

# Logging Consumer Applications in mHealth: Experiences and Opportunities

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## ABSTRACT

This paper addresses the collection of data from consumer mHealth applications (mobile health apps). We use two consumer mHealth apps as examples, both of which we have developed and released. The apps are both designed to encourage and support walking: the first by way of a Commonwealth Games theme; and the second by way of a football themed competition. We discuss what data we collected from these apps, broadly categorizing it in terms of user statistics, game-relevant data, usage data and processed data. We also outline the ethical issues in collecting such data. We give two reasons for collecting data: to understand activity and to inform design. We then argue that a grand challenge in public health is to collect data across various apps in order to understand and support the mHealth “ecosystem”, i.e. the mass of apps that people have access to and can choose between.

## Categories and Subject Descriptors

J.3 [Computer Applications]: Life and Medical Sciences, Health.

## General Terms

Measurement, Design.

## Keywords

mHealth, Logging, Health and Wellbeing, Mobile Applications.

## 1. INTRODUCTION

There is much optimism that consumer mHealth applications (mobile health apps) such as pedometers, exercise applications, food loggers and others can motivate and support people in leading healthy lifestyles (see [[1][2]]). It is common that data is collected from mobile apps. Commercial interests appear to be driving this, particularly data analytics for advertising and market research. In this paper we will consider how data collection and analysis from mHealth apps can positively impact public health. We will argue for a *healthcare centric* approach to logging; one that is driven by health organisations to benefit public health.

This paper introduces two mHealth apps that we have recently developed and released. It will give an overview of the practical and ethical issues in logging. It will then discuss how log data is used, and argue that a grand challenge in this area is to find ways of analysing the mHealth “ecosystem”.

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## 2. EXAMPLE APPLICATIONS

**MyCity:** Glasgow was released for iOS and Android devices in June 2014. The app was designed to encourage people to walk more and learn more about Glasgow during the 2014 Commonwealth Games. The app awarded energy points for walking, enabling users to earn pictures of iconic Glasgow buildings on their map as rewards for reaching their daily and weekly walking targets and collectable photographs for answering quizzes correctly about locations around Glasgow. It had over 1000 downloads. Screenshots are shown in figure 1.

**Fans In Training (FIT)** was released for iOS devices in June 2014. It is an international football themed app designed to encourage walking. Users sign up for a team, and these teams compete head-to-head in matches. When a team’s combined step count passes a particular threshold, a goal is scored. It had over 3000 downloads, and over 650 registered players. Screenshots are in figure 2.

## 3. WHAT LOG DATA WAS COLLECTED?

We collected data from MyCity and FIT. Logging was not a simple case of collecting data that mirrored how the apps were used. Rather, decisions needed to be made about what to collect, how to collect it, and how to manage and store it. The data we collected can be broadly categorised as:

- **User statistics:** We collected general information about downloads, signups, and some demographic data. The number of downloads was not the number of users, individuals may delete and re-install apps, or download them to several devices. We found that not everyone downloading an app would register to play it (in fact less than 25% of people downloading FIT completed the registration process). Among those who signed up, not all used the app more than once. Collecting demographic data was less straightforward for iOS devices than Android as Apple have strict policies on this. An early version of MyCity was rejected by Apple on the grounds it asked for age, gender and ethnicity.
- **Game relevant data:** Both apps required data to be logged to a server to support play. For example, the leader board feature in MyCity had to be supported by a server, as did the ability for users to play as teams in FIT. In both cases, step counts (or energy points) needed to be uploaded to a server and compared or combined with others.
- **Usage data:** Every time users interacted with the apps, we sought to log some aspects of this. For example, we logged when users entered and exited the apps, and what actions they performed in the app (e.g. which screens they visited). A key difference between usage data and game relevant data is that usage data forms a chronicle of actions whereas game relevant data represents the game ‘state’. For example, the game relevant data for step counting in FIT was the total steps taken each day, and the usage data was when the pedometer was turned on and the times steps were taken.

- Processed data: Finally, we distinguished between ‘raw’ and ‘processed’ data. When analysing or otherwise sharing data, it is often necessary to process it (perhaps to aggregate usage data, or to anonymise the dataset).

It was not desirable, nor would it have been ethical to collect ‘everything’. For apps with hundreds or thousands of users, consideration needed to be made about the volume of data to be stored. Also, from a users’ perspective, transmitting log data could have used up (often limited) data allowances. Consideration also needed to be made of how updates and changes to the apps affected logging, and how the differences between the iOS and Android versions affected logging. In sum, the logging was not a technical, but a sociotechnical issue where design decisions had to be made about what to log and how.

### 3.1 Ethics of Logging

There were important ethical considerations in logging, and we sought approval from relevant University ethics committees before release of the apps. Our key considerations were:

- Informed consent. This is a key principle in any research involving humans. In both FIT and MyCity we supplied information about the data collection in Terms and Conditions pages, and required users to agree to these before playing. We also included information about the research within the app itself. We did not seek to force users to read this information or to verify they understood it, but simply to make the information available and clear.
- Relevance. A second key principle was that the data we collected should be relevant to the game and directly relevant to analysis. It is possible to gather a range of information, particularly from Android devices, but given the recognition that not everybody reads information pages in apps, and given our limited ability to verify that participants fully understand they are being logged, we sought only to gather data that we could reasonably expect to be useful.

As McMillan et al [[3]] point out, ethical guidelines from bodies such as the British Psychological Society and legislation such as the Data Protection Act are applicable and offer important guiding principles. However, there are many questions and challenges to address what McMillan et al call “app store research”. Ethical considerations in this area also do not stop with decisions about what data to collect, but extend to its management and analysis.

## 4. WHY COLLECT LOG DATA?

In our present work, there are two general reasons for collecting log data.

- Understanding physical activity: The purpose of both apps was to encourage people to walk, and one purpose of our data collection was to inform us about users’ walking. To an extent, the apps gave us insight into this. However, no matter how accurately our algorithms counted steps, it is clear that people download the apps to devices that were not carried at all times; for example, we saw users downloading to iPads and iPods. MyCity had an ‘always on’ pedometer and so gave a fuller picture of users’ daily activity than FIT, which had a pedometer that could be switched on/off at will. However the times at which people turned on and off the FIT pedometer, itself provides an insight into users’ activity.
- Informing design: Arguably, the primary purpose of data collection is not to understand activity, but to inform further design. In a sense, the apps we are developing are for users themselves to understand their activity and to be motivated to

do sufficient activity. Therefore, from that perspective we should be seeking to make apps that support them in engaging in activity. This includes presenting information in meaningful ways and making the game fun to play. It also includes identifying bugs and problems with the app, and identifying patterns of usage, and design opportunities. For example, the fact that just 25% of people who download the FIT app actually sign up, clearly demonstrates that the signup process requires further attention.

### 4.1 Towards an “Ecology” of mHealth

We have examined two apps, both on an individual basis. These apps have similarities, and clearly there is potential in exploring data across these and other apps:

- Can the findings from one app be used to inform the design and/or commissioning of other apps?
- Might different apps be found to suit different users, and/or people with different levels of experience with mHealth apps?
- For people using more than one mHealth app (which is common, see e.g. [[5]]), can physical activity be tracked across these?

Such questions might be asked not just of our two apps, but across many. A review of the global market estimated that there are over 97,000 mHealth applications in existence, around two thirds of which are targeted at consumers [[4]]. The NHS maintains an online “app library” (apps.NHS) and has approved several hundred apps for inclusion in this. NHS organisations have also funded the development of several apps (including The Walk<sup>1</sup>, and World Walking<sup>2</sup>). Many other mHealth apps have been developed by academic researchers, non-profit organisations as well as commercial companies. We suggest a grand challenge in healthcare computing is to find ways of looking across these, to perform an “ecology” of mHealth. This is a sociotechnical challenge, encompassing data science, design and health research. Clearly data cannot be collected from every single mHealth app, but in the future, we suggest apps commissioned by the NHS or publically funded research councils, and apps registered by the NHS apps library are encouraged to make data available for health research. This may in the future form an important source of evidence for public health policy.

## 5. CONCLUSION

We have given an overview of what data we have collected from two consumer mHealth apps and why we collect this. We suggest that this kind of data can usefully inform us about peoples health, and about how mHealth applications are used. We suggest that such data might in the future be collected at scale to inform public health. Consumer mHealth is in its infancy. Log data stands to act as an important source of evidence for this area - for improving, commissioning and recommending apps, and for insight in the population’s everyday activity.

## 6. ACKNOWLEDGEMENTS

The work reported in this paper is supported by the IT as a Utility (ITaaU) Network+, the Populations Programme (EPSRC EP/J007617/1), and EuroFIT (funded by the European Community’s Framework Programme Seven (FP7) Under Contract No. 602170 ‘EuroFIT’).

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<sup>1</sup> [www.thewalkgame.com](http://www.thewalkgame.com)

<sup>2</sup> [worldwalking.org](http://worldwalking.org)

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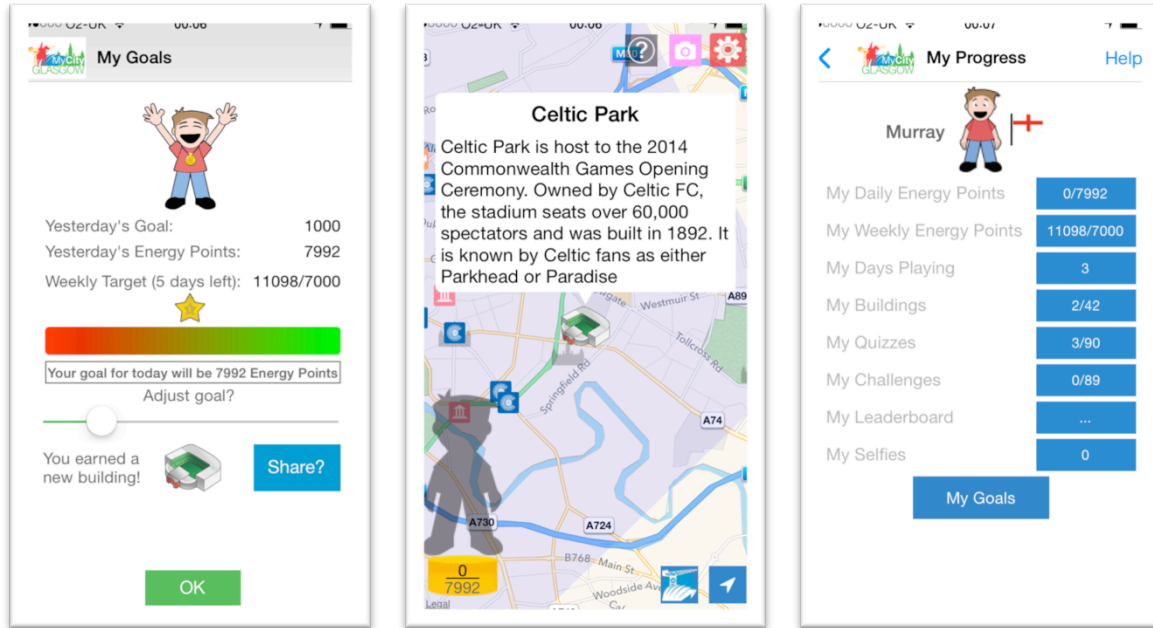


Figure 1: Screenshots from MyCity: Glasgow

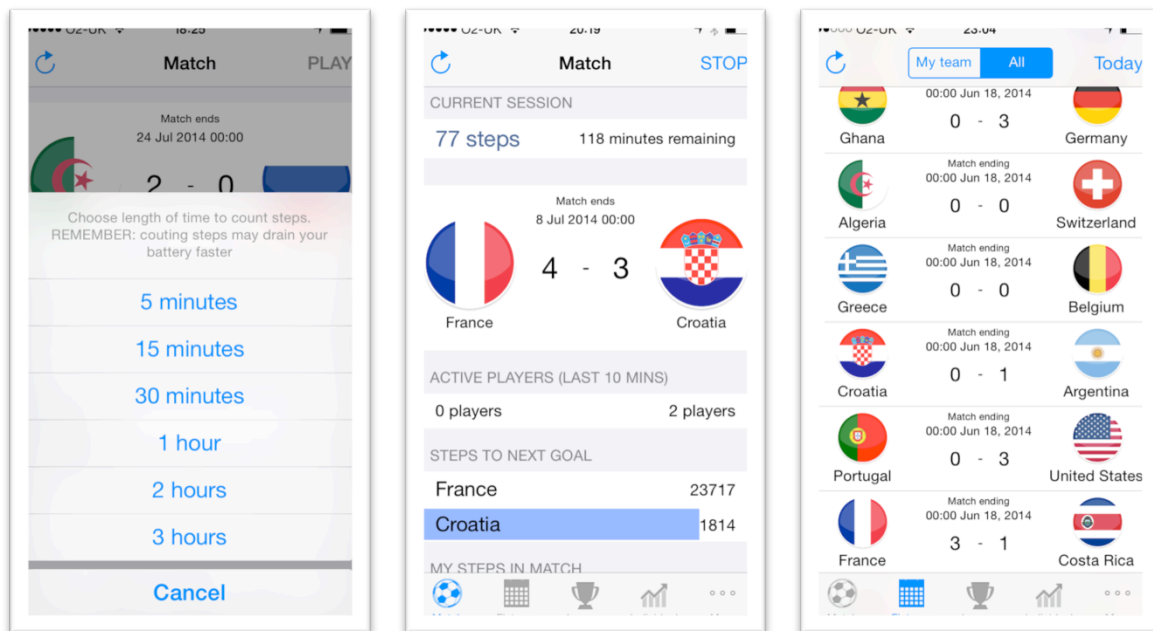


Figure 2: Screenshots from Fans In Training (FIT)