducted a paired t-test to determine users’ satisfaction with current health IT services at each phase: before, during, and after the health-related behavior (Figure 1, left). We found no significant difference in satisfaction for the *during* phase ($M=4.68$, $SD=1.23$) or the *after* phase ($M=4.73$, $SD=1.45$), but satisfaction in the *before* phase ($M=3.58$, $SD=1.81$) was significantly lower than in the *during* phase ($t(39) = -4.188$, $p = 0.000$) and the *after* phase ($t(39) = -3.601$, $p = 0.001$).

As shown in Figure 1(right), eighteen of the respondents mentioned that there was no feature of their health IT services to support their health-related behavior in the *before* phase, while five and two respondents mentioned the same problem in the *during* and *after* phases, respectively. A common feature that supported users in the *before* phase was viewing health-related history. Goal setting, planning, and viewing other users’ health statistics were the features that supported the *before* phase. Most of the respondents noted that the recording and tracking features supported their health-related behaviors in the *during* phase. Several responded that the teaching features of the services (e.g., describing and showing the right postures for exercises) and that the features that enabled the viewing of current health statistics were useful during health-related behavior.

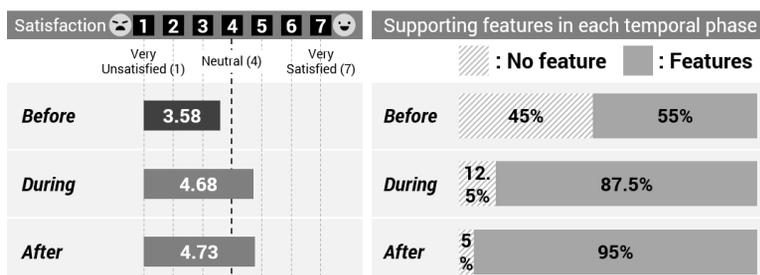


Figure 1 Satisfaction (left) and supporting features (right) in each phase

Resonating with prior studies (Li, Dey, & Forlizzi, 2010; Ploderer, Reitberger, Oinas-Kukkonen, & van Gemert-Pijnen, 2014), it was found that after the health-related behavior, a summary of health statistics supported respondents' health-related behavior in two different ways: as an immediate modification of health-related behaviors and as a source of reflection on longer-term change. In the survey, sharing health statistics with others through diverse social channels, such as in-app communities, social media, and instant messaging applications, was the second most mentioned feature of the *after* phase. Displaying the respondent's ranking among other users and providing rewards such as badges were noted as helpful features of this phase.

From this survey, we found that current health IT services lack support for the *before* phase of health-related behavior and that this may lead to user dissatisfaction during this phase. Additionally, we found that social interaction has an important influence on a user's experience of a health IT service, although we did not request that respondents highlight social interaction features. Interestingly, respondents wanted to be connected with the agent of the application system as well as with human mediators. The definition of a mediator is a human who delivers social reinforcement, which may include social attention, affection, and reputation-building (Watson & Tharp, 2013). However, agent mediators have been perceived as human-like social actors (Fogg, 2003), especially when the application provides voice feedback, and thus they may be effective as potential mediators (Lee & Lim, 2015). Depending on the phase of the user experience, influential mediators will affect respondents' health-related behaviors differently.

Part 2. User Interviews

Current health IT services support users in implementing their health-related behaviors through the use of tracking and real-time monitoring functions. However, participants have already experienced the impetus and trigger behind their health-related behaviors (across the *before*, *during*, and *after* phases) by using the social interaction features of diverse social channels, such as instant messaging applications or social media other than health IT services. From the interviews, we found that each phase of the user journey has its own social interaction qualities; thus, participants' preferred social channels and mediators differed in each phase of the user journey. This meant that participants wanted to experience diverse types of social interaction throughout the user journey. The appropriate social interaction according to before, during, and after the health-related behavior will lead next health-related behavior on and on, and this will help to develop and maintain the health behavior change process rather than an event (Figure 2).



Figure 2 The temporal phases of user journey of using health IT services

The Before Phase: Triggers Are Needed to Propel Action

The phase before the health-related behavior is implemented is crucial because it prepares the user for the actual action and is the source of motivation. However, current health IT services do not offer preparatory phases to support participants who need to propel their health-related behaviors into action, as observed from the results of part 1 of this study. The essential role of mediators in the *before* phase is to stimulate and encourage participants to implement health-related behaviors.

“At first you can motivate yourself to exercise, but over time you can exercise more easily with your friends. In my case, I always need someone who can lead me into action. (M7-Strava)”

It was found that three detailed steps helped participants to direct their actual health-related behavior during this phase (Figure 3).



Figure 3 Social interaction quality and detailed steps in the *before* phase

First, participants gather health-related information from various mediators, such as the computational agent, exercise friends, tutors or experts, and online community members of health IT services.

“Depending on my height, weight, and target weight, my daily food intake needs were calculated (to achieve my target weight). According to this, I could plan the meal. (F5-FatSecret)”

“When the editor of the app posts exercise-related information, like how to do the core exercise or why we have to do it, I can check. (F6-Dano)”

After the information-gathering step, participants develop the intrinsic or extrinsic motivation to implement health-related behaviors. In this step, participants set goals by themselves, with peers, and with tutors or experts. Additionally, using a mixed approach that is both individual and social in the motivation step, participants declare or announce their health-related goals to social media.

“I am motivated when I see reviews and changed pictures from other in-app users before and after the exercise. (F2-Dano)”

“I recorded my strength exercise stats in the Evernote app, and I showed it to the health trainer at the first day of my gym training. He suggested to me a set of exercises and helped me to do those exercises. (M1-Evernote)”

“My friend posted on his Facebook that anyone would be rewarded if s/he reported my friend eating a night snack. (F4-Facebook)”

Additionally, there was a step during which participants prepared for the action with a detailed plan by recruiting their exercise friends and making a commitment with their peers.

“When the weather is fine, my friends recruit people to work out together in the group chat room of the instant messaging app. It can be a good trigger to exercise when I am too lazy to exercise. (M2-Strava)”

As seen in the detailed steps of information gathering, becoming motivated, and preparing

for the action with a detailed plan, the *before* phase is essential: it enables users to take action through social interactions with various mediators from diverse social channels.

The During Phase: Balance between Social and Individual Features Is Needed

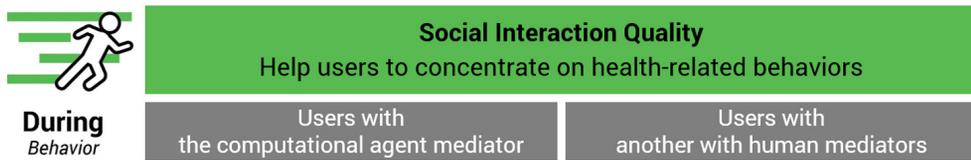


Figure 4 Social interaction quality and two different patterns of social interaction in the *during* phase

The *during* phase is an important phase: it is when users actually implement their health-related behavior in a concentrated way (Figure 4). In this phase, participants showed two different patterns of social interaction, one with the computational agent mediator and another with human mediators. At the individual level, participants regarded the agent as a mediator that helped them to be physically active. Agent mediators provided accurate data automatically, offered health-related information, and forced users to perform health-related behaviors by setting a timer.

“It is good (to use the app) since I could monitor how much I walked exactly according to the time. (F3-Samsung Health)”

“Since this app can set how many seconds to work out, I could exercise in this limited time. It leads me to work more efficiently because there is less compromise with myself. (M6- Circuit Training Assistant)”

At the interpersonal level, there were several different mediator groups that supported participants’ health-related behaviors. First, mediators could come from a group with similar health-related interests. The members of such a group could motivate each other and help them focus on their actions by doing health-related behaviors together. Among mediators, those who were intimate to users were important in influencing participants’ health behaviors in the *during* phase. This second group has similar health interests and a high level of intimacy, which can both positively and negatively impact participants’ health-related behaviors. The positive influence of this mediator group occurs through information sharing, coaching, encouraging, collaborating, and competing during the health-related behavior.

“I used to be with my roommate when I was running. While we were running, we talked a lot and it was so fun. (F3_Runtastic)”

“I exercise together with my colleague in the gym. He does not exactly teach me how to use muscles like a trainer, but he emotionally supports me and shares his health-related information with me. (M4_Bodyspace)”

On the other hand, participants mentioned that social interaction with intimate mediators negatively influenced their health-related behavior in the *during* phase. Such interactions could cause distraction, could cause low efficiency due to the different physical conditions and exercise capacities of the participants, and could create the risk of losing social face.

“My friends and I have different exercise intensity preferences. Exercise should be as effective as your pace. In this sense, being with your friends will be a good stimulus in terms of motivation, but regarding the efficiency, the effect seems to be minimal. (M6- Circuit Training Assistant)”

However, the third mediator group, tutors and experts, provides a different social interaction quality compared to the other mediator groups. This group provides professional knowledge and coaches participants. Unlike agent mediators, tutors and experts have coercive characteristics and strong commitments, so participants rarely compromise and perform at their best.

“When I exercise alone, I compromise with myself. But, with my health trainer, it is so hard since he pushes me to exercise until my limit! However, I believe that my skill will increase. (M6- Circuit Training Assistant)”

In the *before* phase, it was important to become motivated through a virtual world community by reviewing other people’s statistics. However, a physical world community was necessary to influence participants’ health behaviors in the *during* phase.

“I made a swimming club with my friends to workout, leave a record or open a mini-tournament. (M3-Fitbit)”

Different mediator groups had diverse roles, and the groups influenced participants through their social interaction qualities in the *during* phase via health IT services. While current health IT applications support many tracking and monitoring features in the virtual world that help in the *during* phase, they seem to be more effective at helping the user focus on health-related behaviors in the physical world. Future studies should investigate how to orchestrate touchpoints in the physical world while also considering the ecosystem of the health IT service.

The After Phase: The Importance of Sharing Pride in Small Achievements



Figure 5 Social interaction quality and detailed steps in the *after* phase

After users completed their health-related behaviors, they reflected on their behaviors and curated, shared, and announced their results (Figure 5). In doing so, they planned for their next health behaviors. In our interviews, participants discussed steps for the integration of and reflection on their health data at the individual as well as the interpersonal level. We found that participants analyzed, integrated, and reflected on health-related data by themselves, and this result resonated with Li et al.’s research (Li et al., 2010).

“When I enter my weight in the app, the output is shown as a linear graph. It was good to know about expected weight loss. (F4-Dietsense)”

“(After muscle strengthening exercise, M1 used Evernote app for recording the result.) It is good to know how much I have improved myself by comparing my last year’s record with today’s record. (M1-Evernote)”

At the interpersonal level, it is possible to evaluate a participant’s position by comparing his or her health statistics with the statistics of other in-app users. Participants felt competitive and used their health-related data to reflect on their next health-related behaviors.

“In-app users and their rankings became the standard of judgment of my level. I want to

break my level and ride faster next time! (M2-Strava)”

Participants liked to share their health-related data with others. Interestingly, the types of social channels used and the quality of social interaction changed depending on who the mediators were.

Participants shared their health data with specific people through closed social channels, such as instant messaging applications, for the dual purposes of surveillance and receiving praise. Mediators could be exercise friends, family members or a significant other.

“After I exercise, I send a message to my boyfriend that I have exercised. I wanted to get checked and he praised me. (F5-Dietsense, KakaoTalk)”

When participants wanted to announce their achievements, boast and receive unconditional compliments from a large number of people, they shared their health data on social media, specifically on social awareness streams, which are open to a wider audience.

“I got many Likes when I uploaded my exercise record to my Facebook. (M1-Fitbit, Facebook)”

However, participants needed strategies when they wanted to receive compliments from the audiences of social awareness streams without annoying those audiences. Participants wanted to share special events to obtain more reactions from their audiences. If their health-related data seemed mundane, participants added photos or comments to the data.

“Well, this is my know-how. When I post my health-related posting on social media, Facebook friends showed more reaction when I wrote a comment or posted my photo together. (M7-Strava, Facebook)”

Another strategy that users applied was to make information more understandable to others, such as by changing measurements from miles to kilometers and by using analogies. This analogy could be provided by the agent, and participants would make their own and share it by posting comments.

“When I walked 70 miles, people would not know how long that was. When I earned the Penguin March badge, I shared it. That represents the distance of the penguins' annual trip. (M1-Fitbit, Facebook)”

On the other hand, participants did not share their health-related data for various social reasons. For example, other people's judgments prevented participants from sharing the data. They were worried that if they shared health-related data, they would annoy other users on the social awareness stream. Additionally, they were afraid of the possibility of poor evaluations.

“I have approximately 10 activities recorded in the app per week. However, I think that sharing all of them to my social media will be very annoying to other people's (social awareness) stream. (M6-Mi Fit, Facebook)”

“I upload my stats when I think I have reached other people's expectations of me. I never upload my small accomplishments, it will be too trivial to others. (M1-Fitbit, Facebook)”

Respondents raised privacy concerns about sharing their health data. Users did not want to share their private information, or they felt embarrassed about their data sharing activity.

“I do not want to share my data on Facebook, just because. It is a personal thing. (F3-Runtastic, Facebook)”

Participants tended to have social interactions with others in the *after* phase by using health IT services and connected social media and instant messaging applications to generate motivation for their next behavior such as exercising. However, they rarely had social interactions in the physical world, except for reporting and sharing their status with an

expert or tutor. Because participants had fewer chances to meet people in the physical world in the *after* phase, they naturally preferred to use more accessible channels to report their health-related behaviors and wanted to obtain more feedback about their achievements.

5. Design Principles

As seen from the online survey and the user interviews, we found that each phase had distinctive characteristics. In the *before*, *during*, and *after* phases, users showed different preferences for social channels, related mediators, and corresponding user experiences. Based on these insights, we extracted design principles for the social interaction quality of health IT services throughout the user journey.

The Before Phase: Providing Careful and Sequential Warming Up Features

Because current health IT services do not properly support the *before* phase, users have become motivated to implement health-related behavior in their own way. For example, they may pursue social interaction through diverse social channels, such as instant messaging applications. We found that *warming up steps should be fulfilled sequentially* to propel users to actually perform health-related behavior. In this phase, especially in cases where users cannot access human mediators, the agent mediator will have an important role; it will seem like a human mediator who can provide motivation (like exercise friends) and ensure a strong commitment from the user (like experts and tutors would do). Users are dissatisfied with the lack of a *before* phase in current health IT services. It is, therefore, preferable to suggest sequential features that can help the user implement detailed steps of the *before* phase, each enabling that user to proceed to the next step.

The During Phase: Utilizing Agent Mediators as Human Mediators

We found that in the *during* phase, various mediators and their roles had important influences on users' health-related behaviors in the physical world as well as in the virtual world. Regarding support from agent mediators in the virtual world, even if the agent supports the user by using several functions, it can be observed that the requirements of the agent are not met. A close look at the social interaction needs of the participants in the physical world revealed that they wanted to have exercise friends as mediators (who could help users before they took action), experts or tutors as mediators who could teach, and community members as mediators or comrades. Thus, applying these social interaction qualities of human mediators to agent mediators has a crucial influence on users, encouraging them to implement more health-related behaviors in the virtual support context. There are several types of social interaction, such as cooperation, competition, and mixed interactions, and many health IT services apply these social interaction strategies. However, the main drawback of applying social interaction during physical activity is the amount. For instance, excessive competition may lead to a decrease in users' intrinsic motivation to achieve the goals of their health-related behaviors (Jones, 1995). Collaboration may also

have disadvantages, such as social loafing (Latané, Williams, & Harkins, 1979), which is the tendency for individuals to expend less effort in a collective context than in an individual context.

The After Phase: Taking Advantage of the Effect of Social Reinforcement

In the *after* phase, reflection on health-related data and issues of sharing health-related data drove the quality of the user experience and social interaction. While it is important for the system to provide meaningful health-related data to users, it is very important that users are empowered by wrangling and interpreting health-related data in the *after* phase.

Users did not share their achievements in this phase due to the risk of losing social face. Current health IT services socially support users after health-related behavior by accumulating health data on a leaderboard and by enabling the exportation of their health statistics to social media. However, it appears that more active social channels for positive social reinforcement are needed. To offer social reinforcement, mediators do not have to be in-app users as long as health IT services provide a wide range of ways to export health-related data. To promote social reinforcement, it is necessary to develop a rich social interaction vocabulary by enabling users to report, inquire, and show off after physical activity. Additionally, as Epstein et al. mentioned (Epstein, Cordeiro, Bales, Fogarty, & Munson, 2014), personally meaningful data should be prepared, analyzed, and shown to users. Moreover, among various meaningful data types, users should have the opportunity to choose which data will be shared and with whom. The quality of shared data should also be considered, including the possibility of showing nuanced information about improvements and achievements in health behaviors.

6. Conclusion

The temporal dimension of health behaviors is a pervasive topic in health IT services, yet it has not been extensively researched in the contexts of social interaction. In this study, we found that social interaction between the user and mediators – as well as its quality – varies according to each temporal phase, and social interaction has been woven into the user experience. Various features of social interaction along the user journey are crucial driving factors of health IT services. These features also interact with, influence, and synergize with each other to support health behavior maintenance.

Health IT services can be specialized to target a variety of health-related behaviors, such as food journaling, daily physical activity, and fitness tracking. Depending on the user's purpose in using a health IT service, the design principles derived from this study may have different influences, such as being emphasized or simplified in a particular phase. This study explored general health IT services rather than specifying service categories. Future studies should investigate further by focusing on the differences in how social interactions help change users' health behavior based on the specific purpose (e.g., diet, entertainment, sports) or form (e.g., activity tracker application) of a health IT service.

As health information and health technology have evolved, the use of various health IT services has become ubiquitous. This study is based on the experience of people who use

health IT services rather than on an artifact-centered perspective, such as improving the accuracy of the service. This user-centered approach to health IT services will lead to more effective development of the design features of social interaction in future health IT services, eventually resulting in successful health behavior changes by their users.

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