

Activity Tracking: Barriers, Workarounds and Customisation

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ABSTRACT

Activity trackers are increasingly popular, but they have high levels of abandonment and little evidence exists to suggest why this is. This paper explores barriers to engagement with activity trackers. We extend previous research by not only characterising the barriers users experienced, such as tracking accuracy and device aesthetics, but also by reporting the workarounds they created. We discuss implications for the design of activity tracking systems by reflecting on these workarounds, the potential for activity tracker design to help overcome existing barriers, and how customisation could play a role.

AUTHOR KEYWORDS

Quantified self; activity tracking; personal informatics; fitness; health; behaviour change; physical activity.

ACM Classification Keywords

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

INTRODUCTION

Commercial activity trackers such as the *Fitbit* and *Jawbone* are increasingly popular: one report estimated that 19 million “connected wearables” (including 13 million fitness and activity trackers) were shipped in 2014, compared to just 5.9 million in 2013 [2]. However, some reports also suggest that approximately one third of devices are abandoned within 6-12 months [14].

Previous research has mostly focused on how trackers can encourage behaviour change (e.g. [7, 15]), and how they are appropriated in the real world (e.g. [10, 21]). In this paper we take a different approach, focusing on the reasons users stop tracking. These ‘barriers’ to engagement (such as incomplete tracking and poor aesthetics) have been described in previous research (e.g. [7, 10, 17, 21]), and

challenges in other personal informatics approaches such as food journaling (e.g. the effort involved and concerns with accuracy), have also been highlighted [9]. However, little work has looked specifically at real-world barriers to activity tracker engagement and the reasons for abandonment. As discussed in previous research [1, 23], understanding non-use of technology can provide insights and may lead to research and design implications.

In this paper we present findings from a mixed-methods study and extend previous work by making the following contributions: we provide a richer characterisation of the barriers that discourage or prevent engagement with activity trackers over time; we highlight the workarounds people create to lessen the effect of these barriers; and we discuss the potential for end user customisation.

RELATED WORK

Much of the existing academic research on activity tracking has focused on use and behaviour change. These studies have typically used devices supplied by researchers (e.g. [7, 8]), and have provided insight into user appropriation and how their design can encourage behaviour change. Design requirements and recommendations for trackers have also been created [7, 17], which will be referred to later in our discussion. A review of 13 trackers found that they included “5-10 of 14 total [behaviour change] techniques identified from the research literature as potentially effective”, and were mostly implemented in accordance with academic recommendations [16]. One might therefore expect them to be successful in encouraging increased activity levels. However, engagement in academic studies may be different to real world use and while the techniques and implementations may be appropriate, other factors could lead to abandonment. For example, one paper detailed the use of a commercial tracker in research [11], suggesting that devices were sometimes unreliable and a large number of participants lost them.

Rooksby, et al. [21] focus on real-world users of a range of trackers and provide details of the complexities of use, including how some users track irregularly, or switch between devices. However, they do not specifically address barriers and the reasons for non-use. Fritz, et al. [10] studied long-term trackers (those who had tracked for 3-54 months), but did not include those who had stopped tracking. They found that early novelty wore off for some

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UbiComp '15, September 7–11, 2015, Osaka, Japan.

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ACM 978-1-4503-3574-4/15/09...\$15.00.

<http://dx.doi.org/10.1145/2750858.2805832>

participants, but despite this they continued to track. This shows that while engagement changes over time, a subset of users do want to track over a longer period. However, it does not help us understand why some people give up when others continue to track. Other research has specifically looked at barriers to physical activity itself (e.g. [25, 22]), but there has been little discussion of how barriers might relate to tracker use and the majority of these studies rely on quantitative surveys, and lack in-depth qualitative understanding of how barriers affect engagement and use.

METHOD

Participants

Twenty-four participants (13 women) in Atlanta, GA, took part in our survey and contextual interviews. Potential participants were recruited through word-of-mouth and online advertisements, publicised through Facebook and Twitter, which called for “*current and previous users of activity trackers*” to take part. Participants’ ages ranged from 18-55. The majority (n=13) were in full time work, seven were students and four were self-employed. Participants were rewarded with a \$20 Amazon gift card.

Our sample included both those who were currently tracking their activity (n=16), and those who had abandoned tracking (n=8). Three of those tracking had previously stopped for at least 4-weeks, before returning. Recruiting both groups allowed us to gain insights into the reasons for abandonment, along with barriers to use and the factors that might encourage them to return to tracking. Participants tracked with a range of wearables, including various models of *Fitbit* (n=12), *Jawbone* (n=4) and *Misfit* (n=2), and with smartphone apps such as *Moves* (n=2) and *Argus* (n=1). The most experienced participant reported having used a tracker for almost three years, while the least experienced had used it for only two weeks. Over half (n=13) reported using their tracker for more than 6 months. Most participants reported using other personal informatics tools in addition to activity trackers, including food journaling tools like *MyFitnessPal* and sleep tracking tools, such as *Sleep Cycle*. Two participants had previously used a smartwatch, but neither used it to track physical activity.

Surveys and interview

Each participant completed two online surveys and an interview of approximately one hour (range: 00:35-01:30). The first survey took around 5 minutes to complete and included demographics, details of trackers used (type, ownership length, etc.), and a Stage of Change questionnaire for physical activity [4]. The second survey took approximately 15 minutes to complete and comprised two standardised questionnaires: the long-form International Physical Activity Questionnaire (IPAQ) [12], which provides a measure of physical activity; and the Barriers to Being Active Quiz [6], which assesses perceived barriers to physical activity. Survey data was used to support qualitative analysis by providing comparable measures of physical activity level and barriers.

Semi-structured interviews were carried out in winter 2014, over Skype (n=12) or in person (n=12), depending on the participant’s availability. Participants were encouraged to bring tracked data along to their interview as an aide-memoir. Interview questions covered: reasons for wanting an activity tracker; reasons for choosing their specific one; physical activity habits and transport regime; activity tracker use and barriers; other personal informatics use; unmet needs and desires; and reasons for abandonment. Interviews were recorded, transcribed and thematically analysed [3].

RESULTS

From survey and interview data we were able to build up a history of personal informatics use for each participant. A large proportion did not purchase their tracker, instead receiving it as a gift (n=8), through their work (n=6), or as part of a previous study (n=1). Three used it as part of a workplace wellness program and received an additional incentive to be active. Participants’ reasons for tracking were varied, though most had a goal in mind, often either weight loss: “*I started doing it to lose weight*” (P21); or, “*to get more activity into my day*” (P3). Others were simply curious about the technology, or wanted to track: “*I kinda track a lot of stuff, so it made sense*” (P13).

For various reasons, 11 participants had abandoned tracking (for at least four weeks), three of whom later returned. Some stopped tracking because they lost their device (n=6) or it stopped working (n=4). Some replaced the device immediately, whilst others chose not to. Others experienced barriers inherent to their tracker (such as issues with accuracy) which caused, or were partly responsible for, their abandonment. Other participants experienced similar barriers, but created workarounds and continued to track.

Accuracy and tracking

Many participants complained that their tracker did not accurately record all physical activity. This was especially true of those who routinely took part in non step-based activities and wanted more holistic tracking. For some participants this caused mild annoyance, “*on the longer [bicycle] rides [...] I felt I should have gotten some more steps*” (P15), but for others this was a larger barrier. P17 abandoned tracking because of this: “[I] stopped wearing it when I was doing a lot more stuff in the gym [...] it's just like ‘ok, you're not tracking this, now what's the point?’”.

Some participants said that tracking limitations changed their behaviour, “*I'll go for a run instead of doing yoga because I know it'll increase my steps*” (P13). However, others, such as P15 who wanted to be awarded steps for cycling, experimented with workarounds to ‘trick’ the tracker: “*I was trying to figure out where I could put my Fitbit to get what I thought was a good amount of steps. I was y'know, putting it my sock, putting it in my pants pocket, tying it to the cuff of my pants [...] I was also pedalling backwards whilst going down hills*”. Most participants’ trackers offered them the ability to manually

log other activities or link to other tracking systems, but many did not feel this was worthwhile because: *“it doesn't necessarily give me more steps”* (P15), showing that participants wanted a holistic measure of their exercise. However, some participants did track exercise to record calories burned: *“I go to the step class and yoga, which is a bit of a bummer because there's not a lot of Fitbit steps that I'm collecting for yoga. But I do put it into MyFitnessPal which gives me some calories back”* (P20). Other participants, often those who mostly took part in step-based activities, regarded the device as *“strictly a pedometer”* (P11), and were willing to accept tracking limitations.

Participants thought that additional measures, such as heart-rate monitoring, might be useful for more holistic tracking. P2, a cyclist who stopped tracking after his device broke told us, *“heart-rate would be a big draw”*, and that he would return to tracking if he was provided with a more complete record of his effort. Related to the accuracy of tracking, some participants, such as P16, were concerned with the device recording false positives (i.e. logging steps for non-steps), *“I ride a motorcycle too, which I found would mess up the Fitbit data”*. However, other participants appreciated these extra steps being recorded: *“it [his smartphone app] shows a higher number [than his wearable], so it feels like I'm doing more”* (P11).

Social functionality and support

Social functionality, especially competition, was important for continued engagement for many participants. P1 stopped tracking after her workplace wellness program (and social support) finished, *“I've got very slack on continuing. The challenge is over”*. However, her ‘workaround’ was to continue tracking using a new device offering a social comparison: *“my husband has one [a Fitbit], so, it would just like have the team aspect”*. Other participants were annoyed they needed the same tracker as their peers to compare, *“I had a friend who works at Jawbone and he uses one. My uncle uses Fitbit, but I try and use apps [...] it's annoying we can't compare”* (P24). One participant was concerned that tracking inaccuracies could have an impact on competition between users of different trackers, *“I read some reviews when the Fitbit wristband one came out and I was concerned they were all saying it wasn't as accurate”* (P3).

Aesthetics and physical form

Most participants said that aesthetics and the physical design of their wearable were important factors which sometimes acted as barriers to usage. As a result of her wellness programme, P1 used a *“pretty ugly”* wristband device, but came up with a novel workaround to keep it hidden: *“I wore it on my ankle”*. She explained, *“if I had been required to wear it on my wrist [...] I wouldn't have worn it”*. She stopped using the device after her wellness program ended, partially blaming poor aesthetics. Other participants had similar feelings about wrist-worn devices, P17 explained *“I don't want to strap anything to my wrist*

that doesn't look cool!”. Some participants wanted to customise their tracker, mentioning DIY alterations and aftermarket accessories. P13 was concerned with the appearance of her wearable, *“I wish they had more options, like rather than just the rubber band thing”*. She, and others, were interested in a jewellery-like Fitbit Flex cover available from a popular fashion designer, *“it's more expensive than the device itself, I cannot justify paying for it”*. Other participants with the same device were satisfied with its appearance, highlighting that there is no one-size-fits-all solution when considering wearables. Further to this, some participants felt that activity trackers should *“just replace the watch”* (P13), because they didn't see the need for two devices. P15 agreed, *“if something was going to have that much real estate near my hand it should do more than just show me dots”*. However, others such as P22, who had previously used a smartwatch, were less keen with this idea, *“I like my normal watch more”*, further highlighting individual differences and the need to support these.

In addition to the aesthetic demands, comfort and fit were also an issue for many participants, especially those who used wrist worn devices. P9 said this was one of the reasons he stopped tracking: *“I would take it off very frequently, sometimes because of typing, sometimes because of doing bedtime with the kids or whatever, it was just getting in the way [...] it just wasn't practical for wearing all the time”*. He later said, *“I'd go back to one”*, if the device had, *“maybe a slightly longer battery life and it was more comfortable to wear”*, indicating the importance of these aspects for continued use.

Unsurprisingly, battery life was an issue for other participants too. P5 started tracking with a smartphone app, but then stopped using it, *“I don't use Moves anymore because my app took up too much of my [phone] battery”*. He later tracked with a wearable device as it decreased the impact on his smartphone battery. Other participants struggled to remember to charge, or replace, their wearable's battery. In two cases this caused participants to stop tracking: P22 stopped tracking (for over 10 weeks) because of this, but stated that *“I still plan on using it in the future. Once I get around to charging it”* and P7 also stopped tracking after he mistakenly, *“let the battery go down so it didn't count”*.

DISCUSSION

This paper highlights an aspect of activity tracking that has so far received little attention in academic work: the reasons for abandonment and the workarounds to avoid it. We characterise barriers present in current commercial tracking systems, many of which have previously been described in the literature (e.g. [7], a publication from almost ten years ago). Further to previous work, we also detail the effect these barriers have on engagement and use: some barriers proved insurmountable, whereas others could be dealt with through use of workarounds. Interestingly, all participants who were *not* tracking at the time of the interview claimed

that they would start again if barriers were removed, suggesting that longer-term tracking was of interest.

In this discussion we focus on attempts at workarounds, as an opportunity to gain insight into how trackers could better meet user needs. We suggest that activity trackers may need to change to better match users' desires for long-term use and that one way to support this may be to allow for end-user customisation. Based on the themes that emerged in our findings, we suggest three areas where barriers to engagement could be lowered.

Tracking accuracy and reward. The importance of holistic tracking that rewards users appropriately has been emphasised previously [7]. Despite this, most current systems rely upon accelerometers to recognise and quantify activity and most only count steps. Improvements are being made towards more holistic tracking: for example, by integrating more sensors (e.g. the Microsoft Band or Basis Peak), or by offering a broader range of activity classifiers (e.g. [18]). Active logging of non-ambulatory activities (e.g. cycling) is already possible with many commercial systems, but usually requires user input and, as mentioned by our participants, does not necessarily provide an appropriate reward or representation of activity. Our participants created workarounds by deliberately 'tricking' their tracker to count steps during non-step activities, by positioning the tracker on particular parts of their body. Users' reasons for doing this proved insightful: they wanted to be rewarded with steps for these activities because they wanted an aggregate measure of all their exercise. The *Nike Fuelband* offers a solution, with an abstract aggregate measure of activity in the form of 'fuel'. However, users may have difficulty in understanding how different activities contribute to this abstract representation and individual activities may not be tracked accurately. A different approach might be to allow users to customise their own activity classifiers, perhaps allowing them to train their tracker to record different types of exercise. This could be achieved, for example, by placing an accelerometer in an appropriate position and then providing examples of the activity. Such end-user customisation has been proven to be a successful way of increasing engagement in other fields (e.g. [13, 24]). An aggregate activity 'score' could be made up from different tracked activities, which could then track overall activity levels (rather than just steps), something users currently appear to be appropriating the step measure for, via various workarounds.

Social comparisons. Similarly to previous studies [21], our participants wished to track socially, but they sometimes felt frustrated by only being able to track with users of the same system. Some participants swapped to using a similar tracker to their peers, to allow for comparison. A cross-platform tool for social activity tracking could potentially increase the size of each user's social support network and allow them to feel less tied to a single platform. Systems such as *Tictrac* and *Apple Health* offer ways of aggregating

tracked data, but do not yet offer strong social functionality to encourage users to remain active. As noted by one participant, differences in accuracy between devices (which are recognised in academic research, e.g. [5]) may cause issues with cross-platform comparisons, as users of different devices may be differently rewarded for completing the same activity. One way around this could be to require devices to meet minimum accuracy levels before being included in such comparison tools.

It is worth mentioning that there is a tension between users' desire for a more holistic measure that enables comparisons to be made with other people, and the opportunity discussed in the previous section to support end-user customisation in order to have more accurate or appropriate measures. If customisation occurs, then deriving meaningful aggregate measures that can be shared with others will be significantly more challenging.

Aesthetics and form. Appearance and form factor is another area where individual differences play an important role, as users have different desires and there are no one-size-fits-all solutions. Our participants created workarounds to make the trackers better support their desires: wearing them in hidden places and wishing to customise them with aftermarket accessories. Most current wearables offer limited options for customisability, one notable exception being the recently released Apple Watch, which offers 38 different options at point of purchase and different watchfaces offering additional customisation. However, despite this, buyers still often purchase aftermarket straps or even make DIY changes: recently a spray painted Apple Watch Sport gained mainstream attention as it mocked the most expensive gold edition model [19]. A recommendation for future wearables to better support individuals' needs is to use a modular design, similar to Project Ara [20], allowing purchasers to individually pick and choose embedded features (e.g. sensors, displays, etc.) along with providing a custom aesthetic and tailored fit.

CONCLUSIONS

In this paper we present the findings from a study of 24 current and previous activity trackers where we confirm and extend previous findings by characterising barriers that affect engagement with activity trackers. We have also highlighted users' workarounds and discussed how these provide insights into user needs. We have argued that two factors are crucial for the design of trackers to avoid unnecessary workarounds and reflect users' needs and desires for long-term engagement: facilitating the customisation of tracking and social functionalities; and the aesthetics and physical form of wearables.

ACKNOWLEDGMENTS

Many thanks to Marta E. Cecchinato and our reviewers for providing useful comments and feedback on this paper, and to Gregory Abowd and the Georgia Institute of Technology for hosting us whilst we collected data for this study. Daniel Harrison is funded by an EPSRC DTG studentship.

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