Self-tracking over time: The FITBIT® phenomenon

Stephanie Day
Eastern Institute of Technology
Sday@eit.ac.nz

ABSTRACT

The evolution of pervasive sensor technologies has given rise to an increased availability of consumer wearables that track and monitor a variety of human activity. The use of these devices is closely linked to self-quantification; the practice of using the captured data and knowledge gained for self-improvement. In this study a research model based in human behaviour theories informs a qualitative approach to answer the research question, *"How does the use of self-tracking devices influence individuals health and behaviours and goals over time*?". The findings show participants chose the FITBIT® to meet pre-determined step counts, monitor activity and heath indicators, and to lose weight. As time progressed most users reported some change or adaptation to the way they used their devices. Participants used the knowledge gained to set new goals, reevaluate existing goals and over time reported an increased focus on participating in challenges and being part of a community to help stay motivated.

Keywords: self-tracking, self-quantification, FITBIT®, goal setting, mobile technology, wearables, health, fitness, HCI

1. INTRODUCTION

The concept of using wearable devices to self track and monitor activity levels and health biomarkers, has been around for a number of years. The first heart rate monitors were available in the 1980's (Polar, 2007) and as various sensor technologies have improved, these devices have progressively become smaller, less obtrusive and more pervasive (Rooksby, Rost, Morrison & Chalmers, 2014). The use of self-tracking monitors and devices was once considered a niche practice, but recent technological developments mean their use is no longer limited to the realm of serious athletes, those with medical conditions and data collection enthusiasts. Wearable devices that monitor and offer feedback on activity, health and sports performance are now available as mainstream consumer technologies. The process of keeping personal tracking data and using the knowledge gained for personal self improvement is called self-quantification (Li, Dey & Forlizzi, 2010).

This study reports and discusses how the owners of the FITBIT® self-trackers use their self-quantifying wearable devices in conjunction with the FITBIT® mobile application and/or website, to answer the question "How does the use of self-tracking devices influence individual's health and fitness behaviours and goals over time?". By giving an insight into those factors that influence longer term use of self-quantifying devices and how behaviour changes over time, this research contributes to understanding user motivation and engagement with self-quantifying technologies in an area where over half of users reportedly abandon their devices within six months (Ledger & McCaffrey, 2014).

To begin, the current self-quantification literature and related theoretical perspectives is discussed. This is followed by a presentation of the survey results where basic descriptive statistics and a detailed qualitative analysis of the data provide information for discussion. Lastly, some conclusions are drawn and areas for future inquiry and consideration are given.

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2. LITERATURE REVIEW

Wearable technologies are currently being marketed as a way to redefine personal goals, improve health and fitness by providing personalised insights (Jawbone, 2016) and enhancing lives (Garmin, 2016). One such health and fitness wearable is the FITBIT®. The FITBIT® tracks a variety of activity and biomarkers, such as increased heart rate and displays this information within the FITBIT® mobile or web application. FITBIT® claims to "help you fit your fit, stay motivated, and see how small steps make a big impact" (FITBIT®, 2016). The FITBIT® website also provides a platform to connect with friends, join challenges and gather rewards based on personal goals and achievements. The FITBIT® features, along with those of other wearable technologies that monitor user activity and health biomarkers, has been enabled by the development of miniaturized sensor technologies. Personal data can be collected simply and unobtrusively (Rooksby et al., 2014) just by wearing a watch, wristband or clip-on device. Users are then able to analyze their personal data and use that information for self-reflection, understanding and self improvement (Li et al., 2010). This practice of recording personal data and using that data in various ways, is alternatively known as self-quantification, self-tracking, personal analytics, personal informatics and life-logging. (Choe, Lee, Lee, Pratt & Kientz, 2014; Li Dey & Forlezzi, 2011; Roosksby et al., 2014; Trickler, 2013).

2.1 Self Quantification

Self-quantification lies in the merging fields of Human Computer Interaction (HCI) and Human Data Interaction (HDI). Born of a broad gathering of disciplines within the human behaviour sciences and computer sciences fields (McKenzie, 2013), HCI researchers investigate the areas where humans and computers interact. This broad area includes those afforded by the developments in mobile, sensor technologies and intelligent systems (Gupta, 2012). It is these technologies that have enabled the emerging area of HDI, where human interaction with "large, rich personal datasets" (Haddadi, Mortier, McAuley & Crowcroft, 2013, p. 5) forms the foundation area of study. The interaction of self quantifiers with their own personal datasets is of interest to researchers as they attempt to make the links between technological, behavioural and social theories and user practice (Lupton, 2014).

2.2 Models of self-quantification

Self-quantification is defined by Li et al. (2010, p.2) as a "system that helps people collect personally relevant information for the purpose of self-reflection and gaining self knowledge". In developing a model of use, the authors defined 5 stages of user progress in a self-quantification process. Firstly, a user enters into a decision making process about what information is to be collected, how to do this and acknowledges the motivations for doing so. Secondly the process involves collection of raw data and observations of oneself. Thirdly they describe a process of integration, where the various data is grouped together to inform the process of reflection, where the user explores the data and tries to gain meaning from it. Finally, the user takes this new knowledge and uses it as motivation towards new goals. Li et al. (2010), along with Choe, Lee, Lee Pratt and Kientz (2014) identified barriers to successful self-quantification, including lack of scientific rigour and expertise by the user evaluating the data, the user tracking too many events, the user not tracking behavioural triggers, and the user tracking out of context. Lack of time and inconsistent data were also considered barriers to successful self-quantification. The process identified by Li et al. (2010) follows a logical time driven sequence. At some point the process becomes either iterative, or alternatively the barriers are too high and the process stops altogether.

A different perspective to the phases of self-quantification was taken be Rooksby et al. (2014) who investigated styles of tracking., In doing so, they discovered that users were less logical in the self-quantification process and tracking device use was dependent on purpose. Directive trackers were motivated by goal-setting, documentary trackers logged activity for interest, diagnostic trackers looked for cause and effect relationships, reward collectors enjoyed the social aspect of competition and leaderboards, and fetish trackers were interested in gadgets and liked to experiment with new technologies.

Further research by Gimpel and Niβen (2013) investigated user motivation, and identified self-entertainment, self-association, self-design, self-discipline and self-healing as primary motivators. They also found that the more motivation a user had in a single area, the more likely they were to sustain tracking activity.

2.3 Self-quantification over the longer term

Together, this research provides a variety of user motivation and progression models that can be considered when investigating user's self-quantification habits over time. Fritz, Huang, Murphy and Zimmerman (2014) studied the use of wearable activity devices by a group of 30 participants who had owned and actively used their devices for a period of 3 - 54 months. They found that most of the participants had integrated the use of the devices into their daily routine, and used the data gathered to make immediate changes, for example going for longer walks and climbing more stairs. They also reported that motivation and reflection were primary causes of device use and purchase. Although the authors expected use may have diminished over time, for most participants, the long term use remained the same and participants still found the use of their devices motivating. However, an alternative study by Clawson, Pater, Miller, Mynatt and Mamykina (2015) found that equally, users were abandoning their tracking devices. Citing instances where users found the technology too difficult to learn and use or it failed to help with long term goals, was coupled with instances where users had upgraded the technology or switched to one which suited their tracking preferences more closely. Clawson et al. (2015) concluded that the relationship of users with their devices was "rich, complex and highly dynamic", where "individuals lives change, so do their needs and expectations for self monitoring" (p. 655).

3. RESEARCH MODEL AND FRAMEWORK

The model used in this research (Figure 1) is derived from models of human behaviour and Locke and Lathams (2002) Goal Setting Theory. Using the influencing variables of these previous models, this research attempts to understand the various influences on long term use of the FITBIT® as a self quantifying tool. This research theorizes that each of the influencing factors has a positive influence on FITBIT® use.

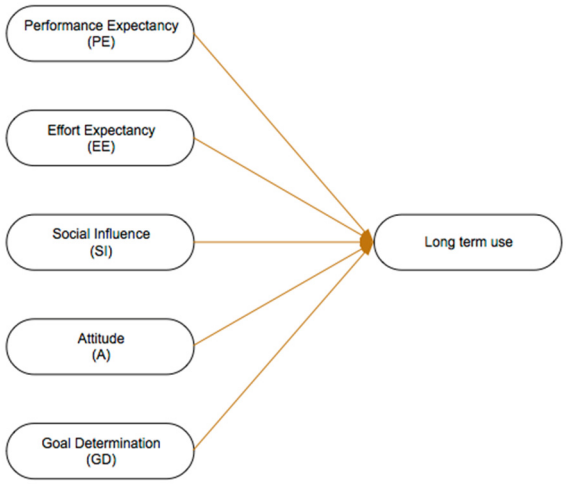

Figure 1. Research Model.

Performance Expectancy (PE) is key variable derived from the Technology Acceptance Model (TAM). In combining Perceived Usefulness (Davis, 1989) and Outcome Expectancy from the Computer Self-Efficacy Model (Compeau & Higgins, 1995), this construct determines a user's perceptions of the general usefulness of the FITBIT® for health and fitness performance.

Effort Expectancy (EE) is derived from the key variable Perceived Ease of Use from the TAM model (Davis,1989) and the constructs of pervasiveness and ubiquity identified by Salinas and Thiesse (2015). This construct identifies the degree of ease or difficulty a user finds when using their FITBIT®.

Social Influence (SI) is derived from Ajzen (1991) and identifies the degree of influence friends, family and acquaintances have on a participant's FITBIT® use.

Attitude (A) comes from Fishbein and Ajzen (1975) and refers to an individual's attitude towards using their device particularly in regards to its ability to provide intrinsic motivation and its ability to elicit positive emotional responses.

Goal Determination (GD) stems from Locke and Latham's (2002) Goal Setting Theory, and assesses how a user goal sets and perceives feedback and revelation of their progress as influential in motivation towards longer term goals.

For the purpose of this research, the model will be used to inform a qualitative study where questions derived from the original theoretical models will be used to capture participant's attitudes towards the various factors that may influence positively on long term use.

Although traditionally tested in a quantitative way, models based on the constructs of these earlier theories have been

applied in a qualitative manner (Shibl, Lawley and Debuse, 2013; Vogelsand, Steinhuser and Hoppe, 2013), particularly when the sample size has been seen as insufficient to perform a full quantitative analysis (William, Rana, Dwivedi & Lal, 2011).

4. METHOD

In order to understand how the use of self-tracking devices may influence individual's health and fitness behaviours and goals over time, a survey of FITBIT® users was undertaken. Participants in this study were required to fit the criteria of the research thereby giving a purposive sample (Ritchie and Lewis, 2003), of FITBIT® users who have owned and used their devices for longer than one month's duration. From the participant responses, the qualitative data was open-coded into the emerging related concepts and second level axial coding used to reveal the deeper conceptual relationships. Descriptive statistics supplement this analysis, offering a summary of participant FITBIT® users, their goals, motivations and use of their devices over time.

4.1 Survey

A survey was developed and deployed using the online tool SurveyMonkey. The survey link was open for six days, after which time the survey was closed. A scan of the survey results at this time indicated that a state of data saturation had been reached and no further information useful to this study would be gained. The survey collected a small amount of demographic data and asked participants to indicate the FITBIT® device they owned and how long they had owned it. The second section required participants to indicate why they bought/owned a FITBIT®, what features they use, to indicate the features they found most influential and how their use may have changed over time. The final section consisted of a series of Likert-type questions that were in part based on the research of Venkatesh, Thong and Xu. (2012) and Salinas and Thiesse (2015). These questions and their appropriateness to each of the models constructs have been validated many times in previous research using structural equation modelling. However for this research, they are used in a qualitative manner to capture participant current level of agreement with statements such as;

I use my FITBIT® because:

- It is fun to use
- It keeps me on track
- It allows me to achieve my fitness goals more quickly.

Groups of questions aligned to each of the constructs of the research model and open-ended questions used to reveal any factors that may be unrepresented in existing models. The survey was designed to lead participants through a logical time based progression, from initial use of the device, current use and future planned use. For the purpose of this research, FITBIT® is taken to mean both the device itself and the ecosystem that supports its use.

4.2 Participants

Participants were recruited via, email, social media (Twitter, Facebook and Google+) and from the FITBIT® website community forums. These methods of recruitment were chosen as they are a quick and easy way to disseminate information to a widespread audience. The messages on the social media channels were appended the hashtag #FITBIT® to help strengthen the connection with the desired audience. The email was sent to all staff at the Eastern Institute of Technology (EIT) as various staff members has previously indicated their willingness to participate in the research. No reward was offered to participants and no identifying information was collected.

The survey was attempted by 123 respondents, of whom 90 completed all questions. The responses were further filtered to exclude those users who indicated they owned a device other than a FITBIT® (e.g. Garmin) or did not know what device they owned. This left 85 completed responses for analysis. Of the 85, 73(85.9%) were female and 12(14.1%) male. Most of respondents were over 35 years old (Table 1).

Age:	Count	Percent
18 -25 years	5	5.9%
25 - 29 years	9	10.6%
30 - 34 years	4	4.7%
35 - 39 years	11	12.9%
40 - 44 years	19	22.4%
45 - 49 years	16	18.8%
50 years +	21	24.7%
Total	85	100.0%

Table 1. Age breakdown count and percentages

5. FINDINGS, ANALYSIS AND DISCUSSION

The survey responses were analysed in two ways. Firstly, basic descriptive statistics were produced where it was possible to give indications of numbers, proportions and numerical relationships and comparisons. Secondly, the information from the open ended questions were open-coded into concepts that were predetermined by the nature of the question. These concepts included, health, fitness, social, data and device. From these categories, the responses were further aligned to subcategories that were revealed during the analysis stage.

5.1 Descriptive statistics

Analysis of the survey responses indicates some basic details of FITBIT® ownership from the 85 participants. Although several different FITBIT® models are owned across the participating users, all FITBIT® devices have some commonalities. These common features include: recording steps, distance, calories and active minutes (FITBIT®, 2016). For the purpose of this study, it is these common features that are given more attention in the detailed analysis, although others, such as heart rate are indicated where the use of this feature is of significant influence to the user. The models used by the participants are indicated in Table 2.

Model	Count	Percent
Charge	11	12.9%
Charge HR	39	45.9%
Flex	17	20.0%
One	8	9.4%
Surge	7	8.2%
Ultra	3	3.5%
Total	85	100.0%

Table 2. FITBIT® device ownership count and percentages

The length of time a user had owned a FITBIT® and the frequency of that use was also determined from the survey. Most people (82.5%), in all ownership time frames, used their FITBIT® every day. These results are summarized in Table 3.

Ownership (Months)	1-3	3-6	6-12	12 or longer

Usage:	Count	Count	Count	Count
Hardly ever	0	0	1	1
Some days	0	3	0	2
Most days	2	2	1	2
Every day	17	10	18	26
Total	19	15	20	31

Table 3. FITBIT® Usage

When asked to think back to when the device was first used, and comparing that to how it is used now, 40(47.1%) of respondents indicated the way in which they use it had changed, while 41(48.2%), indicated no change, and 4(4.7%) indicated they could not remember.

5.2 Analysis of Likert-type responses

The 5 point Likert scale measured either positive or negative responses to a series of statements relating to each of the model constructs. For the purpose of this research the positive and negative counts were reduced to combine all agree and disagree responses related to each construct. These are represented as percentages in Table 4.

Construct	**Disagree Strongly disagree (%)**	**Neutral (%)**	**Agree Strongly Agree (%)**
PE	11	23	66
EE	6	8	86
SI	35	19	46
A	11	19	70
GD	21	21	58

Table 4. Percentage of positive and negative responses for each category

From the combined results, participants generally found their devices useful for health and fitness purposes (66%). effort required to use the device was seen minimal (86%) and users found using their device enjoyable, fun and exciting (70%). Of less importance were those Likert items attached to goal determination; rewards, incentives and support were not seen as particularly influential (58%). However, two items in the category, 'showing progress' and 'keeping on track' were seen as very important when viewed as individual items. These are also closely linked to the importance of feedback and progress revelation as a user is motivated towards longer term goals (Locke & Latham, 2002). Of least importance was the social aspects; the influence of friends and sharing data being rated positively by only 46% of users.

5.3 Analysis of participant feedback

5.3.1 Initial Use

The research participants were asked why they decided to use a FITBIT® and what factors from those reasons given were most influential in initial use. This questioning aimed at gauging participant baseline information from which changes over time could be compared. The reasons for deciding to use a FITBIT® fell broadly under five categories:

- For fitness
- For health
- Device was recommended
- Device was a gift
- The device has the required features.

Many of the participants indicated they were interested in increasing their fitness levels by reaching and maintaining the 10,000 daily steps widely recommended for good health, "maintaining my 10,000 steps walking", and 'encouragement to gain 10,000 steps". Interestingly, the 10,000 steps do "not have its origins in evidence" (Ballard, 2016), but nevertheless has been adopted by FITBIT® as the preset daily step target. Others were more general, indicating they just "wanted to increase my fitness", "ensure that I was on top of my everyday exercise" and "to see how much exercise I am actually doing". Health reasons were also prominent but varied, "I am pregnant and want to stay healthy", "to lose weight", "I am a poor sleeper so thought this would help", and "I was looking for a heart rate monitor, but didn't need to get as high-tech as a chest strap type device". Monitoring existing activity and health along with reaching goals were the prominent reasons. The reasons given here align to the directive tracking style of use identified by Rooksby et al. (2014) and to the abstract setting of goals, described by the Goal Setting Theory of Locke and Latham (2002).

Others indicated that the device came recommended from friends, family or the media. "A friend showed me hers and it seemed easy and fun to use", "My mate brad has the surge and reckoned they were worth it", "recommended by sister" and "Husband had one and he raved about it". The influence of friends and family to use a FITBIT® appear to be stronger at the time of purchase than at any other time of ownership.

Other reasons for ownership were varied. For a few users, the device was a gift and one other had won one in a gym challenge. One participant recognised the FITBIT® as being of quality "Trusted product", others mentioned the good value and had the required features. Its portability was mentioned, "Beats carrying my phone everywhere" as was its convenience, "Easy [to use] because I have a busy life and don't have a lot of spare time" and its ability to integrate with other applications was important to others, "Integrates with Myfitnesspal", and "syncs with Weight Watchers app". Portability and ease of use links directly to the Effort Expectancy (EE) variable described in the model and both the responses from the Likert type questions and the free answer questions confirm the importance of the devices ease of use, convenience and ubiquity. The device's data capabilities interested some users, "Good immediate feedback of useful data" and "The GPS tracking appealed". Users reflected that the data captured by the FITBIT would influence their activity level and encourage activity at a more frequent level, "need to be more active, figured data would challenge me to do that". This indicates the use of data to reset activity goals. The concept of data fetish tracking identified by Rooksby et al. (2014) was apparent with one participant who simply noted that "I needed something to track, this seemed like a good option".

5.3.2 Change of use over time

Participants were asked to reflect on their change of use of the device over time. From those who had owned their devices for 1-3 months, 63% indicated that the way they used their device has not changed. There was a mixed response from those who indicated they have changed the way they use their device. Some indicated the amount of tracking they do is less and they have become less enthusiastic about tracking, "I use it less because the fun has worn off and I keep forgetting to put it back on after charging" and "No longer track sleep". According to the Goal Setting Theory (Locke and Latham, 2002), this may be indicative of a lesser commitment to personal goals due to the goals being too easy, or goals having being met without developing new goals. Others indicated they have changed their goals and tracking tactics, "In the 2 months I've used it I've become more interested in how active I am rather than focusing on my heart rate and sleeping patterns".

Although 67% of users who owned their devices for 3 - 6 months indicated their use has not changed over time suggesting the device had little influence on behavior and goals during the period of ownership. Rather, the users are more interested in ensuring their goals are being met, routines and health and fitness habits are forming, "Initially using it as a new gadget fad, but now I am using it to to helping me become fitter and lose weight. I make sure I meet my goals daily and it keeps me on track" and 'I use it less days now, as I've developed a pattern of walking".

The users who have owned their devices for 6 - 12 months generally report an increase in the features they use (55%) alongside an increased focus and reassessment of their habits and goals, "When I first got it I only used steps but now use most features it helps to be aware of all your habits to either break them or improve them", "I now use more features just as activity tracking, sleep monitoring and weight monitoring. All useful to help meet my personal goals", "It was primarily just a pedometer - but now I am interested in making sure I "climb floors" and have periods of activity (fast walking (aerobic) rather than slow walking). I also exercise more regularly so that I have the "reward" of entering it in the log and achieving another weekly goal".

Locke and Latham (1990) describe the mechanisms by which goal setting benefits performance by encouraging longer term motivation and effort. Often cited as a reason for purchase, the setting of new goals and reevaluation of existing goals based on current activity and health status occurred more frequently with this group of users.

There is a similar rate of change in use shown by those who have owned their device for 12 months or more (45%), however several indicated they are less obsessive about checking the device and they were not as motivated once the novelty wore off. For the majority, however, the way the devices were being used has been embedded and become part of a daily routine or habit. This integration of the devices into daily routine aligns with the results of the study by Huang, Murphy and Zimmerman (2014). Some participants in this group indicated that being part of a community of users, and having friends for challenges were instrumental in helping maintain motivation. This was not something reported by the users in the other categories. However nearly half of the users who fell into this group, indicated that they have experienced no change in how they use their FITBIT® over time.

5.3.3 Future use

Despite the mixed results, 93% of the participants have indicated they will continue to use their FITBIT® in the foreseeable future. Some see continued use of the device as helpful with goal achievement, *"Intend to use it long term in order to maintain level of fitness once l have met my goals"*, *"I have lost 10kg in the last year and the aim is to loose another 5kgs this year by increased exercise"* and *"When I get to my weight loss goal I'll continue to check my charts until I'm certain I know how to maintain... for a year at least...or until the device breaks"*.

6. CONCLUSION

The FITBIT® self-tracking wearable's track a variety of personal activities and health bio-markers, provide feedback on progress and encourage personalized goal setting and behavior modification. Enabled by current sensor and mobile technology developments, the practice of self-tracking is collectively known as self-quantification. Participants in this research provide an insight into how they are using their self-quantifying FITBIT® device, the features they find most useful and how their behaviours and goals may have changed over time as a direct influence of wearing a FITBIT® device.

Results of the study indicate most of the participants used their FITBIT® everyday, and nearly half of those indicated the way they used their device has changed over time. Initially, users chose the FITBIT® as their preferred device for a number of reasons; to meet a pre-determined step count, to monitor their exercise and various heath indicators and to lose weight. Friends were influential in the purchase of the device but less so with long term use. Somewhere from the 6-month and longer period of ownership, most of the users report some changes or adaptations to the ways they use their devices. The data capabilities of the FITBIT® is indicated as influential at this time. These changes reflect setting of new goals, reevaluation of existing goals and an increased focus on participating in challenges and being part of a community to help maintain motivation. Others expressed their motivation had dropped at this point and they had become less obsessive, although the majority still used their device every day.

This study concludes that for some users, self-quantifying devices such as the FITBIT provide the motivation and encouragement to reassess goals and make changes to meet these new goals. For others, meeting existing goals, whether of their own choosing, or those generally accepted as sufficient for good heath is all that is required. For this purpose, the FITBIT provides valuable feedback and data when keeping users on track.

6.1 Limitations

The limitations in this study include the small sample size and the possibility of users relying on their memory to accurately report how their use has changed over time. Of note also, is that this research was limited to FITBIT® users and the results applicable to this small group only and cannot be applied to other self-quantifying technologies that may have different features and processes. Although the constructs within the research model were based on previous theory, the model itself is untested. Within the research group, the range of FITBIT® devices varied and not all devices have all features and this would affect how a user saw the usefulness of their particular device.

6.2 Ethical considerations

The research was conducted using an online survey tool and participants completed the survey without providing any information that would allow identification of individuals. No reward was offered for participation, and participants could leave the survey at any time. The research was approved by EIT's research and ethics approvals committee.

7. FUTURE WORK

This research was conducted as a pre-study in preparation for the Masters in IT Applied Research Project. This study helps to identify further areas for investigation into the use of self-quantifying devices and how they are used over time. Of particular interest is the effectiveness of these devices in informing adoption and adaptation of goals and the processes users go through in assessing their personal goals. How effective these devices are in providing long term motivation, and the value of personalized data as part of the feedback loop in the areas of holistic health and wellness management is also of interest.

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