interplay2015
DESIGN ▶ SCIENCE ▶ TECHNOLOGY ▶ ARTS

IASDR 2015 Congress
2-5 November 2015
Brisbane, Australia
http://www.iasdr2015.com

iasdr QUT

Friends in Activity Trackers: Design Opportunities and Mediator Issues in Health Products and Services

Yeoreum Lee, Department of Industrial Design, KAIST, Daejeon, Republic of Korea, yeoreum_lee@kaist.ac.kr
Min Gyeong Kim, Department of Industrial Design, KAIST, Daejeon, Republic of Korea, kmg6419@kaist.ac.kr
Saeyoung Rho, Department of Industrial Design, KAIST, Daejeon, Republic of Korea, littlebee6@kaist.ac.kr
Da-jung Kim, Department of Industrial Design, KAIST, Daejeon, Republic of Korea, dajungkim@kaist.ac.kr
Youn-kyung Lim, Department of Industrial Design, KAIST, Daejeon, Republic of Korea, younlim@kaist.ac.kr

Abstract
Other people's reactions, including attention, affection, and reputation, reinforce an individual's desirable behaviors. Specifically, this reinforcement has shown effectiveness in promoting health-related behavioral changes. This is social reinforcement, and the person who provides it is a mediator. Although products and services that promote health-related behavior, such as activity trackers, have increased dramatically in the market, little attention has been given to their social influences, such as social reinforcement from mediators. Activity trackers collect a log of daily activity from the user and share it with other users through an application. Naturally, users compare data and compete through the application. Although users are connected through the activity trackers, the influences differ according to the different roles of mediators. To reveal the roles and influences of mediators when using activity trackers, we conducted interviews with 12 participants who use activity trackers to maintain their health behaviors. We found that the participants classified mediators into several groups according to their roles and that the participants wanted to have different qualities in their social interaction with different mediator types. Based on these findings, we

explored design opportunities and issues regarding the mediators in health promotion products and services.

Mediator; Social interaction; Activity tracker; Social reinforcement;

Activity trackers are wearable, life-logging devices or applications for capturing, measuring, tracking, and analyzing data from a user's daily health activities, including sleeping, eating, and moving. There has been a recent market rush on various types of activity trackers, including Nike Fuel Band, Fitbit, and Jawbone UP. Of the activity tracker users Ledger and McCaffrey (2014) surveyed, more than half no longer used their activity tracker and a third of those stopped using it within six months of purchase. Since changes in health behavior take time, it is important to deliver long-term impact on users in designing health products and services. One strategy that helps users maintain their health behavior changes while using activity trackers is social interaction, which we explored, focusing on mediators who provide social reinforcement for health behavior change and their roles, influences, challenges, and issues.

Social Reinforcement and Mediators

According to Skinner (1953)'s operant conditioning theory, reinforcement increases an individual's desirable behaviors, while punishment decreases undesirable ones. Skinner claimed that reinforcement encourages people to maintain their behavior change for longer without side effects such as relapse. There are several types of reinforcement according to the types of reinforcer—the stimuli, events, and situations that increase the behavior. When the reinforcers are rewards from another person, such as social attention, affection, and reputation, the result is social reinforcement and that other person is the mediator. Specifically, the effects of mediators and social reinforcement are displayed in the context of various health issues, such as weight loss (Pasch et al., 1997). Due to the advancement of social networking technology and the development of social media, the place where social interaction occurs has expanded from offline to online (Macvean and Robertson, 2013). As products and services are connected to a huge ecosystem, multiple potential mediators can reinforce users in changing their behaviors through various channels (Lee and Lim, 2015).

Related Works

Persuasive Technology in Health Behavior Change

Fogg (2003; 2009) insisted that a computing device using persuasive technology could create a social relationship between the device and the user. He argued that the device influences people as a social actor and impacts behavior. Human–computer interaction (HCI) has many design cases using persuasive technology to change health-related behaviors in

everyday life (Adams et al., 2014; Macvean and Robertson, 2013). Although those design cases have shown short-term effectiveness, they barely focus on long-term maintenance. Such maintenance prevents relapse (Watson and Tharp, 2005) and provides long-term impacts on users' health behavior. According to trend reports (Ledger and McCaffrey, 2014; IDC Health Insights, 2014; Miller, 2013), most wearable products and services fail to drive long-term use for a majority of users. Reports have pointed out that a strategy to guide *sustained engagement* is the key to long-term success in this market and that motivation through social interaction is a promising strategy. This backs up Skinner (1953)'s arguments that reinforcement encourages the maintenance of behavior change for a longer term, without other side effects such as a relapse. Moreover, among the many types of reinforcement, social reinforcement has proven effective in maintaining various health behavior changes (Pasch et al., 1997; Watson and Tharp, 2005). Thus, in this study we tried to observe the social experiences of users regarding social reinforcement, as well as the method for promoting long-term effects on health behavior change.

Activity Tracker Study in HCI

Papers that deal with activity trackers have become significantly more numerous in recent years within the HCI community. Most focus on technical improvements, such as sensing accuracy, and understanding the methods of self-monitoring, such as research on how to collect, use, and visualize activity data (Choe et al., 2014; Fan et al., 2012). However, current interaction techniques between an activity tracker and its users do not seem to focus on inspiring users to take action. Since a user interacts with not only the product but the system that encompasses the user and various other stakeholders of the system (Forlizzi, 2007), it is important to see the social interactions between the users of activity trackers through the activity tracker applications. Moreover, given the activity tracker's goal of sustaining users' health behaviors, it is crucial to investigate how other people reinforce the user to maintain the behaviors. In HCI, several studies address the importance of social interactions in using activity trackers. Fritz et al. (2014) found that designs matching appropriate communities to activity tracker users are crucial to sustaining long-term use of activity trackers. Rooksby et al. (2014) proposed thinking of activity trackers not as self-monitoring devices but as social tracking devices in which activities such as competition and kinship can arise. These previous studies focused on social interaction in activity trackers, but not on how it occurs or should be designed. To explore design opportunities and social interaction issues specific to social reinforcement through activity trackers, we investigated the various roles and inferences of mediators for activity trackers by conducting interviews with 12 activity tracker users.

Interviews

Participants and Method

We conducted 12 semi-structured interviews (5 male and 7 female) that lasted between 45 minutes to 1 hour per participant, each of whom uses an activity tracker. The average age of the participants was 25.3 (SD = 3.3, MIN = 20, MAX = 31), and the average duration they used the activity tracker was 2.4 months (SD = 2.2, MIN = 1, MAX = 8). We recruited participants by posting on a Facebook wall of a university students' group and a university's online community board. We had two different recruitment conditions for this study (Table 1). First, we recruited and interviewed six participants in Group A, who used their own activity trackers. Second, we recruited six participants into Group B, who wanted to use activity trackers. We gave them activity trackers for 4 weeks, giving them brief online or offline interviews every week that lasted around 10 minutes, followed by one regular interview at the end of the period. We recruited Group B to see the detailed quality change in social interactions per week in relation to activity tracker use. Our participants are all South Korean, and we think this is a good starting region in which to research this subject regarding social interaction and social influences due to the country's high collectivism (Hofstede, 1980). The participants are all university or graduate school students, who are the main target users of activity trackers. Half of both groups' participants used Fitbit, and the others used Jawbone UP.

Table 1: Participants and recruitment conditions

Group	Participants #	Sex, age	Activity Tracker Model	Duration of using the activity tracker
A	A1	M, 29	Fitbit	4 months
	A2	F, 24	Jawbone	1 month
	A3	M, 31	Fitbit	5 months
	A4	F, 24	Jawbone	2 months
	A5	F, 24	Fitbit	3 months
	A6	F, 26	Fitbit	8 months
B	B1	F, 27	Jawbone	1 month
	B2	F, 27	Jawbone	1 month
	B3	M, 27	Jawbone	1 month
	B4	F, 24	Jawbone	1 month
	B5	M, 20	Fitbit	1 month
	B6	M, 20	Fitbit	1 month

The interviews were aimed at understanding each participant's social interactions with their mediators when using the activity tracker. Our interviews had three parts, covering emerging

mediators in using activity trackers, mediators whose influential qualities changed, and the mediators who participants want to be with. The interviews' composition, questions, and timeline were applied identically to Groups A and B.

Data Analysis

Three different design researchers analyzed our interview data more than three times in total. All of the interviews were audio recorded, producing 9+ hours of content. In the first interview, we found 45 different emerging mediators in using activity trackers; the interview data had been coded according to the mediators in order to view the social interactions between the mediators and users. Design researchers classified the 45 mediators into three groups with affinity diagramming. We similarly found several groups in the second and third sessions. We refer to each participant by participant group and number, sex, and the name of the application used (e.g., A1-M-Fitbit).

Findings

From the interviews, we found emerging mediators in activity tracker usage, mediators whose influence qualities changed, and desirable mediators with whom participants wanted to be connected through their activity trackers.

Emerging Mediators in Using Activity Trackers

New mediators emerged because the activity tracker connects its users and shares their health data as a new channel. The detailed features that activity trackers provide to users can differ across tracker brands, but the general features of the activity trackers from our interviews were similar to each other. An activity tracker and its application collect a log of a user's daily activities by logging meals, tracking steps and distances, and recording sleep trends. From the interviews, the participants perceived the **activity tracker and its application as a persuasive agent** (Fogg, 2003).

"This (activity tracker) knows all about me, and based on the analysis, it provides me an important insight that really fits to me!" (A4-F-Jawbone)

The participants considered the activity tracker itself an important mediator because of its physical existence and various feedback modes.

"The powernap function is a smart alarm function that analyzes my sleep pattern and calculates my optimal nap duration. After lunch, I use this function, and it was gently vibrating and waking me up. It is caring about me." (B2-F-Jawbone)

"Whenever I reach my goal of 10,000 steps, this [activity tracker] shows LEDs lighting up and vibrating several times. It feels like this one is my assistant that is always with me and supports me to reach my goal." (A1-M-Fitbit)

In-app users emerged as a new mediator group. Within the applications, users can easily find and add their friends by using the contact list in their smartphones, their friend lists from social networking services (SNSs), and online communities. Users' activity logs can be shared with other users through their applications; thus, users can compare data with each other and compete against one another through the applications.

"I usually go to a leaderboard to check my rank. I realized that I am not a physically active person when I compare myself to other friends in the activity tracker. Well, I do not own a car; I usually commute by bus. After I bought my activity tracker, I sometimes got off one or two stations early and tried to walk more. It was really a good strategy to me regarding the rankings and my own health habits." (B2-F-Jawbone)

Activity trackers recorded the participants' physiological and movement data in real time, so if the participants had similar life patterns and physical conditions, then their competition would increase. Interestingly, the participants perceived the activity logs of other users with similar life patterns and physical conditions as a standard, making them important and influential mediators. This result resonates with our previous study about a running exercise application (Lee and Lim, 2015).

"My roommate and I are using Fitbit together. We are in the same department and have similar activity patterns, so generally our total steps are similar. But whenever I walk more than my roommate, I would taunt him through the application, and we always try to beat each other." (B6-M-Fitbit)

We found one more interesting mediator group from the activity tracker: **the past activity logs of the participants themselves.** Since the applications accumulated the participants' daily activity logs, the participants detached their past data from their present data and reflected their past health habits to the past data. Finally, the participants regarded their past as a different entity from the present.

"Me in the past is an important source of understanding and planning (health behaviors). For instance, I was sick several weeks ago, so I did not exercise enough. Usually I reach the goal, but the average steps for that period were around 3,000 steps. But still, I can reflect my past context to the current goal setting. So I can gradually increase my goal to 12,000 steps from 10,000 steps." (A1-M-Fitbit)

A mediator is traditionally "a social member who dispenses specific contingent consequences to a person who tries to change his or her behavior" (Watson and Tharp, 2005). Thus, technically, it is hard to see the participant himself as a mediator. However, we found that the participants communicated with their past data, which reminded them of their past. This implies that the participants perceived their past as a different subject from their present and that it influences them to maintain their health behavior changes.

Mediators Whose Influential Qualities Changed

The participants were influenced by diverse mediator groups before they used the activity tracker. However, the qualities of influences from several mediator groups changed while the participants were using the activity trackers.

"We are a couple in the same campus, so we usually have lunch and dinner together, go for a walk together, and go to bed around the same time, since we always communicate through an instant messaging application at night. So my boyfriend has always influenced my health behaviors. However, after we started using the activity tracker, we could share each other's health data and see more detailed contexts for ours, for instance, the calories that we burn by walking together. It is good that we could share something new and special." (B4-F-Jawbone)

As seen from the interview above, **significant others** share many parts of their daily life activities. With activity trackers, significant others can share their daily activity log data through the application. This new type of shared data helped participants to be aware of their health, and several participants tried to plan for healthier dating, such as by exercising together.

"My girlfriend tried to go on a diet. When my girlfriend did running exercises, I could leave comments through the activity tracker application, but it felt like it was not enough. I want to encourage her, so we went for a run together for our date weekend."(B3-M-Jawbone)

"Usually, we go out for a meal. After logging the meal, we realized that we greatly exceeded the calorie recommendations for the day. So we are going to eat healthy food." (B5-M-Fitbit)

According to our previous research, emotional bonds between people with intimate relations were reflected in the usage of a running exercise application (Lee and Lim, 2015). Intimate in-app users do not directly help improve the participants' health, but they help provide emotional support to the participants, such as a sense of relief and motivation. However, we found that significant others reinforce each other as caregivers. Activity tracking is more pervasive and continuous than running, since participants have to decide to exercise, while activity trackers collect everyday activities. For this reason, the sense of togetherness more directly helped the participants to sustain their health behaviors with their significant others in activity tracking.

Exercise friends practically and directly reinforce participants' health behaviors.

"One of my friends in my badminton club uses the activity tracker, and we are friends in the app. I was surprised about his all-day activity, and it motivated me. The competition became more systematic and accurate, since we record our every step." (A5-F-Fitbit)

Exercise friends interact with each other in the real world; however, they can see quantitative statistical records for competition when they use an activity tracker. The activity tracker records the user's history of physical activities. Exercise friends can compare their data and

compete against each other, even when they are geographically far from each other. Moreover, the activity tracker measured the all-day activities of the participants, and the competition became more continuous and pervasive than other types of exercise.

"Actually, competition with other app friends does not motivate me that much. I move a lot more than my friend, who works in an office at the city. Once or twice a week, I have time to play soccer with my teammates, but maybe the friend at work does not have enough time for it. Well, I think he will have his goals and I have my goals that reflect our own living contexts. Of course, if one of my soccer teammates uses the tracker, then it will be a really tough competition between us." (A1-M-Fitbit)

The participants perceived that other users from the activity tracker could have different goals, depending on their individual contexts. Moreover, the participants know that each user may have different major usages in the activity tracker, since the trackers support multi-functional health activities, including meal, physical activity, and sleep trend logging. We found that exercise friends could be a specific type of group when using an activity tracker. Their health interests are similar, but they can have different goals according to their environment and health condition. However, if this health interest-based group interacts with each other as mediators through the activity tracker, the influence of social reinforcement can be more effective than that of any other mediator groups, which may have different health interests.

From the interviews, we found that several participants wanted to show their achievements to the public and used **social media** as a showcase.

"I used to share my daily mood, photos, diaries, and other trivial events in my life through Facebook (social media). Recently, I found that I can export my activity records from the activity tracker to Facebook! I shared my first 10,000 steps to my Facebook friends. They cheered me on enthusiastically, and I was really proud of myself. After that, from time to time, I have updated my achievements through Facebook." (A4-F-Jawbone)

Interestingly, in social media, the participants tried to make ideal presentations of themselves and gain emotional support, such as attention and reputation, from their social media friends. As a result, social media may bias the views of the participants' health behavior change, although reinforcement through social media has advantages, including huge human resources and delivering immediate reactions from mediators.

Mediators with Whom Users Want To Be Connected

The participants desired to be connected with several mediator groups that were not connected to the participants at the time of the interview. We tried to investigate the qualities of the desirable mediator groups throughout the interview sessions. The participants categorized their activity friends into several groups based on their roles. Interestingly, they wanted to interact with their mediator groups differently based on the mediators' roles. The first role of a mediator group is to **provide emotional support** to the participants.

"I want to be connected with my sister in the U.S. Because of jet lag and our reserved characteristics, we do not communicate often like other sisters. But we know we adore each other very much. If she uses this, then I will see what she eats and feel a sense of connection with her." (B1-F-Jawbone)

"I want to report my data to my parents in my hometown. In particular, my mother calls me and worries about my health very much. She said I should eat healthy food and exercise. But I think she hardly believes me, so it will be good if this tracker sends my health reports to my mother and makes her feel relieved. Well, but if I have unhealthy data, then I will hide it from my mother. She must be worried so much." (B3-M-Jawbone)

The participants perceived **significant others, family members,** and **best friends** as the mediator groups who provide emotional support, such as a sense of relief, togetherness, and engagement, through the new form of communication provided by activity tracker usage. Emotional support did not directly help the participants to maintain their health behavior change, but it indirectly motivates them. We found that the participants wanted different interactions according to their relationships with mediators in relation to emotional support. In the case of significant others, the value of togetherness was stronger than the desire to be healthy. Thus, significant others want to share their activities, such as going on walks in the evening, and curate this data as commemorative activities between the couple. The participants also wanted to report their health-related data to their parents and share their data with their siblings. However, the participants wanted to show "good" and "healthy" data to relieve their parents' worry. For best friends, the participants wanted to use data from the activity tracker as a communication channel, through which they could share their context. The interactions between best friends resembled those among significant others. However, the mediator group of best friends is more appropriate for competition than the mediator group of significant others.

The influence from mediators who give **practical support** helped the participants maintain their health behavior changes. Interestingly, the participants classified practical support groups based on the specific roles that the mediators could provide to the participants. Also, the participants interacted differently according to the different mediators.

"I want to subscribe to Miranda Kerr's activity logging and meal logging. It will motivate me to move more, and she may let her fans know about her know-how in healthy habits." (B2-F-Jawbone)

"I play baseball at my university as my hobby. I want to add the health data of the senior player in my club as an activity tracker friend. He is my role model, and he teaches me how to be a better baseball player. If we share data, I can see his meal loggings or activity loggings and he can check mine and give some feedback to me during training [in the real world]." (B5-M-Fitbit)

"If my personal health trainer knows my data from the activity tracker, he can suggest some exercises that fit me. He also can reflect my data onto my lesson at the gym; for instance, if I

did not sleep well, I can do more stretching exercises than weight training. I saw on TV that one soccer team coach is using [an] activity tracker as a managing channel for his team. It is something like that." (A3-M-Fitbit)

We found that the participants want to be connected with **celebrities who have ideal health conditions, role models, health trainers, and other health behavior experts**. This group can be categorized according to impact level. Celebrities with ideal health conditions inspire and motivate participants. Role models are similar to celebrities but have high chance of meeting in the real world. Role models can motivate participants and trigger their health behaviors into action. Health trainers are tutors who analyze the participant and give health suggestions, such as on exercising methods.

As seen in the interviews, mediators could reinforce the participants' health behaviors according to their type. Moreover, the mediators' diverse roles influenced participants' health behaviors in different ways, and the participants wanted different interactions based on their mediators' roles.

Discussion: Design Opportunities and Issues

Our findings show how various mediators influence participants' health behavior based on mediators' roles. These findings suggest several opportunities that can aid the designers of new health products and services that deliver long-term impacts on users.

Design Opportunity 1: Myself as a Mediator

Several new mediators emerged when the participants started to use activity trackers, but the most interesting among them were the participants' past selves. We found that when people want to change their behavior, their past selves are separated from themselves at that moment and influence their behavior change. This is slightly dissimilar to the traditional concept of a mediator. However, we expect that this concept, *myself as a mediator*, can be a new design source for health products and services. Many studies on quantified self (Choe et al., 2014; Fan et al., 2012) consider health behavior change as intrapersonal and focus on individual user characteristics. However, this time-transcending interaction has yielded a new perspective on the quantified self and self-monitoring in health behavior change, with design implications.

Design Opportunity 2: From Curating Mutual Data to Achieving Goals Together

In the interviews, significant others valued having mutual data and communicating with each other using new types of data, such as steps and sleeping trends. The participants wanted to record and curate mutual events with their significant others, such as jogging: they jogged together to share their emotions through the application of the activity tracker, for example. As a result, the activity tracker acted as a new communication channel between them. As we observed in this study, participants in romantic relationships can be powerful mediators to

each other by reinforcing health. Several other researchers have found that when users are able to share their goals or compete for goals with other people, they are more committed to achieving these goals (Cialdini, 2001; Ledger and McCaffrey, 2014). Therefore, significant others could reinforce the participants' health behavior changes effectively and affectively in the longer term. For instance, one implication could be a design opportunity in which significant others build a mutual goal and achieve it together. This mutual goal and its achievement should be curated as a health event just for the couple, while carefully delivering the couples' health-related data for a new means of communication.

Design Opportunity 3: Rich Interaction with Role-Based Mediators

In this study, we found that the participants desired diverse interaction methods according to different mediator roles. First, our interviews show that several mediators who played different roles existed throughout the participants' activity tracker usage, and the participants wanted to interact with diverse mediators, including preexisting ones. However, the activity trackers currently in the market search for friends by using a friend list from the user's SNSs and phone book or entered email addresses. Therefore, it limits opportunities to meet new mediators for desired roles. One approach to this challenge may be to establish a set of channels that enable users to meet desired mediators. For example, when a user focuses on the desired mediators' roles and selects a channel like *learning*, the user can contact and make an appointment with mediators such as tutors, role models, and health trainers. Second, from our interviews, we found that the participants wanted to have different social interactions, such as communication, learning, and competition, depending on the role-based mediator groups. However, the current activity tracker system mainly provides competition between in-app users, with insufficient social reinforcement. It is necessary to develop a rich interaction vocabulary in order to help users experience mediator-dependent interaction. These two design opportunities may help users sustain their health behavior changes through rich reinforcement with diverse mediators.

Design Issues: Privacy in Context Data

Activity trackers provide social reinforcement by sharing activity data with diverse mediators. According to Knijnenburg and Kobsa (2013), people feel more sensitive about contextual data such as location and app usage than demographic data such as age and gender. Since activity trackers accumulate users' physiological and movement data in real-time, privacy concerns require circumspection when sharing data through the activity trackers. Excessive disclosure would demotivate users while leading to no meaningful interactions. Sharing conditions regarding what data are shared, with whom, and in what form may decide the quality and impact of social reinforcement. Hence, research on the influence of sharing conditions is necessary to design real-time logging systems, including displaying context, such as for activity trackers.

Conclusion

This paper sought to reveal emerging mediators in using activity trackers, mediators whose influences change, and mediators with whom the participants wanted to be connected, through interviews with activity tracker users. Then, we suggested several design opportunities and issues that need consideration in designing health products and services, specifically for promoting social reinforcement. Although this study was conducted in homogeneous conditions regarding the participants, we found that various social interactions had already occurred in using activity trackers. In addition, reflecting on current social interactions, we revealed that social reinforcement could have a meaningful impact on users' health behavior changes when using an activity tracker. The market has developed an immense number of wearable health devices and services. Beyond technical improvements, a new perspective on the ecosystem's multiple users and stakeholders is needed to guide people to healthier lives. Diverse users of activity trackers represent different ages, cultural differences, and relationships, such as between parent and child and boss and employee. This diversity will be an important theme in future investigations. Activity trackers may also show long-term dynamic influences on social reinforcement in future studies.

Acknowledgement

This research was supported by "Dr. M" Project funded by KAIST (N01140095). We would like to express our sincere thanks to all the participants.

References

Adams, P. et al. (2014). Staccato Social Support in Mobile Health Applications. In Proc. *CHI 2014*, ACM, 653-662.

Choe, E.K. et al. (2014). Understanding Quantified-Selfers' Practices in Collecting and Exploring Personal Data. In Proc. *CHI 2014*, ACM, 1143-1152.

Cialdini, R.B. (2001*). Influence: Science and Practice* (4th ed.). Boston: Allyn & Bacon.

Fan, C. et al. (2012). A Spark of Activity: Exploring Informative Art as Visualization for Physical Activity. In Proc. *UbiComp 2012*, ACM, 81-84

Fogg, B. (2003). *Persuasive Technology: Using Computers to Change What We Think and Do.* Morgan Kaufmann.

Fogg, B. (2009). A Behavior Model for Persuasive Design. In Proc. *Persuasive 2009*, ACM, No. 40.

Forlizzi, J. (2007). The Product Ecology: Understanding Social Product Use and Supporting Design Culture. *International Journal of Design, 2(1)*, 11-20

Fritz, T. et al. (2014). Persuasive Technology in the Real World: A Study of Long-Term Use of Activity Sensing Devices for Fitness. In Proc. *CHI 2014*, ACM, 487-496.

Hofstede, G. (1980). *Culture's Consequences: International Differences in Work-Related Values.* Sage.

IDC Health Insights. (2014). *Vendor Assessment: Consumer Engagement-Fitness Activity Trackers, Improving Health One Step at a Time*, IDC Health Insights (Doc #HI249519), June 2014.

Knijnenburg, B. and Kobsa, A. (2013). Making Decisions about Privacy: Information Disclosure in Context-Aware Recommender Systems, *Transactions on Interactive Intelligent Systems (TiiS)*, Volume 3 Issue 3.

Ledger, D. and McCaffrey, D. (2014). Inside Wearables: How The Science Of Human Behavior Change Offers The Secret To Long-Term Engagement. *Endeavour Partners: Cambridge*, MA, USA.

Lee, Y. and Lim, Y. (2015). Understanding the Roles and Influences of Mediators from Multiple Social Channels for Health Behavior Change. In Proc. *CSCW 2015*, ACM, 1070-1079.

Macvean, A. and Robertson, J. (2013). Understanding Exergame Users' Physical Activity, Motivation and Behavior over Time. *In Proc. CHI 2013*, ACM, 1251-1260.

Miller, A. (2013). Fitness Trackers. *XRDS: Crossroads, The ACM Magazine for Students*, 20, 2 (December 2013), 24-26.

Pasch, L. A. et al. (1997). *Social Support in Marriage: An Analysis of Intraindividual and Interpersonal Components.* Sourcebook of Social Support and Personality. New York, Plenum

Rooksby, J. et al. (2014). Personal Tracking as Lived Informatics. In Proc. *CHI 2014*, ACM, 1163-1172.

Skinner, B. F. (1953). *Science and Human Behavior*. New York: McMillan, 1953.

Watson, D. L. and Tharp, R. G. (2005). *Self-directed Behavior: Self-modification for Personal Adjustment*, (9th Ed.). Belmont, CA: Thomson/Wadsworth, 242-245.

Author Biographies

Yeoreum Lee

Yeoreum Lee is a PhD candidate in the Department of Industrial Design at KAIST. She received her BS and MS in industrial design from the same university. Lee's primary research interests are the intersection of health behavior change and social interaction design within the HCI field. In particular, Lee is interested in applying social reinforcement as a source for designing primary health prevention services, and one part of her PhD study was published at CSCW 2015 as a full paper.

Min Gyeong Kim

Min Gyeong Kim is a master student in the Department of Industrial Design at KAIST. Her research interests include designing user experience regarding privacy issues in digital system. Kim received her BS in industrial design from KAIST.

Saeyoung Rho

Saeyoung Rho is MS candidate in the Department of Industrial Design at KAIST. Her research interests include health behavior change, Quantified-Self, personal informatics, and wearable devices. Recently she has been developing a new way of representing personal data in QS services. Rho received her Bachelor's degree in industrial design from KAIST.

Da-jung Kim

Da-jung Kim is a PhD candidate in the Department of Industrial Design at KAIST, where she holds her BS and MS degrees as well. Her research interests include aesthetics of interaction, personal informatics, and social interaction design. For her dissertation, she has

been studying the design of social applications and its impacts on user's personal and social lives.

Youn-kyung Lim

Youn-kyung Lim is an associate professor in the Department of Industrial Design at KAIST, where she leads the Creative Interaction Design (CIxD) lab. Her research interests have been in the areas of experience-centered design and prototyping in HCI, with a design-oriented perspective, especially focusing on enabling creative interaction design. Lim received her PhD in design from the Institute of Design at the Illinois Institute of Technology in Chicago.