Transportation Research Part A 77 (2015) 126–136

Contents lists available at ScienceDirect

Transportation Research Part A

journal homepage: www.elsevier.com/locate/tra

The use of self-monitoring solutions amongst cyclists: An online survey and empirical study

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ARTICLE INFO

Article history:
Received 7 February 2014
Received in revised form 9 April 2015
Accepted 20 April 2015
Available online 16 May 2015

Keywords:
Cycling
Bicycling
Self-monitoring
Intervention
Wearable computing

ABSTRACT

Self-monitoring has been shown to be one of the most efficient behaviour change techniques to promote physical activity. However, there has been no research on the exact nature and impact of using various self-monitoring solutions (e.g. cycle computer, cadence monitor, smartphone' physical activity apps) amongst cyclists. Initially, an online survey was conducted with 227 adults who did or did not use self-monitoring solutions with their cycling. We found that the most important features for cyclists who use self-monitoring are: time it takes to travel, cycling speed, and distance covered. In contrast, cyclists who do not use self-monitoring perceived features related to location (e.g. directions with maps) as the most important ones. In a subsequent study we included self-monitoring solutions as a part of mixed-design, small-scale, longitudinal intervention aimed at changing transportation patterns. We found that self-monitoring is mainly suitable for performance oriented cyclists rather then recreational cyclists. We discuss the implications of those results for designing interventions to promote cycling.

1. Introduction

Self-monitoring can be defined as a fundamental behavioural self-control skill related to monitoring positively valued behaviours that one is encouraged to increase, and negatively valued behaviours that one is encouraged to decrease (Mcfall and Hammen, 1971; Kirschenbaum et al., 1982). The use of self-monitoring solutions for personal health and fitness (e.g. smartphone apps, accelerometer-based trackers, cadence monitors) has been on the sharp rise over the past few years (Swan, 2012). Research in the health sector has shown that self-monitoring solutions can facilitate positive behaviour change such as weight loss (Womble et al., 2004), and management of chronic illnesses such as diabetes (Williams et al., 2007), asthma (Shegog et al., 2001) or depression (Christensen et al., 2004). Self-monitoring interventions have also been applied in the domain of physical activity. For example, a recent review on behaviour change techniques used to promote walking and cycling found that self-monitoring and intention formation were the most frequently coded behaviour change techniques for those two activities (Bird et al., 2013). There is also some evidence that they work – a study by Baker et al. (2008) found that a pedometer-based self-monitoring walking program, incorporating a physical activity consultation, was effective in promoting walking and improving positive affect over 12 weeks in community based individuals. Another separate study by Merom et al. (2007) also showed that pedometers enhanced the effects of a self-help walking program.

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http://dx.doi.org/10.1016/j.tra.2015.04.010
0965-8564/

Self-monitoring is a particularly promising method for behaviour change in physical activities (such as cycling or jogging) because it can easily increase self-efficacy (Du et al., 2011) and reduce perceived barriers to start, or continue, the activity (Wilbur et al., 2003). In addition, giving people feedback on their performance increases the likelihood of continuing to produce positive behaviour (Bandura, 1997). Self-monitoring also reinforces an intrinsic motivation driven by an interest or enjoyment in the task itself rather than relying on external pressures or a desire for reward (Festinger, 1954).

However, there has also been a substantial criticism of consumer-level self-monitoring solutions championed as 'wearable computing'. This criticism oscillates most prominently around problems with the affordance and usability of self-monitoring technologies, and issues of privacy and ownership of collected self-monitoring data. For instance, recent surveys in the US show that there is a 35% drop in the use of tracking devices after only 3 months – and more than 50% drop after 12 months (Ledger and McCaffrey, 2014). Existing evaluations indicate that the reason for such high drop rates may be that self-monitoring technologies become 'solutions in search for a problem' and do not provide users with a genuine structure for behaviour change, seamless integration with their daily routines, or sufficient long-term value (Swan, 2012). Privacy and data ownership issues are another aspect that is highly neglected in the context of commercial applications of self- monitoring solutions. Data collected from users' activity on smartphones and consumer wearable sensors can serve to decode identity (de Montjoye et al., 2013) or create psycho-demographic profile (Kosinski et al., 2013). At this point it is still a grey area in privacy laws, and typically individuals who use self-monitoring solutions such as *Nike Fuelband* or *FitBit* have to agree for their data to be collected, processed and stored by company that provides specific solution. These companies frequently utilise such data for their own goals; for instance *Strava* (a cycling mobile application or 'app') not only conducts "big data" analytics that can serve a unique insight into cycling patterns around the globe (Strava, 2014), but they also sell "anonimysed" data sets to other companies. This can potentially lead to data abuse from broad range of industries; for instance, healthcare insurance companies could use such personal information to identify 'risky' individuals.

Anecdotally, we know that cyclists frequently use different devices or smartphones in order to monitor, record and share information such as their cycling paths, speed or the distance they cover when cycling. For many cyclists, their bicycle is a mean of transport in which they invest a substantial sum of money and effort to maintain in good condition or to upgrade the components. There is a multiplicity of devices and services available on the market with a broad range of sophisticated self-monitoring and feedback features such as measuring heart rate, (e.g. *Garmin Forerunner* smartwatches), detailed speed and distance traveled (e.g. accelerometers and altimeters in majority of smartphones), mapping locations (e.g. GPS enabled devices), and setting up performance goals with the sharing of achievements on dedicated social networking sites (e.g. smartphone apps such as *Strava* or *Runkeeper*). Cyclists can now use a single device (e.g. *Apple iPhone*) or interconnected set of devices (e.g. *Apple iPhone* connected with *Nike Fuelband*) to enable a broader range of self-monitoring functions. Applying a wide range of tracking sensors and feedback solutions embedded in devices such as smartphones or smart wearable devices eliminates the tedium of conscious self-monitoring and can help people to achieve predetermined goals or outcomes (Fogg, 1999, 2003). Despite the claims that such devices have a powerful potential to change behaviour, there has been limited research into either their general effectiveness or the use of personal tracking solutions in cycling (see conclusions from review by Bird et al., 2013). There has been no research carried out that compares cyclists who use personal tracking solutions and those who do not.

The research described in the present paper begins by investigating what people use for self-monitoring in cycling and how they use it. In the first study, we conducted an online survey looking both at cyclists who use and those who do not use tracking solutions, in order to establish the attitudes cyclists have towards such technologies. The survey also enabled us to extract a set of commonly used features of the apps and devices in cycling and identify features perceived as important by cyclists who do not use self-monitoring apps or devices. Results of this survey helped to inform a second study that used a mixed-method approach with in-depth interviews, quantifiable measurements of bicycle use and detailed socio-demographic questionnaires over five week period to specifically examine how people use self-monitoring solutions in the real-world conditions. The aim was to explore whether self-monitoring solutions can have a facilitating and reinforcing role in increasing cycling engagement, or frequency, and are there any specific personal conditions that make such self-monitoring solutions more efficient when used for the interventions to promote cycling.

2. Study 1: Online survey on the use of self-monitoring solutions by cyclists

2.1. Methods

A total of 227 participants (82 female and 145 male) were recruited to take part in an online survey. Participants were recruited using short invitations posted on social networking forums dedicated to cycling and fitness (e.g. *Cycling Forums*: http://www.cyclingforums.com) and general interest groups on *Facebook* and *Twitter*. The only requirement for participation in the survey was that the person cycles – even if he or she cycles very rarely. The study received ethical approval from the University Ethics Review Board.

The survey was constructed using the *Qualtrics Research Suite* (Qualtrics, 2013) and it took approximately 10 min to complete. Each participant was presented with a brief instruction on the purpose of the study and the approximate time needed for completion. We also included a message instructing survey participants that the information they provided is secured under the Data Protection Act 1998. Participants were asked to confirm that they understood the instructions by ticking a