A Survey on Management of Personal Health Information from Activity Trackers

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Abstract
This paper examines how people manage activity tracker-generated personal health information. A pilot web-survey study was conducted to understand healthy activity tracker users’ personal health information management (PHIM) practices and concerns of the new type of personal health information generated by activity trackers. Preliminary results from 55 responses are presented, showing that current activity trackers users tend to use their devices on a frequent and consistent basis, that they use a range of health/wellness applications and are often willing to try new ones, and that they have various PHIM concerns regarding needs, practices and obstacles. The findings suggest that future mobile and wearable technologies should allow for individualization and customization to support users’ diverse PHIM needs and specific health-related goals.

Keywords: personal health information management; mobile human-computer interaction; information behavior


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1 Introduction
Today’s commercial mobile and wearable devices are often equipped with a range of sensors, such as pedometers, accelerometers, altimeters, compasses, and GPS, allowing users to automatically collect data about their physical activities (Consolvo et al., 2008; Ganti et al., 2010; Sun et al., 2010). In this paper, the term “activity trackers” refers to all devices that provide physical activity-tracking functions, including fitness bands, smartphones and smart watches. The data generated by sensors in these activity trackers are often presented to users via health/wellness applications, creating a new type of personal health information.

Activity tracker-generated personal health information is especially valuable because of its ubiquitous and factual nature. Activity trackers can collect data anytime and anywhere, as long as users carry or wear them with activity-tracking functions enabled. Newer devices truthfully and consistently record data about users’ daily activities, as opposed to the manual input method of personal information that early self-trackers employed, which resulted in less reliable data input and collection.

Recent research studies have looked into how people adopt or engage with activity trackers (Shih et al., 2015; Gouveia et al., 2015). However, current research does not provide much data on how people manage their activity tracker-generated personal health information, nor do researchers have an in-depth understanding of people’s practices in this area. Now that users have easy access to this new type sensor-based and activity tracker-generated personal health information, it is time to investigate their management practices with such information and to explore how future technologies can better support their personal health information management (PHIM) needs. We present an exploratory pilot study that examines how activity tracker users manage their personal health information generated by their devices, with the eventual goal of generating design implications for future activity tracking technologies to better support PHIM practices.
2 Literature Review

Researchers from different disciplines have examined the phenomenon of self-tracking, the overarching behavior that includes the usage of activity trackers. This literature review starts with different research areas of self-tracking, then introduces prior works on user behavior with activity trackers, and finally reviews literature from personal health information management (PHIM), a new but growing research area within information science.

2.1 Research Areas of Self-tracking

Humans’ use of self-tracking has a long history, the bulk of which includes keeping personal logs or diaries. It was not until recent decades that people started to employ digital technologies to help with their self-tracking efforts. A few emerging research areas examine self-tracking with different focuses, including lifelogging, quantified self, and personal informatics.

Gurrin et al. (2014, p. 2) defined lifelogging as “a phenomenon whereby people can digitally record their own daily lives in varying amounts of detail, for a variety of purposes”. Using various technological tools, such as audio recorders, digital cameras and activity trackers, lifelogging focuses on recording aspects of a person's life to create a personal digital memory (Gemmell et al. 2006; Gurrin et al. 2014). Quantified self refers to the movement as well as to the community dedicated to self-tracking to obtain self-knowledge through quantitative numbers (Quantified Self, 2016). It emphasizes the understanding of quantitative data about oneself and addresses the importance of personal analytics (Cho et al., 2014). Personal informatics is another area of self-tracking research, specifically focusing on issues around personal informatics systems that help people collect and reflect on their personal information (Li, et al., 2010 & 2011).

The research areas of lifelogging, quantified self and personal informatics tend to embrace various aspects of personal information, including physical activities, health data, food intake, mental status and their everyday whereabouts. Our study specifically examines the personal health information related to people’s physical activities.

2.2 Activity Tracker User Behavior

Activity trackers utilize built-in sensors to record users’ daily physical activities and to present such information to users. The information generated by activity trackers benefits those who want to monitor their health conditions or improve their physical fitness (Anderson et al., 2007; Consolvo et al., 2008).

Researchers have investigated user behavior with activity trackers. Shih and colleagues (2015) conducted a six-week user study based on Fitbit usage logs and surveys. They found half of the participants stopped using Fitbit after two weeks and only 9 out of 26 participants ended up in their high usage group. Similarly, Gouveia and colleagues (2015) analyzed the usage data of Habito, their own application, to study users’ engagement with their activity trackers, but only 97 out of 256 users used the application longer than a week. Among those who adopted Habito for more than a week, most users only took brief glances checking out their current activity levels without further interaction. These studies show that major issues of activity tracker usage are low user adoption rates and limited user engagement.

These prior works on activity tracker user behavior focused on adoption and usage, with little discussion of users’ management behavior of their personal health information. This study specifically considers activity tracker users’ PHIM.

2.3 Personal Health Information Management

Personal information management (PIM) is an area of information science that refers to “both the practice and study of activities a person performs in order to acquire or create, store, organize, maintain, retrieve, use and distribute information complete tasks and to fulfill various roles and responsibilities” (Jones, 2007, p. 453). Personal health information management (PHIM) is a branch of PIM that investigates the
management of people’s personal health information to support health-related needs and goals (Pratt et al., 2006).

Past PHIM research took a patient-centered approach and mainly emphasized information technologies, such as personal health record systems (PHRs), to assist patients with their healthcare needs (Burrington-Brown et al., 2008; Pratt et al., 2006). Less work has focused on studying non-patient general PHIM – the everyday health information management practices of ordinary people. This study targets non-patient activity tracker users and examines their PHIM with the information generated by their devices as well as their relevant concerns regarding PHIM needs, practices and obstacles.

3 Research Questions

This paper reports on a web survey study that comprises part of a larger research project aimed at understanding PHIM of activity tracker-generated information. This first stage of the project was designed to investigate two research questions:

(1) How do activity tracker users use their devices and relevant health/wellness applications to monitor their personal health information?

(2) What PHIM concerns do activity tracker users have with the information generated by their devices?

4 Methodology and Study Design

We chose a web survey as the primary method to collect data because of its low cost and ability to reach a large number of potential respondents. As we aim at non-patient PHIM, we employed purposeful sampling that targeted a population who intentionally participate in physical exercises – gym members. To recruit potential participants, we partnered with a university-affiliated gym located in a large city in the Eastern U.S. and invited its members to the web survey. Note that this large-size gym not only serves students, faculty and staff of the university but also has a large number of paid members from outside the university.

We distributed questionnaires by email to 1000 randomly selected members using the listserv of the partner gym. We also distributed the questionnaires via Facebook to a small number of activity tracker users. Note that this was the pilot stage of the web survey study and one of our goals was to test the questionnaire’s content and the sampling method for improvements. In this pilot study, we therefore only collected data for two weeks and then closed the link to the questionnaire. The later full study will distribute the improved questionnaires to all members of the partner gym and via a large scale social media snowball sampling.

We used the web survey tool Qualtrics to create the questionnaire, which consists of three sets of questions, covering respondents’ background information, their usage of activity trackers and health/wellness applications, as well as their PHIM concerns. After basic questions that can be answered by all respondents who have ever used an activity tracker, the questionnaire diverges into two branches: one for current users and the other for past users.

5 Preliminary Findings and Discussion

5.1 Respondents’ Background Information

We received 55 usable responses during two weeks of data collection. Because we used gym-goers as a proxy to reach activity tracker users, it is likely that many of those who received the invitation email were not activity tracker users. Thus, the response rate of this study should be considered differently than surveys that directly target eligible populations.
5.1.1 Demographic information

Among all respondents, seventeen respondents (51%) are male, thirty-seven respondents (67%) are female, and one respondent (2%) identifies self as “other gender”. Figure 1 shows that the age and profession of respondents range widely, indicating that the pilot study reached relatively heterogeneous groups of activity tracker users via our partner gym and that the sampling method is inclusive.

5.1.2 Respondents’ physical activities

Among all respondents, 17 (35%) visit a gym at least four times a week, 13 (24%) two to three times a week, 9 (16%) once a week, and 14 (25%) less than once a week. Figure 2 shows the types of physical activities respondents usually do both in and outside the gym. When visiting a gym, most respondents use treadmills or elliptical machines for walking or running exercises (67%) and use weights for strength exercises (55%). Respondents also engage in cycling, swimming, group exercises and other exercises such as climbing and solo yoga during gym visits. Outside the gym, respondents reported they participate in various physical activities, including walking, running and biking outdoors.

Figure 2: Respondents’ Physical Activities

Most of the respondents actively participated in various physical exercises and sports, often motivated by a combination of reported health-related goals. They reported three major health-related goals from their
gym visits and other physical exercises: to stay healthy, such as to improve physical health (85%) or live a healthy lifestyle (80%); to stay in shape, such as to look good (55%), lose weight (65%) or build muscles (56%); and for personal fulfillment, such as for personal enjoyment (55%) or personal achievement (45%).

5.1.3 Past and current activity tracker users
We designed a branching question to distinguish current users who continue use their activity trackers and past users who gave up using their devices. Forty-seven respondents (85%) identified themselves as current users and eight respondents (15%) as past users. Most findings presented in this paper are based on the data from the forty-seven current users.

5.2 Usage Patterns and PHIM

5.2.1 Usage of activity trackers
Thirty-nine out of fifty-five respondents (71%) reported they owned or used more than one activity trackers and two of them even used five or more activity trackers. For the types of activity trackers, thirty-eight respondents (69%) have used fitness bands, thirty-one respondents (56%) have used smartphones for activity tracking, and only twelve (22%) have used smart watches.

![Figure 3: Primary Activity Tracker Usage](image)

We asked the forty-seven current users to identify their primary activity tracker and to respond to a set of questions about usage length and frequency. We discovered that current users generally exhibit long-term engagement with activity trackers and high frequency of using their primary activity trackers, as shown in Figure 3.

We also asked respondents’ predicted future use of their activity trackers in six months. All forty-seven current users were optimistic about their continued use in future. In the open-ended question followed by predicted future use, some respondents commented that “I enjoy tracking my progress”, “it motivates me and keeps me honest”, “it is a habit now”, and “the data collection ensures proper goals are met”. Interestingly, three respondents explicitly commented on their intention to upgrade or switch to a better activity tracker in the near future.

The findings confirm that people tend to continue using activity trackers once they have adopted the device and technology (Gouveia et al., 2015). We also discovered that some activity tracker adopters intend to upgrade their devices for better functionality or accuracy.

5.2.2 Usage of health/wellness applications (apps)
All 55 respondents reported having tried multiple health/wellness applications for accessing and managing their activity-tracker generated information. Figure 4 shows the range of applications being used, including device-based applications such as Fitbit apps and Garmin apps, operating system-based apps such as Apple
Health and Google Fit, and various applications with specific focus, such as Nike apps, My Fitness Pal and Map My Run.

![Chart showing health wellness applications usage](image)

**Figure 4: Health/Wellness Applications Usage**

When asked about their current usage of these applications in comparison with the first month they used them, respondents showed different patterns. Twenty-five respondents (53%) reported using the applications about the same amount as during the first month, while twelve (26%) and eight (17%) reported increased and decreased usage respectively. The remaining two users (4%) selected “other usage pattern”, one of which explained that “I use a Fitbit but other apps to analyze the data”.

We also asked about predicted future usage of these health/wellness applications in six months. Answers varied, with twenty-nine respondents (62%) predicting they would continue to use current applications for reasons such as “low maintenance” and “consistency”. However, the remaining respondents (38%) either intended to switch to a new device for use with the same application, or stayed open-minded to try better applications if they were to become available.

Some respondents’ comments revealed that they expected more from health/wellness applications but were limited by available technologies. One respondent expressed the hope “to be able to plot data” and another expressed that “my use is determined by the technology I get.”

The findings show that activity tracker users are generally satisfied with health/wellness applications they currently use, but many are open to trying new applications with better functionality, possibly because their PHIM needs are not fully met by available applications.

### 5.3 PHIM Concerns

We used open-ended questions to gather data on PHIM concerns about needs, practices and obstacles for activity tracker-generated information. All respondents, both current and past users, reported a range of PHIM concerns. Keeping in mind the small size of the pilot study participant pool, we analyzed the text data from open-ended questions using preliminary thematic analysis (Braun & Clarke, 2006) and synthesized several findings here that merit examination as a part of the full study.

#### 5.3.1 PHIM needs

Two past users gave up activity tracker use due to PHIM needs that activity trackers could not meet. One said “my tracker was unable to capture (without manual input) most of the information that made my activities interesting to me.” The other explained that: “I was most interested in how much activity I was getting outside of scheduled exercise that my device could not track”.

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Current users reported more diverse PHIM needs than past users. A few respondents expected to have a smart reminder/alert function to keep them motivated, but contrarily one respondent wanted better customization and minimal invasiveness from health/wellness applications. Some expressed the need for better data accuracy from their activity trackers, some hoped for better interoperability among different applications, and some even had non-PHIM but device-related needs such as fashionable designs.

These findings suggest that future mobile and wearable technologies should put more focus on individualization and customization to better support users’ diverse PHIM needs.

5.3.2 PHIM practices
Three respondents wanted to export data generated by their devices but the function was not always available (e.g. some applications charge a fee). One respondent made extra efforts to manually transfer data into a spreadsheet for further analysis. We also discovered that users often used activity tracker-generated information as part of their broader overall PHIM practices. For example, two reported they also kept exercise journals on paper or spreadsheets, while five kept food intake journals using My Fitness Pal in support of their overall fitness goals.

These findings indicate that PHIM of activity tracker-generated information is part of people’s overall PHIM practices to support their overall health-related goals. Therefore, future health/wellness application should design functions to better support users’ specific health-related goals.

5.3.3 PHIM obstacles
Respondents’ comments revealed two major PHIM obstacles of activity tracker-generated information. First, many respondents were disconcerted about potential PHIM risks such as data retention, data misuse and privacy leak, but felt there was not much they could do about it. Second, two respondents expressed frustration about PHIM fragmentation created by multiple health/wellness applications. As one commented “I’d like to take the best aspects of Jefit for weight training, Endomondo for running, and My Fitness Pal for food logging, and have them altogether in one app.”

6 Conclusion and Future Work
This paper presented our pilot web survey study examining people’s personal health information management of activity tracker-generated information. This pilot study provided insights into users’ management practices of activity tracker-generated personal health information and explored their PHIM concerns regarding this new type of personal health information.

The results confirmed that activity tracker adopters tend to continue using their devices (Gouveia et al., 2015). We further discovered that these adopters use their devices on a relatively frequent and consistent basis and that they intend to upgrade their devices for better functionality or accuracy. The findings also show that respondents often use multiple health/wellness applications to manage personal health information from activity trackers, while having unfulfilled PHIM needs, broader PHIM practices, and certain PHIM obstacles.

The next step is to carry out the full web survey study to collect larger data, allowing us to analyze results using statistical methods, text mining techniques and qualitative thematic analysis to generate comprehensive findings and design implications. Specifically, we will statistically compare PHIM practices between current users and past users and among users with different types of activity trackers, which will shed light on the factors contributing to activity tracker adoption. Also, we will apply both text mining techniques and qualitative thematic analysis on the answers of open-ended questions to identify further patterns of activity tracker users’ PHIM needs, practices, and obstacles.
7 References


