IN SITU STUDY OF CONTEXTUAL FACTORS INFLUENCING USE AND NON-USE OF TECHNOLOGY IN THE GYM

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ABSTRACT

The importance of the design of interactive technology for sports and exercise has increased with new available fitness technologies such as the Samsung Gear Fit. However, research has not focused on studying the technologies in the real world context of use. Therefore this exploratory study takes a situated approach in investigating how people do and do not use such fitness technology during exercise within the context of the gym. The first stage of the study was an autoethnography with the Samsung Gear Fit device. The main user study involved 11 participants; four female, seven male between the ages of 21 and 35, who were adopters of wearable devices or fitness applications and members of a university affiliated gym. Participants were interviewed in the context of the gym and observed during their exercise session in the gym. Findings discovered varied use and non use of technologies in the gym, used both for fitness reasons or otherwise. This was found to be influenced by factors such as the complexity of the physicality of the gym and individual differences in motivation and preferences towards technology use. Findings emphasize the importance of situated studies especially to inform the design of future wearable technology for fitness.

CONTENTS

CHAPTER 1. INTRODUCTION

It is well known that regular physical activity is essential for a good state of health and wellbeing. It brings about a range of physical, social and mental health advantages, which are important for both the individual as well as society (Albinali, Intille, Haskell, & Rosenberger, 2010). The topics of exercise, fitness and wellbeing have been an increasingly popular topic of interest in the Human Computer Interaction (HCI) community. For example, CHI conference (International conference on Human Factors in Computing Systems) 2014, included workshops concerning HCI and Sports as well as the Quantified Self for health and fitness (Nylander, Tholander, Mueller, & Marshall, 2014; Meyer, Simske, Siek, Gurrin, & Hermens, 2014).

There has been a lot of emphasis on fitness within the domain of persuasive technology; designing technology with the aim of encouraging people to engage in physical activity. This includes the design of computer supported physical games (Chi et al., 2005), ubiquitous computing (Albinali et al., 2010), the development of fitness device architectural systems (Gupta & Jilla, 2011), virtual trainers (Buttussi, Chittaro, & Nadalutti, 2006) and interactive social computer games (Lin, Mamykina, Lindtner, Delajoux, & Strub, 2006). There has also been an increase in technologies in relation to personal informatics (Klasnja, Consolvo, & Pratt, 2011). This includes the growth in mobile applications and wearable devices that have embedded activity tracking functionality to track fitness activity, such as the Samsung Gear Fit[1].

Many HCI studies have been concerned with the user evaluation of these persuasive fitness technologies which entails focusing on the user experience of a specific technology. Evaluations are sometimes carried out in isolation; more so for studies taken place in a laboratory setting (Kientz et al., 2010). Evaluation studies do not tend to look at the user's behaviour as a whole; they may ignore the user's interaction with other features in their environment including other types of technology present in the situation, which may or may not be fitness related. Nonetheless in real life, people may

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[1]www.samsung.com/uk/consumer/mobile-devices/wearables/gear/SM-R3500ZKABTU

not use just only one type of technology at a point in time; it has been discovered that some people interweave their use of different activity trackers (Rooksby, Rost, Morrison & Chalmers, 2014).

It is apparent that the focus of exercise and technology literature in HCI is predominantly situated in the subject of designing and evaluating particular persuasive technologies for exercise behaviour. However, a view of the bigger picture is needed, beyond looking at the use of a particular fitness technology in isolation. There is limited exploratory style research in investigating *how* and *why* different people use and do not use fitness related technology, as well as non-fitness related technology, in a real world context. As part of the User Centred Design process (Rogers, Sharp & Preece, 2011), it is crucial to first gain an in-depth understanding of user's behaviours, goals and needs regarding how people use technology to achieve their tasks in order to inform the design of interactive technologies to be able to support these tasks. It is therefore necessary to explore how people naturally use technology during exercise in order to inform the design of new fitness wearable devices.

Users' behaviours and needs regarding health and fitness technology have been investigated in many different ways, such as through the use interviews and diaries that provide self-reported and retrospective data (Rooksby, Rost, Morrison, & Chalmers, 2014). Yet it is disputed that these methods are not appropriate for investigating technology use as behavioural insights are obtained after the interactions occur and independent of its context. As a result such methods do not elicit comprehensive information about the actual behaviour as it happens in the real world (Brown, McGregor & Laurier, 2013).

Examining interactions with technology within the context of use is crucial as it is believed that user actions are fundamentally embedded within a particular situation (Suchman, 1987). Context is an ever-changing notion (Dourish, 2004) and people's behaviour is derived through how they respond to their environment at a specific time. In light of this, it is suggested that the most appropriate way to understand people's interactions with technology is to study technology use within the real context where the actions actually occur. This promotes an 'in the wild' approach to research (Rogers, 2011) which is especially necessary for research into the use of fitness mobile

applications and wearable devices, as they are designed to be used in an array of uncontrollable and diverse settings (Dourish, 2001).

Previous research has looked into the use of specific fitness technology outside of the gym setting, whereas within other domains, there have been some exploratory situated studies investigating general technology use within larger contexts including the workplace (Bardram, 1997) or the home (Blythe & Monk, 2002). Nevertheless, there is no evidence of exploratory research that investigates people's interactions technology within the context of the gym. Questions remain, for instance what prompts technology use? Are there situations of non-use, where technology is present but people cannot use or choose to ignore it? What is the purpose? How might the technology use be influenced by the gym setting? In regards to insights by Brown et al. (2013), a situated action approach must be taken to address the gap in our understanding of real world behaviours and the current usage of fitness as well as non-fitness related technology in the gym.

1.1 Aims

The research aims were to uncover the different uses and non-uses for technology in the gym through using a situated action approach. This entailed using field research methods consisting of an autoethnography, contextual interviews and participant observations; these data collection methods allow exploration of behaviours within the context of use. This study consisted of two phases: a four week autoethnography study to obtain first-hand experience of the subject area that was being studied, followed by an interview and observation study with 11 participants in the context of the gym.

This paper is potentially of use to general HCI practitioners and researchers who plan to investigate the use of or design fitness technology as it demonstrates the benefits of using a situated action approach to study user behaviour during exercise. This is critical to understand for the appropriate design of future interactive technologies such as wearable devices for fitness.

The paper presents a concise review of the existing literature on fitness technologies and in HCI in the field of exercise and technology, followed by the theoretical, methodological and analysis approaches that the study used. Subsequently, a description

of the study settings, procedures and results are presented. Following this is the discussion of results including limitations of the study. Finally, the conclusion of the study including the implications of findings towards future research is presented.

CHAPTER 2. BACKGROUND AND RELATED WORK

This chapter first takes a brief look at sports psychology and behavioural change theories in general. Following this, a summary of technology in the gym is presented and then an overview of research in HCI that has investigated technology use to view and evaluate methodology of existing work related to the topic of the current study.

2.1 Sports psychology and behavioural change research in fitness

Exercise is well studied in the domains of sports psychology and behaviour change literature. The concepts behind some persuasive technologies to support physical activity are loosely based on health behaviour change theories featuring elements of social support, motivation and self efficacy. Some of the literature is briefly outlined here, including the topics of motivation, activity monitoring, goal setting, flow and music.

Motivation is a key feature in exercise behaviour and can account for individual differences in behaviours inspiring people to engage in exercise. Intrinsic motivation is described as performing a behaviour for its own sake (Vallerand, 2007); exercising for the enjoyment of the experience. It has been shown that performance feedback and having a personal choice to the type of music to listen to influences situational motivation. On the other hand, extrinsic motivation is doing something as a means to an end as opposed to for its own sake (Vallerand, 2007), for instance, exercising for the purpose of rewards such as achieving a weight loss target or winning a competition.

In relation to motivation literature, it has been found that tracking one's activity is a beneficial for fitness behaviour change (Speck & Looney, 2001). Setting goals for oneself is also a well known strategy that has been shown to contribute towards

behaviour change (Locke & Latham, 2002) for fitness activity (Cobb, Stone, Anonsen, & Klein, 2000). The design of many mobile fitness applications evolve around activity tracking and goal setting with the aim of increasing user's physical activity (Consolvo, Everitt, Smith & Landay, 2006).

As well as the influence of individual personal goals on motivation, research has also demonstrated the motivational effects of external stimulation during physical activity. Engaging in technology for entertainment such as watching TV and listening to music has been discovered to have positive psychological and physiological effects on exercise performance (Annesi, 2001). In a review, Karageorghis & Priest (2012) summarised that during repetitive, endurance-related anaerobic activities, listening to self-selected motivational music demonstrated ergogenic (performance enhancing) effects, for instance, an increase in stamina. Music was found to reduce perceptions of exertion; it is hypothesized that this may be due to the 'dissociation' effect in which music distracts attention away from the pain associated with the exercise (Yamashita, Iwai, Akimoto, Sugawara, & Kono, 2006). Another way in which music has been shown to increase performance is through the characteristics of synchronous music, whereby the rhythm of the music moderates movement patterns (Anshel & Marisi, 1978; Karageorghis, et al., 2009).

Other theoretical concepts that relate to the individual's experience during exercise is 'flow'(Petosa & Holtz, 2013). 'Flow' is a positive state of mind characterised by complete immersion and absorption in an activity (Csikszentmihalyi & Csikzentmihaly 1991). Research has mentioned the positive effects of 'flow' on physical activity adherence (Petosa & Holtz, 2013)

2.2 Technology in the gym

Dedicated activity areas of gyms have long been integrating fitness tracking technology within the exercise facilities in order to measure and motivate an increase in user's performance. Exercise machines, such as the treadmill, measure activity as the interactive display shows distance, time, heart rate, calories and has various options for automated workouts. The visual display on some machines, such as the rowing machines, may include performance visualisations and games for entertainment.

Recently, some gyms have implemented heart rate tracking wearable systems that allows for individuals to track and share their performance statistics across all kinds of equipment, for example 'MYZONE' in Virgin Active gyms (Alger, 2012).

The focus of design literature for technology in the gym is mainly on the biomechanical and human factors aspect (Culén, Finken & Bratteteig, 2013). However, there is not much research on gym technology concerned with HCI and investigating what influences people's preferences for use of these technologies.

2.3 Fitness related work in HCI

As well as within behavioural science, fitness research in HCI is growing in popularity. This section reviews the literature on technology use for fitness including personal and fitness informatics and then studies evaluating fitness technology and general exploratory studies within the realm of health and fitness.

Personal and fitness informatics

Personal Informatics and the Quantified Self within health and wellbeing involve collecting and using personal data, usually derived from tracking and life-logging devices. During recent times the emergence of health and fitness tracking technology has grown (Gittleson, 2013). In light of this, fitness tracking functionality, such as heart rate monitors, accelerometers, pedometers and GPS (to track outdoor running and cycling), are being added to mobile and wearable devices such as Smartphones and Smartwatches. An example of a fitness tracking Smartwatch is the Samsung Gear Fit; this device tracks everyday activity such as the number of steps, presenting values to the user such as calories burnt and distance achieved. There has also been a huge growth in mobile sports and fitness Smartphone applications (Khalaf, 2014).

There has been some research investigating behaviour relating to the use of personal informatics technology for general health and wellbeing. Ahtinen, Ramiah, Blom, & Isomursu (2008) conducted a cross-cultural field study involving a technology probe where participants recorded subjective experiences about their use of a wellness mobile

app (the Wellness Diary) for two weeks. Findings showed that cultural and environmental factors influenced user needs and usage of the application.

Similarly, Rooksby et al., (2014) explored the area of 'lived informatics' in terms of the ways in which people use health and wellbeing activity tracking devices they have already adopted. The self-reported study used consisted of an unstructured interview and a follow up interview a month later. Several categories of tracking behaviour were identified, including documentary tracking (where participants track their activity for reasons such as facilitating understanding of their activity or sharing their stories with others) and goal driven tracking (where participants track their activity in order to change their behaviour).

HCI evaluation studies and exploratory research

The majority of HCI research that investigates technology use and exercise is for the purpose of evaluating particular fitness technologies. Ahtinen, Isomursu, et al., (2008) examined the user experience of a mobile outdoor sports tracking application (Sports Tracker). Usage habits and user experience data for existing users of the application were collected through the use of one time phone interviews and text-message questionnaires lasting two weeks.

In contrast to the use of self-reported and retrospective methods used in the mentioned studies so far (Rooksby et al., 2014; Ahtinen, Isomursu, et al., (2008), the following studies used an 'in the wild' approach towards the evaluation of mobile fitness technology. Consolvo et al. (2006) conducted a field evaluation of Houston, a mobile application that enables step count tracking to enhance users' physical activity levels. A three week in situ evaluation study was implemented where participants used the application, were interviewed about their experiences, completed questionnaires and daily records of step counts.

Another system that was evaluated in a similar way was the UbiFit Garden system, (Consolvo et al., 2008), a mobile application along with a fitness device which displays a visualisation of the user's physical activity. The evaluation of the system was run on phones that participants used and they were interviewed to examine their user experiences.

Additionally, Temir (2013) carried out a four-week exploration evaluation of two commercially available running applications through the use of a mixture of field testing techniques, contextual interviews, diary studies and autoethnography. This situated method of research enabled the discovery of various situated influences of use in the context of outdoor running.

Nevertheless, these studies have focused on investigating the use of particular technology to be evaluated. There are only a limited number of studies within the HCI literature that take a more open, exploratory approach in examining general user behaviour in the domain of health. Fritz, Huang, Murphy, & Zimmermann (2014) investigated the behaviour of long-term users of activity monitoring devices to find out how they use their devices, however they only used interview data. On the other hand, Goodman (2006) used more extensive methods to explore people's health issues and behaviours in order to discover ways in which health technology could be designed to support exercise behaviours. The study analysed blog readings, participant interviews and diary reports for activity logging, as well as pedometer data and cameras for which participants used to document health-related features of their lives.

2.4 Summary of Literature

In summary, research has shown the relevance of sports psychology and behaviour change theories in understanding aspects underlying exercise behaviour and its relevance towards the design of fitness technologies. There is existing research that investigate the use of personal informatics and the user experience of particular fitness technologies, however, there are few studies exploring general health behaviours. There is a lack of evidence of exploratory HCI based research on the use of technologies in the context of the gym.

Furthermore, despite a few studies (Consolvo et al., 2006; Temir, 2013), many investigations looking at technology use in this review did not carry out contextual research. The methods that were primarily used consisted of post-hoc interviews, diaries, experience sampling methods and logging devices (Ahtinen, Isomursu et al., 2008; Rooksby et al., 2014). These methods are deemed unsuitable for studying interactions with technology as the data are based on retrospective and self-reported

information rather than the actual behaviour as happens in the real world, during real time (Brown & Laurier, 2013). Additionally, retrospective reports lack detail and may not capture every occurrence of use as they are susceptible to report bias, where recall is dependent on what the participant remembers and considers relevant (Ainsworth et al., 1998). Logging devices can obtain data at the point of use, but they only provide a conceptual outline of device usage and produces descriptions of only general use rather than understanding particular accounts of use (Brown et al., 2013). Moreover, the use of these methods undermines the pertinent role of the environment and situation of the activity in influencing interactions with technology (Rogers, 2011).

Contrary to these non-contextual methods of studying technology use, Brown et al. (2013) took on a situated approach towards documenting use of mobile phone maps. This was achieved through the implementation of video data methods such as screen-captures of Smartphone use along with video recordings derived from wearable cameras that participants used whist in their natural settings. Findings uncovered that mobile use was influenced by the events of particular situations, thus promoting the importance of a situated based study for the investigation of mobile technology usage. In light of the appropriateness of the approach used by Brown et al. (2013), the current exploratory research warrants a situated approach in investigating technology use in the gym. The following chapter will discuss the approaches that the study took to address this gap in research.

CHAPTER 3. STUDY APPROACHES

This chapter reviews the approaches that were taken in the current study. Firstly, the theoretical approach is discussed, followed by the methods approach and finally, the data analysis approach.

3.1 The Theoretical Approach

The theoretical approaches outlined are the Situated Action Theory (Suchman, 1987) which underlies the view of context that is applied within HCI research (Dourish, 2004). In relation, the 'in the wild' approach (Rogers, 2011) to research is then described.

Situated Action Theory

The Situated Action Theory (Suchman, 1987) argues that people's actions (thus, interactions with technologies) are executed in the course of everyday activity, therefore opposing the notion originating in cognitive science that behaviour is determined through a person's pre-determined goals and plans of action. The theory emphasises that a person's environment is a fundamental shaper of their behaviour; it is also believed that human activity is improvisational in the way they specifically respond to their environment (Lave, 1988). This implies that people's interactions with technology are manipulated by the context of particular situations in the gym and the actions are unique to specific situations, time and place. It is therefore suggested to conduct and analyse in-situ research through conducting moment-by-moment observations of everyday activities where the actions of the user are integrated within realistic and critical contexts of usage (Suchman, 1987), such as the gym.

Context in HCI

Dourish (2004) relates the situated action approach towards the understanding of context within the HCI. Context is seen not as a singular and static concept but as being dynamic and relational to situational factors. Dourish (2004) presents a multi-faceted

account of context; in the case of exercise, context is a mixture of an individual's physical environment, social interaction, emotions, exercise experience, goals and technology used to facilitate exercise in the gym. Moreover, these factors are all particular to a specific situation.

With this view of context, Dourish (2001) criticises context-aware computing, where sensors are used to automatically be aware of and respond to environment in which the technology is integrated. Dourish (2001) considers that this approach to technology design to be unsuitable within certain situations because these technologies cannot account for the complexities within a constantly variable context. He states that the design of context-based computing should consider sociologically motivated explorations of interaction.

'In the wild'

Taking a situated action approach to research links to studying "cognition in the wild", which means human cognition in its natural surroundings (Hutchins, 1997). This can be explored through adopting 'in the wild' methodology which aims to understand everyday living through studying interactions with technology in situ (Rogers, 2011). This involves implementing field research methods to allow the observation of natural behaviour in a real environment as opposed to in an artificial lab setting (Marshall et al., 2011) where the focus is on the whole activity as opposed to only on the device (Bly, 1997).

The use of self-reported retrospective methods such as interviews and diaries, as evident in previous fitness technology use studies, (Ahtinen, Isomursu, et al., (2008) are unsuitable for studying real life behaviour. They undermine the pertinent role of the environment and situation of the activity in influencing interactions with technology and therefore do not allow for the capture of contextual use of technology. Rogers (2011) argues that human behaviour is unpredictable and there is a difference between what people say they do and what they actually do in the real world. Observing action within the relevant context therefore enables discovery of how individuals come to understand

and appropriate technologies to their own terms and for their own situated purposes (Consolvo et al., 2007).

In regards to the advantages discussed of these theoretical approaches, it was considered that field research was the most appropriate method in investigating how people use technology during exercise in the real world gym.

3.2 Methods Approach

This section will discuss the methodological approach taken towards carrying out the current situated study. Suchman (1987) traditionally proposed video recording studies as a required method for a situated action study; this method was also supported by Brown et al., (2013). However, Randall, Harper & Rouncefield (2007) argue that it is important to have a more open and flexible view towards research methods as it is not possible to video record participants in all situations, especially in the context of the current study of a public space of the gym, where there are privacy and consent issues. The methods for the current study consisted of autoethnography, contextual interviews and participant observations. Finally, triangulation of methods is described.

Autoethnography

Autoethnography is a qualitative self study, a form of ethnography; an investigation of phenomena within the context of use of the system acquired through the researcher's own personal experience (Ellis, Adams, & Bochner, 2011). It entails the exploration of use of the system through explicit personal narrative reports on the activities, thoughts, emotions and sensory experiences within different contexts (Ellis & Bochner, 2000), towards an objective perspective on self behaviour (Cunningham & Jones, 2005). This therefore also facilitates gaining empathy with the user of the system (O'Kane, Rogers, & Blandford, 2014). This method can elicit subtle insights which can inform reasons for adoption and use of a system that may have not been discovered without having experience of use of the system. The findings from autoethnography may provide possibilities of topics of what the researcher may want to investigate from the users and

so is useful for the planning of future user studies (O'Kane et al., 2014). Nevertheless, this autobiographical approach to the documentation and interpretation of activities inevitably imposes researcher bias (Duncan, 2004). For this reason, the autoethnography study was triangulated with other methods, including contextual interviews.

Contextual interviews

Interviewing participants allows the researcher to discover and understand past experiences of activities in the gym. Contextual interviews are interviews held within the context of where the behaviour of interest usually happens, in order to gain understanding of the participant's environment (Holtzblatt & Jones, 1995). The environment provides cues that help the participant remember details about their behaviours in the context, thereby aiding the researcher in comprehending participants' experiences (Holtzblatt & Jones, 1995).

As the study was exploratory, semi-structured interviews (Gillham, 2005) were chosen as they allow for some focus on the goal of the study yet also enable rich and detailed exploration of insights of the underlying behaviours, motivations and needs (Rogers et al., 2011).

Participant observations

Rather than rely on self-reported interview data only, the study involved directly observing and documenting the behaviour of the participant when they were exercising in the gym. This enabled in-depth insight into what people do and how they interact with technology whilst exercising in their usual setting (DeWalt & DeWalt, 2010). With this method of observation there is no enforced predetermined structure and so the situation is viewed with a perspective of 'fresh eyes' (Lazar & Preece 2010). In addition, the researcher and participant engaging in dialogue can add richness to the observation notes (Wright & McCarthy, 2008).

Triangulation of methods

Triangulation describes the use of multiple approaches to attend to the same research question (Mackay & Fayard, 1997). The qualitative methodologies used in the current study are subjective as they are constructed upon opinions and emotional data; these methods used alone can be interpreted to be lacking in reliability and validity (Cunningham & Jones, 2005). This necessitates the implementation of triangulation of methods and analysis as a way of increasing the reliability and confidence in findings (Wong & Blandford, 2003).

3.3 Data analysis approach

A grounded theory approach was implemented and thematic analysis (Braun & Clarke, 2006) was used as a coding technique for the analysis of the gathered data. This section will briefly discuss these approaches of data analysis taken in this study.

Grounded Theory

Grounded theory (Glaser & Strauss, 1967) is a qualitative, exploratory method (Barkhuus & Polichar, 2011) used to form a theory grounded in the gathered data (Braun & Clarke, 2006). It involves the iteration of data collection and analysis where the data is collected based on the emerging theory (Rogers et al., 2011). It entails the relationship between the theoretical concepts and the subjective interpretations, at the same time obtaining consensus with the data (Pidgeon & Henwood, 1996). An exploratory grounded theory was used in the current study to develop insights into how and why people use certain technologies in the gym, as no previous research have provided a strong hypothesis regarding this.

Thematic analysis

Due to the exploratory approach of the study, thematic analysis was chosen as the coding technique for the systematic analysis of the gathered data. It provides a rich description and allows for themes to emerge from the data (Braun & Clarke, 2006). As

the study lacked a formal hypothesis, it was important restrictions on data analyses were not imposed as to influence the data insights of the research.

CHAPTER 4. METHODS

This chapter discusses the method that the study took in gathering and analysing the data. It involves a description of the context of the study of the gym, followed by the autoethnography study, then the procedure for the situated user study which consisted of contextual interviews and observations of participants in the gym. Finally the data analysis and ethical considerations are outlined.

4.1 Context of the study

The study took part within Bloomsbury Fitness, a gym that is located in the University College London campus, but is open to the general public. Permission was gained from the gym to recruit members for the study. Bloomsbury Fitness is a relatively basic gym in regards to the facilities and technology available, in comparison to other exclusive and more expensive gyms in central London. It is comprised of five main areas machines for aerobic exercises (including treadmills, cross trainers, elliptical trainers and exercise bikes), resistance machines, free weights and a mat area for stretching or body weight exercises (as seen in Figure 1 and 2). Upstairs is an area for group classes. Aerobic exercises are activities that involve movements of the arms and legs where the muscles are used in constant rhythmic or repetitive movements, heightening heart rate and respiration; an example is running. Interval aerobic training consists of systematic fluctuation of speed. Anaerobic exercises comprise short bursts of intense exertion such as weight lifting. Recovery breaks are usually taken in between exercises where the person is simply waiting around; we refer to this as 'dead time'. On the wall in front of the aerobic machines are a set of mirrors and five television screens which display various programs along with subtitles; there is no option to be able to listen to the TV through earphones. Loud, popular music plays through speakers around the whole gym area.

Figure 1. Photo of Bloomsbury gym[2]

Figure 2. Diagram showing the gym layout

4.2 Autoethnography

The initial phase in this research was a four week autoethnography study with the
Samsung Gear Fit; a wearable Smartwatch device geared towards fitness tracking
(Figure 3). The device includes a pedometer, heart rate monitor, coaching for running
and allows for Smartphone notifications. The purpose of this autoethnography was to

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[2] Picture taken from: http://uclu.org/facilities/bloomsbury-fitness/gym-facilities

obtain an in-depth understanding of the various contexts of everyday use of a fitness related wearable device. My experiences and emotions relating to its use were documented in the form of text at the end of every day. The self-reported diary studies were analysed and the insights that emerged from this formulated topics of interests that helped to form the user study by inspiring research questions.

Figure 3: A photo of myself wearing the Samsung Gear Fit

4.3 Contextual user study

Participants

Participants were recruited through posters put up on a notice board in the gym and around the University campus. Participants were only recruited if they currently use or have used wearable technology or fitness applications and were members of the gym. This ensured participants had prior experience with using tracking technology and the facilities in the gym to prevent the additional extrinsic motivation of making them exercise or adding technology only for the purpose of the study (Pelletier et al., 1995). Participants were financially compensated with £10 cash on completion of the session.

The study consisted of 11 participants; four females and seven males between the ages of 21 and 35 years (mean age of 26 years). Nine participants were students and two were professionals, all currently living in London. All had experience with fitness related technologies. Eight participants currently owned or had used a wearable device

including: Fitbit[3], Nike Fuelband[4], Sony Smartband[5], heart rate monitor and pedometer. Five participants occasionally use a Smartphone application for tracking running or diet. Eight participants brought in their Smartphones to the gym to listen to music, watch TV, messaging and social media, or as a tool to record their exercise. Table 1 displays participant demographics and key information; pseudonyms are used for the participants to preserve anonymity.

Table 1. Participant demographics and key information

Participant	Gender	Age	Fitness motivations	Experience with fitness technology	Technology use in gym	Activity in the gym
Helen	F	25	Health, prevent weight gain, stress release	Fitbit, previously used fitness application	Smartphone for music, machine display	Cross-trainer. Prefers group classes
Nigel	M	25	Health	Sony Smartband, fitness application	Smartphone for Audio books and music,	Treadmill, rowing machine, free weights, resistance machines
Andy	M	29	Health, stress release, hobby	Smartphone diet application, previously used	Smartphone for diet application, machine display	Treadmill, free weights

[3] http://www.fitbit.com/uk/flex
[4] http://www.nike.com/gb/en_gb/c/nikeplus-fuelband/
[5] http://www.sonymobile.com/gb/products/smartwear/smartband-swr10/

				Pedometer, Kayak activity tracker		
Sammy	F	23	Weight loss	Fitness application	Smartphone for messaging and music, machine display	Elliptical trainer, resistance machines
Juliette	F	24	Weight loss	Fitbit, diet application	Smartphone for TV and music	Elliptical trainer
Dan	M	28	Health	Previously used fitness application and heart rate monitor	Machine display	Cross-trainer, free weights
Jake	M	23	Health	Phone calendar for recording activity, previously used pedometer	Smartphone for TV and music	Treadmill, resistance machines
Kevin	M	22	Health, hobby	Heart rate monitor, heart rate variability monitor	Heart rate monitor, machine display	Exercise bike, treadmill, rowing machine, free weights
Harry	M	30	Health	Nike	Smartphone	Treadmill

				Fuelband	for social media and web-browsing, machine display	
Martin	M	35	Health	Nike Fuelband	Smartphone for music	Free weights
Marie	F	24	Health, appearance, stress release	Heart rate monitor, fitness application	Heart rate monitor, machine display	Treadmill

Procedure

To test and refine the chosen methodology, two participants (who fulfilled the recruitment criteria) took part in pilot studies. Data from pilot study was not directly included in the results of the main user study as the participant observation changed significantly after their participation, but the findings did contribute to the overall analysis.

The main user study involved three different data collection phases for each participant:

1. Entry briefing and contextual interview
2. Participant observations and dialogue during exercise
3. Exit contextual interview and debrief

Entry contextual (semi-structured) interviews

The semi-structured interviews lasted for 30 minutes and were conducted in the gym reception area, next to a big window with a view of the gym (see Figure 4). In this way, participants were able to point to a specific machine that was being referred to in the interview. The purpose of the interview was to gain understanding of how they currently perceive their use of technology during exercise. An initial interview script for the first interview was generated as a product of the autoethnography and pilot

interviews and was used to guide the interview; the interview script can be found in Appendix 1. Questions involved asking about demographics, participant's experience of various technologies during exercise and the impact of technology on their exercise behaviour. Interviews were semi-structured in the aim to develop rapport with participants and for them to feel comfortable to talk about themselves and experiences. The interviewer would sometimes prompt the participant to keep focus on relevant conversation. Interviews were audio recorded to facilitate the verbatim transcription.

Example of questions:

1. What are your motivations for exercise; why do you attend the gym?
2. What type of wearable technology or fitness applications do you use or have you used in the past?
3. Do you think the use of this technology impacts on your exercise behaviour?

Figure 4. The view from the table where interviews were held

Participant observations and dialogue

Immediately after the interview, the researcher carried out observations of the participants whilst they performed their usual exercise regime in the gym to capture

routine behaviour. Participants were asked to engage in dialogue where they verbalised their current actions, thoughts and feelings to enable the researcher to understand their experience and motivations underlying certain actions. Observations lasted the duration of the participant's exercise routine but no longer than one hour. The researcher was dressed in wokrout clothing and was situated near the participant on an exercise machine in order to blend in with other gym users and not make the participant feel uncomfortable with being directly observed. Observation and dialogue notes were written on a mobile phone.

Exit contextual interviews

Post-interviews were conducted immediately after the participant observations and lasted for about 10 minutes, taking place in the gym reception. The researcher clarified any questions about the participant's observed behaviour and summarised the information gathered from the interview and observation.

Data analysis

Iterative data gathering and analysis proceeded as such: the researcher interviewed and observed the participant, the interview and observation was immediately transcribed and then coded. Throughout the analysis process, I recorded emerging themes and insights which then accordingly formulated and altered the questions for the subsequent interview. After the analysis of the 11th participants' data, theoretical saturation was reached (Henwood & Pidgeon, 2003): no new insights or additional conceptual development were emerging from the data and so data gathering was discontinued.

The data analysis process took part in four stages, loosely following the phases of thematic analysis as summarized by Braun and Clarke (2006) to prevent weak or unpersuasive data analysis and promote methodologically sound practice. This process also follows the stages outlined in the Grounded Theory (Corbin & Strauss, 1990).

1. I transcribed the audio recordings verbatim and familiarised myself with the data to gain a sufficient understanding and forming initial interpretations of the data prior to coding (Braun & Clarke, 2006).

2. Open coding of the data between each interview; highlighting and labelling salient statements from the contextual interview, observations and autoethnography diary notes into relevant codes.

3. Axial coding process where the identified codes and concepts were categorised systematically. This was completed through transferring the codes and concepts on to sticky notes producing an affinity diagram (Hartson & Pyla, 2012). This helped to visually systematize the codes into a hierarchy of concepts and themes (Rogers et al., 2011). Following a grounded theory and thematic analysis approach, the new concepts and themes arising from coding of current data set would be compared against the existing categories identified in the previous interview findings and grouped accordingly.

4. The themes were reviewed and re-organised several times to produce inclusive and well fitted categories:
   a. The first round of thematic analysis elicited several general themes:
      i. adoption - for instance, adoption and non-adoption
      ii. carrying - for instance, carrying and non-carrying
      iii. use- for instance, use and non-use
   b. Second round of thematic analysis:
      i. Non-fitness related technology - Use and non-use (during exercise)
      ii. Fitness-related technology - Use and non-use (during exercise)
      iii. Technology outside of exercise - Use and non-use
   c. For the third round of thematic analysis, themes started emerging about motivations for engagement with the technology (e.g. distraction) as well as patterns concerning the physical nature of the exercise and the gym (e.g. type of activity). This is further explained in the Discussion chapter.

Triangulation

Triangulation of research methods was implemented through the conjunctive use of autoethnography, contextual interviews and participant observation methods. Further, the analysis of the data was triangulated; all data transcripts were coded and used together to draw out themes. Data was also analysed through the association to previous literature (Golafshani, 2003). In addition, discussions about the findings took place with my supervisor within the context of the study to encourage relevant contextual insights, as seen in Figure 5.

Figure 5: Photograph of the area by the gym where participant interviews took place as well as discussions about findings.

Ethical considerations

A risk assessment underwent and ethical approval was obtained through the University College London Interaction Centre. All participants received an information sheet explaining the purpose and details of the study. Participants gave their informed consent to record and use their data which is kept confidential and anonymised. The information sheet and the consent form can be seen in Appendix 2.

CHAPTER 5. FINDINGS

The findings have primarily been categorised into fitness-related technology and non-fitness-related technology as well as technology used outside of the gym. These categories are further split into the use and non-use of these technologies which encompass further themes. It must be noted that the categories identified may overlap and are not finite, but are separated as such to aid the reader in understanding the findings of this study.

5.1 Non-fitness related technology

Non-fitness technology describes technology of which the primary purpose of the technology is not directly for fitness activities. This includes the use of Smartphones for videos, social media, messaging, web-browsing, listening to audio books, and music (that is not for the purpose of moderating performance). It also includes the TV screens displayed and the music that is playing in the gym area.

5.1.2 Use of non-fitness related technology

Several uses for non-fitness technology have been identified during exercise at the gym. This section includes the use of non-fitness technology for reasons of entertainment and productivity, and distraction.

Entertainment and productivity

Performing aerobic exercise at the gym, such as running at a constant speed, was sometimes perceived as an activity requiring low cognitive workload as concentration on the activity is not always necessary to facilitate performance. In this situation, the physical body is occupied whereas the mind is unoccupied and so mental resources are available for use in other domains. The use of technology in the gym was as a result of boredom or the need to achieve something productive, other than exercise, in the time at the gym.

Boredom describes a state of an unpleasant affective state in which the individual experiences a lack of interest and trouble focusing on the current activity (Fisher, 1993). Participants described that at times they experience a feeling of boredom during exercising in the gym without the presence of entertainment; this can influence how they feel towards going to the gym in general.

"I would get bored without being able to use my phone [...] I wouldn't like coming to the gym as much if I didn't have it" (Juliette, interview)

QUOTE 1

The participants have shown to adopt and use technology in order to alleviate this boredom through using it as a source of entertainment or just simply something to do to pass the time. Many participants brought their mobile phones to listen to music or audio books, to watch TV on, or to message and keep up to date with social media. Some participants listened to the music that was played in the gym or their own music, watched the TV displayed in the gym or looked at the digital display on the machine as a response to feeling bored.

(Messages on phone) "It's something to do when I am bored" [...] I listen to music to pass time" (Sammy, observation and dialogue)

QUOTE 2

Some participants believed that times exercising at the gym whilst their mental resources were not being occupied was a waste of time; therefore technology was sometimes used to make efficient use of available mental resources and time. Three participants used aerobic exercise at the gym as an opportunity to use technology to engage in tasks to make them feel that their workout time is more productive.

"I think exercising can be a bit of a waste of time, there is no need to focus on my running. I am able to concentrate on two things at once so I try and do something else to make use of the time" (Nigel, observation and dialogue)

QUOTE 3

Harry made the most of the 'dead time' during breaks between resistance training by browsing the internet on his phone to look for papers for his university research project, as well as checking messages, updates on social media and reading the news. Similarly, Nigel used running on the treadmill as an opportunity to learn something through listening to audio books because he does not get much of a chance to do this elsewhere. He explained that learning through audio books in the gym environment can be a frustrating experience because it requires constant concentration. The nature of the tasks in these examples indicate that the reason for technology use was primarily to increase productivity at the gym as opposed to merely wanting to pass the time.

"The process of learning isn't actually enjoyable; it's frustrating when I get distracted and miss a word when and lose concentration for a moment, but it is something I need to do because I don't get to listen to them (audio books) otherwise" (Nigel, observation and dialogue)

QUOTE 4

Distraction

Distraction is something that prevents a person from focusing on something else (Oxford Dictionaries, 2014). Participants claimed that they required distraction from concentrating on performing certain exercises in the gym as this would serve to reduce the intensity of their perception of pain, effort and tiredness that is experienced during the moment of exercise. Six participants were observed using technology as a source of distraction; they got immersed into watching TV, listening to music or audio books or looking the machine display and this diverted their attention away from thinking about the exercise to the technology. As mentioned in the literature review, this effect is referred to as dissociation, whereby listening to music can redirect the mind from feelings of tiredness and therefore reduce perceptions of exertion (Yamashita et al., 2006).

(Referring to the machine display and music) "Having something else to concentrate on takes my mind away from pain and tiredness" (Andy, interview)

QUOTE 5

"I try not to think about what I am doing so I watch TV on my phone. Distraction is my key. When I cannot use my phone I have to concentrate on it and I feel every second of it" (Juliette, observation and dialogue)

<div align="right">**QUOTE 6**</div>

This need to use technology for distraction purposes was only observed for participants performing aerobic exercises which did not necessarily require attention on the activity or the machine display in order to achieve performance, such as running at a steady pace on the treadmill. This type of exercise allowed participants to disengage their attention from the exercise and to direct it towards something else (e.g. the non-fitness technology). However, when participants performed interval training or weight training, they did not use technology for the purpose of distraction as this type of exercise requires more concentration on the machine display and on the activity. This finding implies that the type of exercise performed in the gym has an influence on how participants used the technology.

"I only watch TV on my phone when I'm doing aerobic exercises like on the elliptical machine, but I don't on the resistance machines" (Juliette, observation and dialogue)

<div align="right">**QUOTE 7**</div>

The need for distraction meant that some participants used any means of technology for distraction purposes. One participant watched TV to distract her from her cross trainer exercise, regardless of the value of entertainment it provided.

"I would watch TV just to take my mind off what I'm doing, even though I don't really like what's on" (Helen, observation and dialogue)

<div align="right">**QUOTE 8**</div>

The need for distraction during activity exercise proved to be strong enough to influence the way participants exercised in the gym. Juliette adapted the way she used the elliptical trainer in a way to minimize interaction with the display to prevent conscious awareness in her performance and disruption to her watching the TV program. This portrays how the individual's motivation for distraction during exercise influenced their exercise and technology use in the gym.

Juliette exercises at a constant speed and sets the time to the maximum workout length. When asked about this she explained "I guess I want to keep at a steady pace so I can concentrate on watching TV and not have to think about changing my speed or playing with the display [...] I don't really want to be distracted from my distraction!" (Juliette, observation notes, observation and dialogue)

QUOTE 9

5.1.3 Non-use of non-fitness related technology

There are cases where participants purposely did not make use of non-fitness related technology in the gym due to the unwanted distraction it caused, reasons relating to personal taste as well as the physical restrictions of the gym environment and exercises inhibiting intended use of the technology.

Avoid disruption

It has been observed and described by participants that at times, they avoided the use of non-fitness related technology because they found it disruptive and distracting to when they were engaged in concentration on the exercise. In the current study, four participants consciously avoided watching the TV screens that were placed in front of them and three people tried to tune out and ignore the existing music in the gym.

"I find looking at the TV is distracting and it makes me lose my focus and so I face away from it" (Mike, observation)

QUOTE 10

Being inadvertently distracted by the use of technology prevented participants from directing their focus on to their exercise technique. Nigel believed it is beneficial for exercise performance to concentrate on and monitor his technique and breathing pattern during exercising; therefore he would aim to focus on looking at himself in the mirror during running on the treadmill. Although Nigel listened to audio books whilst running, he tried to avoid looking at the TV because it was a source of visual distraction from his visual attention.

"I don't like watching the TV, but the TV just caught my attention because there was an advert about Game of thrones. Watching TV actually affects my performance because it means I am not concentrating on monitoring my technique" (Nigel, observation and dialogue)

QUOTE 11

As described in cognitive psychological theories, when an individual is using their visual attention to concentrate on one task (such as monitoring their technique) but their visual attention is directed and occupied by a second task (such as watching TV), there are less cognitive resources available for the primary task (Anderson, 2004). Participants perceived that when their attention was diverted to watching TV it reduced their level of concentration on the exercise and consequently had an undesirable affect on their physical performance. It was found that some participants avoided non-fitness technologies that occupies the same modalities of attention needed for their own motivations related to concentration on the exercise.

"You have to read the subtitles to watch TV, and when I start reading them, my running pace slows down and I have lost awareness of how I am running"
(Nigel, observation and dialogue)

QUOTE 12

I personally also experienced an avoidance of non-fitness technology due to its negative effect of disruption to my performance during my autoethnography. When the Smartphone notification feature was active on the Samsung Gear Fit during my activity on the cross trainer it disrupted my concentration on my exercise. I observed that I was

slowing down my speed to be able to read the incoming messages on the device. I found this constant disruption to the rhythm of my exercise frustrating and so I eventually disabled that feature for the rest of the duration of my exercise sessions. This shows that unintentional disruption to the concentration and consequently the performance of exercising caused by non-fitness technology is viewed negatively and can lead to disengagement of the use of the technology.

"The notifications made me lose concentration of what I was doing and I had to slow down just to read the message which was annoying, so I turned it off" (autoethnography diary*)*

<div align="right">**QUOTE 13**</div>

Physicality of exercises

One factor that influenced the non-use of the technology was the restrictions imposed by physical characteristics of the exercise. Exercise involves dynamic body movements which then limits the type of technology that can be used that interferes with this. An example of this was the impracticality of using technology that required sustained visual attention such as reading when running. Harry stated that he would have liked to use his mobile phone but the physicality of running does not make this possible, forcing him to not use the technology as desired.

"*I would like to read from my phone when I'm running, but it's difficult when I'm moving around so I have to wait until the breaks"* (Harry, observation)

<div align="right">**QUOTE 14**</div>

There was a noticeable difference observed in participants' non-use of non-fitness related technologies between aerobic and anaerobic exercises. It is speculated that the difference between the nature of these exercises, in terms of the amount of concentration they require, influences the types of technologies that participants preferred to use during that exercise. Participants described that anaerobic exercises such as weight lifting and using resistance machines require a higher workload, greater self awareness and concentration in comparison to running at constant pace.

"I have to concentrate when I'm lifting weights because it's harder than when I am just running" (Nigel, observation and dialogue)

<div align="right">**QUOTE 15**</div>

Participants were observed to not use the same non-fitness technology during anaerobic exercise that they used during aerobic exercise. Five participants who previously used non-fitness technology whilst exercising on the aerobic machines, did not engage in the same use of the technology during exercise on the resistance machines or free weights; they either did not use any technology or used technology which demanded less cognitive resources. For example, Nigel described that the use of audio books require more concentration than listening to music; whilst he listened to audio books when he was running, he switched to listening to music instead when performing weight lifting. Listening to music was perceived as occupying fewer cognitive resources, allowing him to be able to concentrate on performing weight training whilst listening to music. This suggests that participants perceived a higher need for concentration during weight training exercises and therefore avoided using non-fitness technology in order to have more cognitive resources available to concentrate on the exercise. This highlights that the requirements of the exercises may have had an influence participants preference for non-use of non-fitness technology.

"I have to concentrate on listening to the audio books, which is fine when I am running, but for when I am doing weights I just listen to music because I don't have to think about it" (Nigel, observation and dialogue)

<div align="right">**QUOTE 16**</div>

One of the reasons that participants increased the availability of cognitive resources (by not making as much use of non-fitness technology during anaerobic exercises as they did for aerobic exercises) was because many preferred to mentally count the number of repetitions they were performing to keep track of their exercise progress. This shows that the behaviour during weight training exercise influenced the non-use of technology.

"I would stop listening to music and focus on counting the reps in my head instead, so I know how many I can manage to do today" (Sammy, observation and dialogue)

<div align="right">**QUOTE 17**</div>

Physicality of the gym

Following from the previous point, the difference in non-fitness technology use during aerobic and anaerobic exercises may be influenced by the differences in the physical area and the functionality of the exercise equipment.

Unlike aerobic machines, the resistance machines did not encompass automatic activity tracking functionality and so participants were required to manually count their repetitions. This need for concentration on repetition counting inhibited the use of non-fitness technology, even when participants would have preferred to use it (e.g. for distraction purposes). Three participants would have still preferred to use their phones to watch TV and listen to music during weight training but they did not because it conflicted with their need to count their repetitions.

"It would be great if the machine or my Fitbit could automatically count my reps so I could listen to my music properly" (Sammy, observation and dialogue)

QUOTE 18

The physical set up of the equipment was described to influence the non-use of non-fitness technology. The physical set up restricted the participants being able to use the technology in the desired way. For example, Juliette usually prefers to watch TV on her phone for distraction purposes and the elliptical trainer allows her to do this because the machine also provided a shelf to place her phone. In contrast, the resistance machines did not afford a physical space to place a phone and so she was unable to watch TV during that exercise. She described that this limitation consequently affected her experience of the exercise as she was forced to focus on her performance, thus increasing her awareness on the feelings of pain. Having this repeated experience contributed to her losing motivation towards this exercise and disengaging from it.

Beliefs about exercise

Another reason as to why some participants did not use non-fitness technology stems from their beliefs about the relationship between exercise and technology use. Some participants believed that exercise is an opportunity to focus on the mind and body; to be immersed in the experience of exercise. The deep concentration may be related to a sense of 'flow'; a state characterised by complete immersion and absorption in an activity (Csikszentmihalyi & Csikzentmihaly, 1991). Participants believed that at times, the use of non-fitness technology that warrants distraction is not appropriate for this experience.

"I think exercise should be a time to get away from unnecessary technology and distractions and just focus on exercising and being in the zone, that's why I don't even bring my phone with me" (Kevin, interview)

QUOTE 20

"I like to run because you don't have to think about anything, it is a chance to empty your mind, it's almost like a state of meditation. I don't like seeing the TV anything distracting that takes away that focus from running" (Martin, interview)

QUOTE 21

Personal preferences

Personal taste and preference for the technologies was described as a contributing factor for why most participants didn't make use of non-fitness technology. Participants cannot control the music or the TV in the gym; it is not possible to listen to the program, but only read the subtitles on the screen. Five participants did not watch the existing TV because they did not enjoy it or find it entertaining.

"I find the TV dull; they always show food programs which is not really appropriate for in the gym" (Helen, observation and dialogue)

QUOTE 22

5.1.4 Summary for non-fitness related technology

In summary, the study has revealed that there is a wide variety of individual differences in fitness motivations and preferences, even among the small participant set, for the use and non-use of non-fitness technology. Factors that motivate people to want to exercise and the physicality of the gym equipment both influence use and non-use of non-fitness related technology.

Some people use non-fitness technology because they want to entertainment themselves, achieve something productive during their exercise time or distract themselves from concentrating on the exercise. This need tended to be apparent mainly during aerobic exercises where the perceived cognitive workload of the exercise was low, the machines incorporated activity tracking functionality and a space to place mobile phones. The type of technology used would depend on personal preferences; some participants would watch the TV whilst others would look at the machine display or listen to music and audio books.

On the other hand, participants did not make use of non-fitness technology because it is disruptive to when they want to concentrate on exercise; this was especially apparent for anaerobic exercises when participants perceived these exercises to have a higher workload and also wanted to count their repetitions. A reason for the non-use of non-fitness technology during anaerobic exercises was partly due to the lack of automatic activity tracking functionality and physical space to put phones, inhibiting the desired use of non-fitness technology. It was shown that not only does the physicality of the gym influence the non-use of the desired technology, but this also has consequences on people's engagement with the exercise. Personal beliefs about exercise and personal taste were also important factors in influencing the non-use of non-fitness technology.

5.2 Fitness related technology

Fitness related technology includes technology used to track fitness activity or in technology that some way facilitates exercise performance. This includes music for the purpose of motivation or performance moderation, the information displays on the aerobic machines in the gym and fitness tracking wearable devices. This section describes the use and non-use of fitness related technology uncovered in this study.

5.2.1 Use of fitness related technology

This section describes the reasons for use of fitness related technology, including music, monitoring performance and sharing data.

Music

Music was used as a tool to increase motivation and exercise performance. Seven participants listened to music during exercise; five participants described that they try to adjust the pace of their exercise movements of running or lifting weights, to match the beat of the music which facilitated consistent movements. As mentioned in the literature review, the use of synchronous music is found to facilitate performance (Karageorghis & Priest, 2012).

"It doesn't really matter if I like the music or not, as long as I can match my movements to the beat" (Helen, observation and dialogue)

QUOTE 23

Participants mentioned that particular types of music can provide a perceived sense of increased energy to help them with their performance. This is supported by research that listening to simulative music during exercise can delay fatigue and reduce perceived exertion and give rise to higher levels of strength (Yamashita et al., 2006). Martin described that the use of fast paced and loud music is particularly useful for exercises requiring a high level of exertion.

"With weights I need an aggressive beat that is stimulating and makes it easier to lift heavy weights" (Martin, interview)

QUOTE 24

Another way in which music was used as motivation for performance is through the effect of music increasing stamina Karageorghis & Priest (2012). Jake described that the music encouraged him to sustain his effort for a longer duration as he does not stop until the end of the song.

"I feel like it pushes me to keep running at this pace until the end of the song"
(Jake, observation and dialogue)

<div align="right">**QUOTE 25**</div>

Listening to synchronous music helped participants to achieve a greater sense of an immersive exercise experience, which could have also be related to a sense of 'flow' as characterised by the full absorption in the activity (Csikszentmihalyi & Csikzentmihaly, 1991).

"When my exercise is in line with the beat of the music it helps me forget that I am running and zone out" (Jake, observation and dialogue)

<div align="right">**QUOTE 26**</div>

Monitoring performance

Participants in the current study used the visual display of performance feedback in order to monitor and improve their performance. Nine participants primarily used the measures of time, distance, calories and heart rate on the fitness tracking displays on aerobic machines. Based these measurements, participants monitored their current progress, set themselves goals and moderated their level of exertion accordingly to reach their goal. This goal directed tracking behaviour relates to the 'directive tracking' trait identified by Rooksby et al., (2014). For example, two participants were concerned about maintaining their heart rate within certain ranges and therefore during aerobic exercises they constantly focused their attention on the heart rate display, moderating their exertion level to achieve their target heart rate.

"I look at the heart rate monitor, if it is lower than my target then I speed up to try and reach it" (Kevin, observation)

<div align="right">**QUOTE 27**</div>

This observation of using performance data as motivation for concurrent exercise was apparent even for measures that were not meaningful towards the activity. An example of this is the use of Fuelpoints (associated with the Nike Fuelband) which is an arbitrary measure of performance, or calories which also means nothing in reality as they do not indicate a true measure of performance. One way in which this motivated participants' performance was their strategy to work towards the 'next full number' on a constantly

ascending or descending value, such as aiming to achieve 3000 calories rather than stopping at 2800.

"I would never stop before I reach a full number, even though I don't really know what the Fuelpoints are based on" (Harry, observation and dialogue)

It was observed that participants used different aspects of performance feedback values to motivate their activity. For some participants, when they saw that they were at a stage of low progress towards their goal, it provided them with motivation to work harder to increase this, such as Julie. Four participants found seeing low time remaining of their workout motivating to increase exertion, including Marie.

"When I see that my strides are low it motivates me to push harder" (Juliette, observation and dialogue)

"When I see there is only 40 secs left I think to myself, come on you can do it" (Marie, observation and dialogue)

In contrast, some participants preferred looking at positive feedback for their performance progress for motivation. They described that seeing a positive effect on their performance data provided them with a sense of satisfaction and motivation to increase their goal. Two participants chose to focus on looking at the calorie counter on the machine display. Although in reality this is an arbitrary and inaccurate measure, it is satisfying enough for them just to know that calories are being burned, especially as their motivations to exercise were for weight loss and body shape.

"I like to see the calorie numbers going up. It shows I am making progress and sometimes I feel like increasing my goal" (Juliette, interview and dialogue)

As well as for motivational purposes, activity monitoring is sometimes required for particular exercises. The three participants who performed interval training exercises used the information on the machine display as a way to structure their workout. They described that they use the time display as an indicator for when they need to adjust their speed control.

"I'm looking at the time so I know that every two minutes I need to change my speed" (Marie, observation and dialogue)

There were some situations where the participant wanted to use technology for performance tracking but the limitations in the functionality of technology did not allow for the desired use, leading to a change in the exercise behaviour. Juliette wanted to monitor her performance on the elliptical trainer but her Fitbit did not automatically capture the strides when she held onto the handle bars (as she would prefer). Due to this, she did not hold on to the handle bars whilst using the machine, to enable the stride movements to be captured on her Fitbit.

"*It's annoying that the Fitbit doesn't count my gym activity [...] I don't hold onto the handle bars so my strides can count towards my daily step count. It looks stupid and makes the exercise harder*" (Juliette, observation and dialogue)

Sharing data

One way to use the performance data was to show other people in order to motivate the individual's performance. This was only described in reference to group fitness classes, implying that social factors may also play a role in the use of fitness technology. Marie displayed her heart rate monitor to the fitness instructor in order to facilitate her performance in group classes.

"I show it in spin class so the teacher can see my level of effort and tell me to push harder" (Marie, interview)

5.2.3 Non-use of fitness technology

This section describes the non-use of technology, including avoidance of seeing de-motivating values of performance on the machine displays and the shame of not achieving a goal. The limited functionality of technology in the gym is also discussed.

Avoiding time and low progress

It was observed and described that some participants avoided looking at certain measures of fitness tracking because they found it de-motivating towards their performance. For constant aerobic fast paced, high intensity exercises (e.g. running on the treadmill), six participants consciously avoided looking at the time on the machine display.

Juliette placed her phone on the display pad, deliberately covering the time during use of the elliptical machine (Juliette, observation notes)

QUOTE 35

"I avoid looking at the time when I'm running, it makes my goal seem further away" (Nigel, interview and dialogue)

QUOTE 36

A reason for this was because participants believed that watching the clock increases their perception of their effort and tiredness, and reduces the perceived speed of time. This distortion of perception of time can have a negative effect on participants' motivation and consequently affect their performance.

"I don't want to know how long I have been running for, if I do look at the time, I usually tend to run for a bit and get bored and stop" (Martin, interview)

QUOTE 37

This avoidance of time was observed even for participants performing interval training by which the monitoring of time is necessary for the manipulation of the workout. For example, when doing interval training, Marie preferred not to look at the time when she

felt tired, suggesting a conflict between information needs of certain exercises and personal preferences for avoidance of time for motivational reasons.

"When I am tired I avoid constantly looking at the time, it makes it feel like more effort and time seems to go slower!" (Marie, observation and dialogue)

QUOTE 38

As well as the time measure, participants avoiding looking at values on the machine display which indicated low performance progress. Two participants did not look at the progress display near the beginning of their workout when progress was low because they found it de-motivating. This highlights that the non-use of fitness technology is influenced by certain temporal stages within a workout.

"I don't want to look at calories at the beginning because it is low and I think I am not doing well" (Sammy, observation and dialogue)

QUOTE 39

Not useful

Another reason for why some participants did not make use of fitness technology during exercise was because the technology was not deemed useful during that period for certain exercises. Martin did look at the measure of Fuelpoints on his Nike Fuelband during weight training because it did not benefit his performance; he only checked it before and after the session.

"There is no need to check my Fuelband during weights, it doesn't really help me so I it straight before and after" (Martin, interview)

QUOTE 40

Similarly, some participants did not use measures that they did not perceive as being meaningful to them. Harry did not find it useful to look at the distance measure on the treadmill because the machine is stationary.

"There is no point looking at the distance because I'm not actually travelling anywhere!" (Harry, observation and dialogue)

QUOTE 41

Avoiding disruption

Another reason for participants not using fitness technology was due to practicality that the use would cause disruption and conflict with their use of non-fitness technology. Although Juliette mentioned that she wanted to check her performance progress during exercise, she did not check her progress recorded on her Fitbit because it required her to connect to the related Smartphone application. This meant that she would have to disrupt and disengage from her current activity of watching TV through her phone.

"I kind of want to see my progress but I would have to see it through the app and stop my TV program and so I just wait until after I finish exercising"
(Juliette, observation and dialogue)

QUOTE 42

Inability to use technology as intended

A further reason for non-use of fitness technology is due to limitations in functionality impeding on the desired use of the technology. The limitation of functionality, (or the failure to meet functionality expectations) of the wearable device prevented use for certain activities in the gym. This was experienced during my Autoethnography. The Samsung Gear Fit was unable to track my fitness when I used the bicycle machine in the gym because the Smartphone was required for the GPS distance tracking function, which opposed my expectations of using a wearable device during exercise without the need of a phone. This resulted in my disappointment in the inability of the technology to track my cycle activity in the gym.

"I was excited to be able to use the 'cycle' tracking function at spin class, however I discovered that this feature only works when the phone is nearby for GPS detection. I felt disappointed" (Autoethnography diary)

QUOTE 43

5.2.4 Summary of fitness technology
Reasons for use of fitness technology include music for motivational purposes, activity monitoring and goal setting. Reasons for non-use of fitness technology were also related

to motivational factors, personal preferences in terms of personal meaning of the feedback value and the limitations in the functionality of technology inhibiting use. There were observed individual differences within the use of fitness technology which depended on what participants found motivating. Some participants preferred to see low progress whereas others found only high progress motivating; some people were motivated by seeing performance feedback values that were relevant to their goals, whereas others used data that was not meaningful in ways to motivate performance.

These differences in technology use were also influenced by factors relating to the nature of the exercise or the gym equipment rather than always personal choice alone. Usually, participants would prefer not to see the time because it was seen as de-motivating, however, when there was only very little time left it was perceived as motivating. This suggests that the use of technology varies within the course of the workout even for the same participant. Further, environmental restrictions on technology use had consequences on the way people exercised in the gym.

5.3 Technology use outside the duration of exercise

This section describes the interaction with technology associated with the gym that occurs outside of the period when people are exercising or even at the gym. As with the previous sections, it is split into use and non-use categories. Use includes viewing and sharing data for motivation and activity planning.

5.3.1 Use of technology outside the duration of exercise

Performance data

Individual performance data accumulated by activity tracking technology was viewed by participants. Eight participants described that they enjoyed looking at their performance data from wearable devices to facilitate understanding of their fitness behaviour. This relates to the type of 'documentary tracking' trait which identified by Rooksby et al., (2014).

"Data is knowledge when you look at it in the right way" (Nigel, interview)

"I look at my distance after my workout to understand how much I did"
(Marie, observation and dialogue)

It was observed that some participants preferred to view their performance data only after their workout session as opposed to during. One reason for this is because seeing a larger achievement at the end provided a greater sense of accomplishment and surprise than viewing smaller increment of progress.

"I prefer to see my data after exercise because I feel good when I have seen that I have burnt 500 calories in one go, it is a nice surprise when I see I have done well" (Juliette, interview)

Motivation for exercise

One reason as to why participants described they use fitness technology outside of exercise was to motivate exercise behaviour. Martin claimed the Fuelband data motivated him to exercise in order to continue the goal streak he developed; the motivation stemmed from the disappointment of the thought of not meeting the goal. This shows the powerful motivational effect that tracking fitness and goals setting can have on the participant's behaviour.

"I was addicted to meeting my daily goals; once you develop streaks, you don't want to break it. It motivated me to go for runs at 11pm, just to meet the goal"
(Martin, interview)

Sharing data

Some participants claimed that they like to share their performance information with family and friends whereby it fosters a sense of competition, which is a motivational influence. One participant compares her performance data with her brother to motivate her to increase her performance.

"I always have competitions with my brother; it motivates me to work hard so I can beat him and feel good about it. I always tease him about it" (Marie, interview)

<div align="right">**QUOTE 48**</div>

5.3.2. Non-use of technology outside of the gym

There are circumstances where participants did not use technology outside of the gym setting although this was related to their gym attendance. This included reasons for the purpose of exercising in the gym as well as to avoid seeing an unaccomplished goal.

Motivation to go to the gym

It was uncovered that a participant avoided the use of non-fitness related technology outside of the gym in order to motivate her to exercise at the gym. Juliette refrains herself from watching TV and films on Netflix from outside of the gym environment. This motivates her to come to exercise at the gym as it allows the opportunity to watch TV.

"I feel less guilty when I binging on Netflix at the gym. I promised myself I would only watch them here (in the gym) and not at home" (Juliette, observation and dialogue)

<div align="right">**QUOTE 49**</div>

Shame of unmet goal

Another reason for why participants described that they do not use fitness technology outside of the gym is to avoid the feelings of shame and disappointment of not being able to meet a goal. Harry explained that he avoided wearing his Nike Fuelband device

on certain days where he would know that he would not be able to achieve his goal, in order to avoid the negative affect associated with seeing an unmet goal. This may relate to the participant self identity as 'somebody who always reaches his goal' and so he avoids behaviour that would violate that perception.

"When I am too busy to exercise as much, I don't wear the Fuelband. I don't like to see that I have not reached my goal so would rather not wear it at all on some days" (Harry, interview)

<div align="right">**QUOTE 50**</div>

5.3.3 Summary of technology outside of the gym

In summary, participants used the technology at times outside of exercise periods in order to see their fitness performance data to provide motivation and greater satisfaction. On the other hand, participants did not use non-fitness technology outside of the gym as a motivational strategy to be able to use the non-fitness technology during exercise, or to avoid experiencing shame of an unmet goal. This shows that interactions with technology relating to gym use do are not necessarily always contained within the context of the gym but they leak into people's everyday lives.

CHAPTER 6. DISCUSSION

Exercising in the gym is usually perceived as a singular activity in a box; people going in, exercising and coming out. However, the findings of the current study show that this is not the case; the gym is an environment which has a complex ecosystem. A situated action approach (Suchman, 1987; Rogers 2011) to the investigation of technology use in the gym has allowed the examination of exercise activity within a real world context. This has revealed the bigger picture of gym; including the complexity in the gym environment and the members who use it, and how these factors influence the various uses and non-uses of fitness and non-fitness technology observed in the gym.

The findings have reinforced Suchman's (1987) and Dourish's (2004) stance about the importance of the dynamic context in shaping behaviour as it demonstrates the relationship between the factors in the gym environment and individuals influencing technology use in the gym. The complexity of the context and individual differences identified in the findings highlight that the current 'one size fits for all' approach to the design of technology is not appropriate. Implications of the findings point towards the importance of taking a situated action approach in carrying out research for the design of wearable technology.

The following discussion will describe the complexities in the physicality of the gym, followed by the complexities in individual differences. Following this is a discussion on the benefits of a situated action approach to exercise and fitness interactive technologies.

6.1 The complexity of the gym environment influences adoption and use

Suchman (1987) and Dourish (2001) emphasise how an individual's action is derived from their response to the specific setting. This has been reflected in the findings of the current study where the variety in technology use and non-use were seen to be broad; this can be explained by the complexity in the gym environment and the various situations occurring which impacted the dynamic interactions with technology.

A situated action approach to the current study has discovered the varied, dynamic and complex nature of the gym context and environment. This includes the variety within the physicality of exercises, physical space, and the facilities (including available technology) as well as variance of time during exercise. The most dominant factor is the difference in types of exercise performed in the gym influencing the use and non-use of technology. Exercises are inherently different in the way that they are performed and what they demand from the individual. Also, across the data set, it was found that the type of exercise linked to other contextual factors; it influences the occupation of certain physical space, the certain physical equipment and therefore the technologies available, which were all seen to have impact upon participants' use and non-use of technology.

The exercise itself influences technology use

The different types of exercise performed in the gym, whether aerobic exercises or anaerobic exercises, greatly influenced technology use behaviour. Types of exercises are inherently different in the way that they are performed and the requirements of exertion during different stages of the workout.

The physicality of all exercises influences the types of technology use; participants moved dynamically with their bodies, limiting the use of certain technology that was not appropriate to this situation. An example of this was during running where the participant's head was moving up and down, preventing the use of technology that required sustained visual focus such as reading a book from a Smartphone screen.

Different types of exercises encompassed different requirements, in terms of patterns of exertion and cognitive workload, which influenced the different uses for technology. The performance of certain forms of aerobic exercises, for example, running at a constant speed, usually involved a distributed workload over time and was described as requiring low levels of cognitive resources as it did not necessarily require attention on the tracking display on the machine. This availability of cognitive resources within this situation allowed participants to make use of other technology without interfering with the exercise, for purposes such as entertainment or distraction. On the other hand, performing interval style running (where the running speed systematically fluctuates) required visual attention on the tracking display to manipulate the speed, therefore

reducing the potential to concurrently use technology that also required sustained visual attention, for example reading subtitles on the TV.

In contrast, the physical requirement for anaerobic exercises were usually short bursts of intense exertion. All participants were seen to count their weight lift repetitions, of which required extra cognitive resources. This activity therefore limited the scope of technology that could have concurrently be used, especially types of technology that also required high concentration and cognitive load that would have interfered with repetition counting, such as listening to audio books.

The physical space influences technology use

The different physical areas in the gym, including the physical set up and functionality of facilities influenced the differences in technology use in the gym. These factors were greatly determined by the type of exercise associated that physical area.

The availability of technology within the exercise facilities impacted on participants' technology use during the performance of the exercise (an example of this is the continuous presence of gym music throughout the gym forcing people to listen to the music). A vast difference in technology use between aerobic and anaerobic exercises was evident in the findings. Part of the reason for this difference in use may have been due to the availability of activity tracking technology only on aerobic machines and not on the resistance training machines. This resulted in the users being required to keep track of the number of their weight lifting repetitions themselves during weight exercises, thereby limiting the type of technology that can be used alongside this to reduce interference (as mentioned above).

With regards to the physical set up of the exercise machines, the aerobic machines provided a space on the visual display for where people placed their mobile devices. Nonetheless there was no such appropriate space seen on resistance machines. Additionally, the TV screens were displayed only on the wall in front of the aerobic machines. The way that the physical environment imposed restrictions on desired technology use had longer term consequences on some participants' exercise behaviour, such as the disengagement from weight training due to the inability to have a space to place the mobile phone for watching TV.

Time influences technology use

Throughout different activities in the gym, the factor of time influences the way people use technology. There was the presence of 'dead time' in between the performance of activities, where participants engaged in technology use that was inhibited during exercise due to the physicality factors previously discussed, for example the exercise movements restricting Smartphone use. As time progressed, performance measures also increased, and naturally so did participants' intensity of experienced tiredness. This alteration in internal state influenced the way participants used technology, especially for motivational purposes. An example of this was that towards the end of a workout session when participants were tired, they chose to listen to music that had more stimulation effects or they directed their attention towards the TV in order to distract themselves from the uncomfortable feelings and looking at performance measures. The variety of responses observed in this situation also points towards the involvement of individual differences for preferences within technology use.

Functionality of technology influences technology use

An additional factor that influenced technology use was the practicality of using the technology itself during exercise. This especially concerned the suitability of wearable technology for use in the gym in terms of tracking data during certain exercises, such as the inability for the Fitbit to capture strides on the elliptical trainer, resulting in alternative use of the exercise machine (not holding the handle bars) in order to do so. Similarly, the requirement to check performance data through connecting to a mobile application prevented participants from using this as it disrupted their use of their mobile phone for other purposes, such as watching TV. Additionally, the activity tracking wearable devices did not provide directly useful for the performance of some exercises, for example the measure of heart rate during weight training.

6.3 The complexity of individual differences influences adoption and use

The findings of the situated study have revealed the complexity of the members of the gym. There are many available options for technology use in the gym and participants were seen to use it in various different ways. This variety in use was related to participants' individual preferences towards certain technologies. Their preferences towards technology use were influenced by what motivates them during exercise.

Across findings, there is evidence that there are individual differences in what motivates people to exercise at the gym and what motivates them to keep exercising and increase performance. Some participants expressed intrinsic motivation toward exercise (Vallerand, 2007) they exercise because they enjoy the experience and they want to perform at their best. These participants' wanted to concentrate on the exercise and therefore they used technology that was useful to helping them to concentrate on the exercise and increase their performance, such as engaging with the activity tracking display or listening to performance enhancing music. Simultaneously, these participants avoided types of technology that was not directly useful for their performance or those that would cause distraction and disruption to their concentration on the exercise, such as watching TV. This preference for technology non-use could also have stemmed from individual beliefs regarding the gym as a place to focus on exercise only.

In contrast, some participants need extrinsically motivated (Vallerand, 2007) if they are to be motivated to exercise at the gym. One source of motivation was through the gym providing the participants with the opportunity to use their desired technology, such as watching TV (for which its use is restricted outside of the gym) or performing tasks that they do not otherwise have time for out of the gym, such as listening to audio books. Some people gain motivation through engaging in social competition, the need to maintain their goal streak or seeing their positive progress. Some participants were motivated during exercise only through being distracted from the exercise or being entertained and so they engaged in technology that facilitated distraction or entertainment.

However, there were individual differences for preferences even within technology use for the same motivation; individuals have different needs for distraction. Some participants believed distraction was crucial for their motivation to exercise and so they

used any means of technology for this purpose, such as watching TV even though they don't like the program. This need for distraction influenced their exercise behaviour such as setting the cross trainer at a constant speed to be able to watch TV without disruption. On the other hand, some participants wanted some entertainment but also to visually monitor their technique and so they were more selective in their choice of technology to enable this, such as using audio mediated technology rather than visual.

Like Rooksby et al. (2014) identified, there were differences in the way that individuals use the activity tracking technology. Some participants displayed directive tracking traits as they used the fitness tracking data to moderate their current performance to reach their goals, such as adjusting exertion level in order to reach a target heart rate. Some participants used the data to gain an understanding of their activity (documentary tracking) such as knowing the amount of distance a 30 minute running workout was equivalent to.

There were different measurement values of the fitness tracking data that participant perceived as useful, motivating or de-motivating; this influenced the way in which they interacted with the display at different times. Seeing low performance progress was perceived as de-motivating for some people and so they avoided looking the display screen at the beginning of the workout when they had not achieved much. Some preferred to look at their performance data during the workout or after the workout when they have achieved more that provided them with a sense of accomplishment. In contrast, other participants find seeing low performance progress motivated them to increase the level of their exertion. Some participants were motivated by monitoring fitness data values that were relevant to their personal fitness goals, which they used to moderate their exertion level, such as reaching a target heart rate. Contrastingly, other participants used meaningless data in ways to motivate performance, even measurements that were arbitrary, such as the Fuelpoints (associated with the Nike Fuelband) or the calorie count.

Despite people's motivations for how they use technology, people's personal tastes and preferences would also sometimes determine which type of technology they chose to use. For example, some participants brought in their own music because they did not like the music that was playing in the gym. Preferences for use also related to how

useful participants perceived the technology to be; some participants did not use the distance value because they thought it was not useful for use on a stationary machine.

In light of Suchman (1987) and Dourish (2004), people's action derives from the relationship between individuals and their environment. This is relevant for these findings as rather than independently, the influence of the complexity of the environment and the complexity of individual differences are connected and intertwined in how they influence the use and non-use of technology in the gym.

6.4 One size does not fit for all people and uses

In line with Dourish (2004), it was found that the gym context is dynamic and relational to situation, rather than static. The findings of this study can similarly criticise a technology-driven approach towards the design of fitness wearables.

The technology in the gym and the current design of technology for exercise takes a technology-driven, top-down approach and is designed in a way that assumes 'one size fits for all individuals and all situations'. However the complexities within these findings have shown that this 'one size fits all' approach for technology design is not suitable for the gym context. Features such as sensors and pedometers are being added to Smartwatches; assuming that this is what people want and are able to use every day throughout different settings, when in reality, people are having to change the way they exercise in the gym in order for the pedometer function on their wearable to work correctly.

The environmental and individual difference factors interact to influence technology use behaviour. Different people have different motivations and preferences for using technology; nevertheless, even if the design did cater for these individual differences, there is still the complication in that the same individual uses different types of technology in different ways in relation to specific situations in the gym. Across the data set, in response to the physicality of the exercise and the gym equipment, every user changed the technology that they used from aerobic exercise to resistance training.

Nevertheless, the particular type of technology the individual chose to use in this situation was different to other people; some people listened to music whereas others did not use technology at all.

Like Dourish (2001), I discovered that there are situations in the gym where context-aware technology would not be suitable, due the complexity of the context that is also dependent on individual differences and their choice of behaviour at that particular time. This research has particular relevance to the growing trend of wearable technology, especially those geared towards fitness, such as the Samsung Gear Fit, where it has been developed within the assumption that one size fits all. This implies that we should be taking the same perspective as Dourish (2001) in critiquing context-aware computing towards the design of wearable technology which assumes that 'one size fits all'. There are sensors built into these systems that automatically respond to its environment and the user, however this is not what is always needed by the users in all situations. Wearable technology is inherently mobile and so its use is influenced by the context in which it is used and the individual using it. We should be wary of the singular design of wearable technologies and instead design them to be useful in various contexts including in and outside of the gym, in conjunction with the use of a variety of other technology, as well as use by various individuals.

Suchman (1987), Rogers (2011), Dourish (2004) and Brown et al., (2013) all emphasise the importance of investigating interaction with technology in the context of use, claiming that this approach elicits richer insights towards understanding everyday behaviour. The advantage of this approach has been demonstrated through the findings of this study, which has obtained insights into how technology use is shaped by the contingencies in the environment, which would not be possible to have studied using traditional research methods such as interviews and diary studies alone. Further, it has been detected that the way participant's claimed to interact with technology (during the contextual interview) was not always coherent with their observed behaviour in the gym. This is an important link to perspectives in situated action (Suchman, 1987; Lave, 1988) as it indicates that the way people perform their actions is in an improvisatory manner in response to the real world situation, rather than through executing a predetermined plan. It highlights the importance of observing and investigating people's behaviour within the context in order to understand human behaviour, to be able to

explore the interaction between both the individuals and the environment, which is particularly relevant to mobile fitness technologies.

Wearable technology and fitness studies are becoming increasingly more popular as further wearable technologies are released. The use of these technologies have not been looked at in the appropriate context. By using a situated action approach, the current study reveals that it is not so straight forward to design technology for fitness for the gym as that the gym is a complex space.

6.5 Limitations

There were some limitations to the design of this study. Firstly, there may have been an 'observer effect'; whereby the participant may have altered their behaviour due to the awareness that they were being observed (Morwitz, Johnson & Schmittlein, 1993). For example, avoiding interactions with other people in the gym or intensely watching TV because they thought it might seem rude to ignore the researcher.

Secondly the study was limited to looking at individuals' use of the gym; it did not study the use of technology when a person is exercising with a gym partner or in a group fitness class. If the study involved the recruitment of participants who come to the gym to exercise with other people, including group classes, it might have obtained richer information on how factors relating to the social context influences technology use. This is a suggestion for future work to address this further.

Thirdly, as this was a cross-sectional study, the observed behaviour may have not been representative of the participant's everyday behaviour. For example, one of the participants did not bring her heart rate monitor because she forgot to carry it with her on that particular day. Also, people do not perform the same activities in the gym everyday and so their interactions may have differed according to the activity (as discovered in the findings). Further, the study of 11 participants is not a large sample size to have been able to capture all types of interactions with technology that may exist in the gym.

Finally, it is noted that the insights gathered from this study are particular to the use of these specific technologies by these participants in this specific gym. As the Situated Action theory implies, behaviours are particular to a specific situation Suchman (1987). As a consequence, findings may not necessarily be applicable to the patterns of technology use for other gym members in other gyms.

CHAPTER 7. CONCLUSION

The aim of this study was to discover the use and non-use of technology during exercise in the gym. Through taking a novel situated action approach (Suchman, 1987) to this research, it was revealed that the gym is complex; there are many complexities that exist within the context of the gym which influence the use and non-use of technology, whether it is for fitness purposes or not. This includes complexities and variances both in individual differences of the users as well as the physicality of the gym. It is not the case where one size fits all; it is not appropriate to design fitness technology and assume that it is suitable for all users, according to their individual fitness motivations and personal preferences. On the other hand, even if the design of the technology was catered for the variance in users, it cannot be assumed that the user will use the technology in the same way for all exercises, and in the same way throughout the same exercise, in the same places. This is because context is dynamic and people react in accordance to their environment at that particular moment in time (Suchman, 1987; Dourish, 2001). These findings point to the importance for future work to take a situated action approach when conducting user research for the design of technologies which are designed to be used in a variety of contexts by a variety of individuals, particularly for fitness wearable devices.

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APPENDIX

Appendix 1 Entry Interview questions

Demographics

What age are you?

Gender

What is your occupation?

1. How would you describe your comfort with technology: very comfortable, comfortable, neutral, uncomfortable, or very uncomfortable?
2. How often do you attend the gym?
3. What is your current exercise regime? Gym/outside
4. What are your motivations for exercise; why do you attend the gym?
5. How much do you enjoy exercising at the gym?
6. What kind of level of fitness do you think you are at? Low/average/high
7. What type of wearable technology or fitness applications do you use or have you used in the past?
8. Why did you start using it?
9. Do you think the use of this technology impacts on your exercise behaviour? How?
10. Goal setting
11. In which contexts/ how do you use them? (regularly, occasional) Where do you put the device?
12. Do you like the aspect of tracking behaviour.. do you see yourself as a 'data person'
13. Do you like sharing the data?
14. If you did in the past, what were the reasons for stopping using it?
15. What are your frustrations?
16. In an ideal world, how would technology work for exercise?
17. Are there any exercises that would benefit from more technology use?

18. Which type of devices do you bring along with you during exercise at the gym? – phone/wearable fitness tracker/ Music player/ other

19. Do you make use of existing technology in the gym? (including music, TV, machine displays..)

20. For what purpose do you think you use these technologies? Distraction/tracking/motivation?

21. How use technology differently for different exercises?

22. Do you think there are technologies that you don't like to use? (e.g. clock)

Appendix 2: Participant information sheet

Information Sheet for Participants in Research Studies

You will be given a copy of this information sheet.

Title of Project:	Exploring the use of technology during exercise

This study has been approved by the UCL
Research Ethics Committee as Project ID
Number:

Name, Address and Contact Details of
Investigators:

Email:

Phone:

We would like to invite you to participate in this research project. You should only participate if you want to; choosing not to take part will not disadvantage you in any way. Before you decide whether you want to take part, please read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or you would like more information.

Details of Study

The purpose of this study is to learn about the way in which people use technology during exercise. Your participation will consist of a face-to-face interview with a researcher at the gym, which will be audio recorded, followed by observations of yourself whilst exercising in the gym, followed by an exit interview. As a participant, you will answer questions about your experiences with any wearable devices and your exercise habits. During the exercise session you will behave as you would do normally. There are no foreseeable risks involved in your participation and you can choose to end your participation at any time.

It is up to you to decide whether or not to take part. If you choose not to participate, you won't

incur any penalties or lose any benefits to which you might have been entitled. However, if you do decide to take part, you will be given this information sheet to keep and asked to sign a consent form. Even after agreeing to take part, you can still withdraw at any time and without giving a reason.

All data will be collected and stored in accordance with the Data Protection Act 1998.

Appendix 3: Informed Consent Form for Participants in Research Studies

Title of Project:	Exploring the use of technology during exercise

Participant's Statement

I ………………………………………................................

agree that I have

read the information sheet and the project has been explained to me orally;

had the opportunity to ask questions and discuss the study; and

received satisfactory answers to all my questions or have been advised of an individual to contact for answers to pertinent questions about the research and my rights as a participant and whom to contact in the event of a research-related injury.

I understand that:

My participation will be audio recorded and I am aware of, and consent to, any use you intend to make of the recordings after the end of the project.

I understand that the information I have submitted will be published as a report. Confidentiality and anonymity will be maintained, and it will not be possible to identify me from any publications.

I understand that I am being paid £10 cash for my assistance in this research and that some of my personal details will be passed to UCL Finance for administration purposes.

I understand that I am free to withdraw from the study without penalty if I so wish, and I consent to the processing of my personal information for the purposes of this study only and that it will

not be used for any other purpose. I understand that such information will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.

Signed: Date:

I, Misha Patel

confirm that I have carefully explained the purpose of the study to the participant and outlined any reasonably foreseeable risks or benefits (where applicable).

Signed: Date: