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Exploring the prolonged use of wearable self-trackers: a practice theory perspective

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To Dad

Sabah Bakr Al-Kaissy

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You believed in me and taught me to dream. This thesis is only possible because of you.

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ABSTRACT

Smart wearable devices are one of the most popular consumer technologies in the world (Ferreira et al., 2021; Statista, 2021). In 2021 alone, consumers spent over $80 billion on wearable devices worldwide (Statista, 2021) with over half of this spent on commercial, wrist-worn, wearable self-trackers (WSTs), (Statista, 2021). The popularity of WSTs mirrors the rise in healthy lifestyles (Millington, 2016; Stiglbauer et al., 2019). Such widespread uptake might be expected to dent the trajectories in physical inactivity, obesity and related chronic diseases (Blair, 2009; Blue & Kelly, 2021) but they continue to climb relentlessly upwards.

WSTs are seen as an easily accessible means to achieve and sustain physical activity (Lupton, 2016) and prevent lifestyle disease[1] (Mintel, 2017; Perski et al., 2017; Thirlaway & Upton, 2010) but extant research reveals that the use of wearables is often short lived. Novelty usage patterns are widespread such that over 50% of users lose interest in self-tracking or abandon the device all together within the first 6 months (Attig & Franke, 2020; Chuah, 2019; Dehghani, 2018). Little is known about how people use self-trackers after the initial novelty period or the activities associated with prolonged use, even though sustained physical activity is needed to reap the health benefits (Piwek et al., 2016; Stiglbauer et al., 2019).

The extant academic literature on WSTs primarily focuses on the adoption and is dominated by human-centric theoretical perspectives, most notably the technology acceptance model (and derivatives), that emphasise users' cognitive processes in the take-up decision (e.g. Kim & Shin, 2015; Shin et al., 2019), and sociological theory which assumes a form of uniformity amongst users (e.g. Lupton, 2016).

Turning attention to the prolonged use of WST calls for approaches that account for the routinised nature of usage activities, and acknowledge that, despite the widespread ownership, use is not identical and uniform across all users. Therefore, this study applies practice theory, which recognises practices to be configurations of activities, with significant meanings in specific sociocultural settings, that people draw on as templates for everyday action (Reckwitz, 2002; Warde, 2005). Practice theory offers a reasonable medium between the hyper-individualistic psychological theory and the collective sociological approach and allow the focus to be on WST usage practices, including underlying elements such as skills, knowledge, tools, and/or emotional and cognitive procedures (Schau et al., 2009; Shove & Pantzar, 2005; Spurling et al., 2013), and the ways in which they align and diverge. Further, this research adopts a post-humanist approach (Fox & Alldred, 2017) in order to address questions on the

[1] Obesity, diabetes, and heart disease are a few of the most prevalent types of lifestyle diseases (the kings fund, 2022b).

relationships between human and non-human entities in the configuration of WST practices. Such questions are pertinent in this context given the design, features and interactive capabilities of smart WST technologies (Hoffman & Novak, 2018; Schweitzer et al., 2019) but they have been overlooked to date. This is not surprising given that the prevailing theories in this field foreground the user, and assume a hierarchy where the human is at the top (e.g. Kim & Shin, 2015; Shin et al., 2019). However, practice theory studies, and post-humanist approaches in particular, direct attention to the role of the technology (non-human) as well as the user (human) in (re)-forming and performing WST practices (e.g. Gram-Hanssen, 2010; Reckwitz, 2002). Further, it also acknowledges the reflexive and personal nature of self-tracking, which is of critical importance to our understanding of the phenomenon (Lupton, 2014).

These gaps in the extant literature and the theoretical position of this study give rise to the following research questions:

1. What are the practices associated with the prolonged use of wearable self-tracking technologies?
2. What factors influence how the use practices take place?
3. What role do wearable self-tracking devices play in the interaction?
4. Are there any patterns linked to the performance of these practices? If so, how can they be differentiated?

To address these questions, I conducted thirty interviews with a demographically diverse sample of UK-based Fitbit [2] users using a stimulus-driven, qualitative approach where conventional semi-structured interviews were combined with a discussion of visual artifacts of the participant's own self-tracking data.

This novel application of practice theory uncovers eighteen usage practices (UPs) involved in prolonged use of WSTs and their underlying elements including characterisation of the device centrality and device agency for each practice. It shows that all participants perform activities that align with a core set of WST practices but distinguishes three groups that diverge in some ways, primarily in terms of the intensity with which they perform WST practices but also their engagement in a number of non-core practices. The different patterns of intensity (high, low, and fluctuant) observed across the groups is closely associated with the level of agency that people attribute to the device in the performance of practices. For instance, participants who regularly checked their device and thought about achieving targets explained that the WST 'knew better' about goal setting and how

[2] A popular commercial wearable self-tracker brand owned by Google.

to achieve them. The findings also show contrasting fitness identities across the three groups, with the high, low and fluctuant practice intensity patterns corresponding, respectively, with Aspirer, Fitness Oriented and Newly Fit identities.

This research contributes to the literature on WST by shifting attention to prolonged use. It brings a novel theoretical contribution to this multi-disciplinary topic of study by applying practice theory and revealing the configuration of activities involved in WST use, the underpinning elements and ways in which WST practices align and diverge. By adopting a post-humanist approach, this thesis contributes to three bodies of literature, namely the WST literature, practice theory literature and the wider literature on smart technology use and influence by illuminating the role of smart wearable devices in (re)shaping practices and triggering deliberation. A further contribution of this research arises from the finding of a connection between fitness-identities and divergent patterns of WST usage practices. These novel contributions enable me to adapt the Spurling and colleagues' iceberg model of practices (Spurling et al., 2013) to the WST context, adding device agency and device centrality as underpinning elements of WST practices. I also add fitness identity as the base of the iceberg to reflect that, throughout use experiences, users engage in self and/or device trigged deliberation which initiate cycles of reflection on the alignment of the practice with users perceived identities, and/or the fulfilment of such performance of their identity goals.

The implications of this research extend beyond its theoretical contributions to inform how wearables are designed and personalised, to tailor their cues and notifications to the user's fitness-identity and to foster the performance of UPs that are associated with prolonged use for each user. This, consequently, could help in realising the health benefits of self-tracking by encouraging long-term physical activity.

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CHAPTER 1: INTRODUCTION

1.1 RESEARCH BACKGROUND

Lifestyle disease is a major societal health challenge in the UK and many other places around the world (Blair, 2009; Thirlaway & Upton, 2010). Obesity, diabetes, and heart disease are a few of the most prevalent types of lifestyle diseases (The Kings Fund, 2022). Physical inactivity and sedentary behaviour have been identified as leading contributors to obesity which in turn is directly linked to heart disease, excessive blood cholesterol and diabetes (Mintel, 2017; UK Department of Health, 2011). In the UK, over 63% of all adults are overweight or obese, and the situation is similar for children with almost a quarter of all children under the age of six wh obese (NHS, 2020). Similarly, over 66% of British adults do not meet the recommended physical activity levels which is a serious problem that is estimated to cost the UK £8.7 billion annually (The Kings Fund, 2022a).

Lifestyle disease, particularly obesity, are believed to be avoidable with lifestyle modifications and sustained physical activity (Mintel, 2017; Perski et al., 2017; Thirlaway & Upton, 2010). Since the 1970s there has been a concentrated effort to battle these diseases which not only impact a large population, but is an area that costs the government over 70% of its health care budget (UK Department of Health, 2011). With the rise of individualism in the neoliberal west, healthcare took a preventative turn with a focus on behaviours rather than treatment and medication (Brown, 2018; Lupton, 2013; McColl-Kennedy et al., 2017; Vatter et al., 2021). This *behavioural turn* specifically emphasised the role of the individual in maintaining their health and preventing illness via various behavioral approaches such as physical activity, hygiene and reducing alcohol consumption etc. (Brown, 2018; Vatter et al., 2021). This approach was indeed fruitful for public health especially in terms of improving people's living conditions, sanitation and life expectancy (Brown, 2018). Yet while preliminary evidence shows a recent increase in physical activity among adults in the UK , obesity is still on the rise (Office of Health Improvement and Disparities, 2020). This raises questions about the sustainability of this behaviour and whether this increase in physical activity consistently meets the recommended guidelines (The Kings Fund, 2022b).

This shift in healthcare towards a form of responsibilisation of health has led to a "fitness boom" where fitness, defined as a leisurely physical activity, began to be conceived as a necessity, a moral obligation and an essential part of one's daily life (Brown, 2018; Maguire, 2008b; Millington, 2016). The moralisation of healthy living, and the urge for people to take responsibility for their own health and wellbeing led to the unprecedented popularisation of the curious term 'self-care' (Kickbusch, 1989; Maguire, 2008b). Official bodies like the World Health Organisation (WHO) started issuing

guidelines for *Self-Care*[3] where it is suggested that the new most effective approach for public health today is *"a continuum of [health- and self-] care"* (World Health Organization, 2022).

Caring for one's self through adopting a healthy lifestyle is becoming more prevalent and is predicted to form a global 'mega-trend' by 2030 (Stiglbauer et al., 2019). This is often referred to as 'Healthy living' which is a term used to describe an encompassing way of life that includes taking good care of one's mental and physical health, and overall wellbeing. While it is indeed not a completely new phenomenon, healthy living has gained exposure and was further popularised through living in a digitally hyperconnected world where health, diet and fitness prompts and cues are everywhere (Rodney, 2019). Whether that is through the fitness and health 'blogsperts' on social media (Daudi, 2022; Rodney, 2019), or the toned bodied influencers (Rodney, 2019; Uhlmann et al., 2018).

Another important characteristic of the current healthy living trend is self-tracking and the heavy use of technology (Millington, 2016). The concept of self-tracking is not strictly digital, it is an approach that assumes that the body is a machine-like entity, that can be optimised through actions (Lupton, 2013). However, insufficient evidence is available on the effectiveness of self-tracking in supporting prolonged physical activity and the more general healthy living trend.

Until the early 2000s, the majority of fitness and health self-tracking activities took place within small groups of people interested in "lifelogging"[4] or the "quantified self"[5]. However, the availability, affordability and intelligence of self-tracking digital tools have played a crucial role in the growth of the *digital self-tracking* trend (Ferreira et al., 2021; Lupton, 2016a). Today, self-tracking is normalised and is practiced both privately, and socially for a host of reasons which range from the purely voluntary and personal to the predominantly pushed or imposed (e.g., by employers or insurance companies) (Jovanov, 2019; Lupton, 2014, 2017; Paluch & Tuzovic, 2019).

Digital self-tracking tools are numerous and diverse yet, in essence, they all are designed to assist in performing similar sets of practices such as step-tracking, heart rate monitoring and exercise (Piwek et al., 2016; Steinhubl et al., 2015). Part of their design is also to provide aggregates of information on the body and physical activity creating data *profiles* of users that can be acted upon (Lupton, 2021a). The self-tracking data, or data profiles, are utilised by the device via sophisticated algorithms to create notifications, cues and feedback loops that are generated for the purpose of promoting or supporting

[3] In terms of incorporating self-care in both public health and medical interventions.
[4] Lifelogging refers to tracking various aspects of one's life including but not limited to physical activity, exercise, mood, and finances using analogue (and more recently, digital) tracking methods such as notebooks, spreadsheets and/or computer programmes (Feng et al., 2021; Lupton, 2016a).
[5] The Quantified Self can be considered as an outcome of self-tracking where the entire self is described in terms of numbers (Lupton, 2016)

'good' behaviours (see section 2.5 The Design and Capabilities of Wearables). This poses questions on the potential agentic capacities of self-tracking devices especially when the agency of 'things' has been hypothesised in related fields[6].

Today the most popular types of self-trackers are mobile software applications (i.e., Apps) and wearables (e.g., Fitbit) (Ferreira et al., 2021; Grundy, 2022; Hardey, 2019; Wittkowski et al., 2020). Smart wearable self-trackers (WST) are sensor-enabled devices often attached to the body in the form of wrist-worn bands and are one of the most popular consumer technologies in the world (Ferreira et al., 2021; Statista, 2021). This is hardly surprising given the numerous health promises associated with them, as well as their astonishing accuracy (Godino et al., 2020) and compact design (Statista, 2021).

Despite their similar positioning, the key difference between the Apps and WST is that by being attached to the body wearables are capable of tracking numerous bioparameters and types of movement seamlessly, continuously with minimal input from the user (Table 1; Chuah et al, 2016; Nelson, Verhagen and Noordzij, 2016; Krey *et al* , 2019). This, combined with real-time feedback loops and behavioural cues make wearables a unique self-tracking technology with a true potential to support, and enhance, a wide range of fitness- and health-related behaviours (Grundy, 2022). Yet despite the popularity and promise little is known about the actual prolonged use of wearables as scientific research remains focused on the acceptance of wearable technology, and novelty usage period, despite evidence showing that prolonged use is necessary for achieving any lasting benefits (Canhoto & Arp, 2017; Piwek et al., 2016; Stiglbauer et al., 2019).

Table 1: Feature summary of self-tracking technology (Apps vs. WST)

Feature	Standalone smartphone apps	Wearable activity-trackers' bundles (wearable + companion app)[7]
Automated step count	Yes (limited accuracy)	Yes (higher accuracy)
Automated exercise recognition	No	Yes
Exercise tracker (caloric burn, heart rate, intensity)	No	Yes
GPS tracker	Yes	Yes
Running/walking distance	Yes	Yes
Heart health (Heart rate, blood pressure, arrhythmia)	No	Yes
Sleep tracker	No	Yes
Menstruation	Yes (manual input)	Yes (manual input)
Caloric burn	No	Yes

[6] Hoffman and Novak found that smart, technological devices, enabled with capacities to interact with the user/consumer and each other, possess agentic capabilities (Hoffman & Novak, 2018)

[7] Based on a mid-range commercial activity-tracker (e.g., Fitbit charge 3)

Active minutes/reminder to move	No	Yes
Swim tracker	No	Yes

1.2 RESEARCH GAPS, AIMS AND APPROACH

Wearable self-trackers are designed and promoted as behaviour change (and/or support) tools that can support people's self-tracking efforts, and sustain healthy living practices, through standard behaviour change techniques such as goal-setting, virtual rewards, and frequent reminders (Abraham & Michie, 2008; Mercer et al., 2016). This approach emphasises the user's cognitive processes and views use as a rational and identical experience, despite early evidence suggesting that self-tracking is a highly personal and reflexive phenomenon (e.g., Lupton, 2014). Thus far, the WST literature is highly focused on the initial 'novelty' use which many argue does not reflect the prolonged use which, studies show, is necessary for realising any sustained health benefits (Stiglbauer et al., 2019). This comes at a time where there is an evident challenge with continued use manifested as a surge in abandonment and disengagement with WSTs. This raises questions on how long-term users utilise their WST devices, and in which ways do their usage patterns align or diverge (Feng et al., 2021; Ferreira et al., 2021; Lupton, 2017; Shin, Jarrahi, et al., 2019). Further, the scholarly literature is largely dominated by psychology-grounded approaches such as the Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT2), Theory of Planned Behaviour, and similar (Shin, Jarrahi, et al., 2019) which emphasise the human. In addition, the sociological approach of studying self-tracking *cultures*[8] (often including all self-tracking technologies together) looks at the use as a collective and uniform social phenomenon, ignoring the inter-personal differences inherent to humans (Lupton, 2016a). These approaches further assume that the human is the sole agentic entity, ignoring the potential role of other, non-human entities, in the usage experience (i.e., the device itself) despite the emergence of a new body of literature which illuminates the interactive capabilities of smart devices (e.g., WST), highlighting the features and design which give them the ability to auto-generate feedback loops and push notifications (Hoffman & Novak, 2018; Schweitzer et al., 2019). Lupton recently found that when users are faced with self-tracking data aggregates that do not match their expectations (or aspirations) they become defensive and try to 'dissociate' themselves from them claiming that they are superficial and incomplete (Lupton, 2021a). This suggests that the device may possess a form of *agency* or capacity to influence the way users engage in health and physical activity practices, their emotional state, and may trigger deliberation.

[8] This work acknowledges the device as a tool that self-tracking cultures/communities utilise to reach their self-tracking goals as such still keeps the emphasis on the human (Lupton, 2016a, p.63)

Hereby I take a post-humanist approach to further investigate the use of wearable self-trackers beyond the early adoption stage while emphasising the role of the self-tracking device in (re)shaping practices and triggering reflection (e.g., Canhoto & Arp, 2017; Shin et al., 2019). To ensure consistency and comparability across the collected data, I base my research on the use of Fitbit, one of the most popular and user-friendly wearable self-tracking brands in the world (Statista, 2021).

I approach the phenomenon from a practice theory angle, moving beyond the focus on the individual to examine *practices* as a unit of analysis, while considering both the observable performances and the constellation of factors underpinning how they take place (i.e., users' skills and knowledge, tools and material objects, and emotional and cognitive meanings) (Schau et al., 2009; Shove & Pantzar, 2005). The core benefit to this approach is the theoretical flexibility it offers to investigate the widespread WST usage phenomenon, giving direct attention to both the human and the non-human in shaping practices, and the ways in which users' practices align or differ. Further, this theoretical lens aligns with the post-humanist philosophical stance and the qualitative methodological approach I take in this thesis.

The aims of this thesis are to a) understand the practices associated with the prolonged use of wearable self-trackers (WST) and reveal the role of wearables (and associated technology) in this context, and b) uncover the similarities and/or differences in the way users utilise their WST. Put concisely, I aim to answer the following research questions:

1. What are the practices associated with the prolonged use of wearable self-tracking technologies?
2. What factors influence how the use practices take place?
3. What role do wearable self-tracking devices play in the interaction?
4. Are there any patterns linked to the performance of these practices? If so, how can they be differentiated?

While I focus on wearable smart devices in this thesis, the findings are expected to be relevant to other 'smart' technology contexts. This is due to the similarities between many smart devices design, capabilities, and properties e.g. sensor-enabled, real-time data collection and reporting, personal data informed notifications amongst others (see section 2.5 for further details).

To investigate this research topic in a time where there were strict social-distancing rules (see 3.4.1 The impact of the pandemic on research design), I utilised the WST device-generated data records visually in the form of figures and diagrams to complement conventional semi-structured interviews and prompt for deeper and/or alternative accounts in a non-intrusive manner (see 3.4 Research Design Approach). As a 'method theory' (Jaakkola, 2020), practice theory proposes a certain way of analysis focused on *practices* while considering the device, the human and the variety of factors that

may underpin them (Nicolini, 2017). As the analysis progressed, preliminary indicators started to emerge pointing at potential *patterns of use*. As such, an idiosyncratic analysis (Pelham, 1993; Fournier, 1998) took place to uncover those prospective typologies. The analysis process was iterative and both data collection and analysis were conducted until saturation was reached (Saunders & Townsend, 2016).

1.3 INTENDED CONTRIBUTIONS

By addressing the research questions, this study could contribute to the WST literature by shifting the attention to the activities and processes of prolonged use. The post-humanist approach of this research allows for the consideration of the WST design, and features, which could further contribute to this body of literature by highlighting the role of the device in (re)shaping the practices of use and triggering deliberation. Additionally, by utilising practice theory in the context of wearables, the study intends to contribute to the wider practice theory literature by shedding a light on these increasingly popular smart-technology mediated practices and their special dynamics, potentially uncovering previously unknown underpinning elements.

Lastly, the application of the post-humanist approach and practice theory *together* in this study should contribute to both the WST and practice theory literature by offering a better understanding of the different ways in which individuals use their WST as such offering important insights into the use of this widespread technology. This in turn could inform the theoretical development of practice theory and offer new conceptual models more suitable for the study of contemporary smart-technology mediated practices such as these ones. The implication of this study is expected to extend beyond theory to inform how WST are designed, personalised and utilised to make realising the promised health benefits of long-term fitness-tracking more attainable.

1.4 THESIS OUTLINE

This thesis is composed of five remaining chapters which are organised as follows:

Chapter 2 provides a review, and critically evaluates the multidisciplinary literature on the use of wearables, and their utilisation for behaviour change. In this chapter, a review of the technological literature on the design of WST is also provided to explain the unique features and capabilities of the device. The chapter also includes an introduction and an overview of practice theory in marketing, self-tracking and the use of wearables respectively, and finishes with a close examination of the specific theoretical model applied in this research.

Chapter 3 is the methodology chapter which presents and justifies the research design and its appropriateness to the study. The research philosophy (new materialism) and the post humanist approach are described first before the research design is discussed and justified. The data collection procedure is then discussed, followed by a discussion of the iterative analytical approach (inductive thematic analysis, and idiosyncratic analysis) of this thesis. Ethics, data handling and limitations are also outlined in this chapter.

Chapter 4 is the first findings chapter in which usage practices are introduced and discussed (RQ1) along with the core concepts of Device Agency and Device Centrality (RQ3). Eighteen usage practices are described according to the practice theory analytical model explained in chapter 2 and are supported by extracts from the interview data. The usage practices are then grouped under five dimensions according to their predominant nature (i.e., physical activity, tracking, social, cognitive, and emotional).

Chapter 5 is the second findings chapter in which the usage practices are contextualised. In this chapter, eight core practices related to prolonged use of WSTs are identified which were commonly performed across all research participants. Further, the typological (idiosyncratic) analysis findings are presented in the form of three patterns of engagement with WST for long-term Fitbit users (RQ4). These patterns are then discussed in relation to users' sense of identity (fitness-identity) and how that is manifested in the performance of the WST usage practices (RQ2).

Chapter 6 is the final chapter, presenting the discussion and conclusions of this thesis. It includes a detailed discussion of the findings of this research and how they related to the initial research aims. The theoretical contribution of this research to the wearable self-trackers use and practice theory literature are presented, with a special focus on the novelty of the findings of this thesis in terms of the value of considering practices as a unit of analysis, identifying an agentic quality of WSTs and the prospective role of fitness-identities in this context. Empirical implications are also discussed, in addition to remarks on the limitations of this thesis and pointers for future research.

CHAPTER 2: LITERATURE REVIEW

2.1 Chapter Introduction

In the previous chapter, the research background, and context were explained, and the gaps in the literature were highlighted to summarise and justify the need for the research of this thesis. Those gaps were identified through a thorough literature review that will be discussed in this chapter.

This literature review chapter provides an overview, and a critical appraisal of the multidisciplinary WST literature, and by doing so connects the fragmented bodies of literature and defines key concepts. Further, this chapter critically evaluates the wider practice theory literature concluding with its application in *relevant contexts* e.g., service, and social marketing.

The chapter starts with a broad scoping review of the WST scholarly literature to connect it to the various relevant fields. It then moves to discussing the current body of knowledge on WST use, and applications e.g., in behaviour change. After that I explore, and critically evaluate the literature on the design, functions and potential influence of the device which is mostly situated within the information technology (IT) field before finally outlining key gaps in the literature.

The last part of this chapter is focused on practice theory, justification of its selection as a theoretical approach and the application of the Iceberg model (Spurling et al., 2013).

2.2 Overview

The body of academic literature on WST has grown exponentially over the last decade (Ferreira et al., 2021; Shin, Jarrahi, et al., 2019). However, given the multidisciplinary interest in the phenomenon (Figure 1) and the variety of theoretical, and methodological approaches operationalised, the wearable trackers' literature is rather fragmented (Dehghani & Dangelico, 2017; Ferreira et al., 2021;

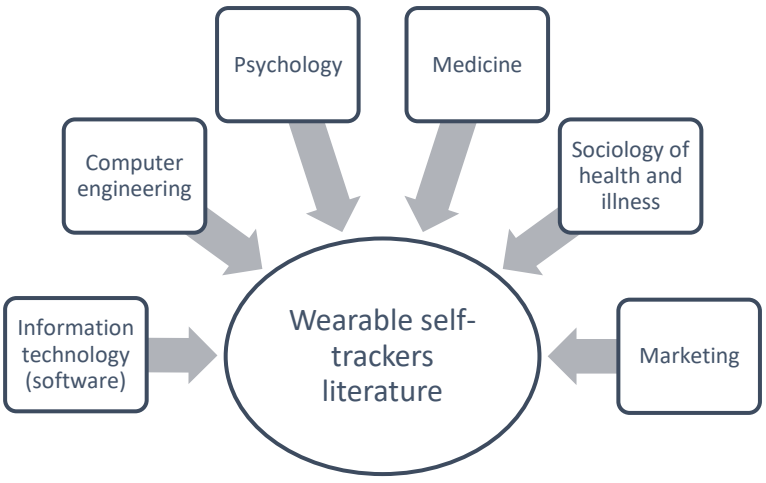

Figure 1: Key disciplines contributing to the literature on WSTs

Krey et al., 2019; Piwek et al., 2016; Shin, Jarrahi, et al., 2019). While researchers from IT have focused on the design and software of WSTs (Dehghani & Kim, 2019), those studying them as computing systems took interest in WST's sensors and algorithmic capabilities (Aroganam et al., 2019). As a self- and health-care technological solution, healthcare researchers explored wearables for their potential physical and mental health benefits (Jakicic et al., 2016; Kanstrup et al., 2018) while health sociologists explored WST as an emergent, collective, social phenomenon (Fotopoulou & O'Riordan, 2017; Lupton, 2017). Finally, marketing researchers are beginning to catch up with the wave, showing interest in WST mainly from a value(-formation) perspective (Canhoto & Arp, 2017; Luyen et al., 2021). The aim of the following part of this chapter is to outline and discuss what is known about WSTs while highlighting the gaps in the existing literature. Taking a helicopter view of the self-tracking literature, one can divide it into two streams based on the studies' positioning, 1) the WST use literature, and 2) the behaviour change literature which will respectively be reviewed in detail next.

2.3 WEARABLE SELF-TRACKERS USE

The process of integrating a WST device into one's existing self-care lifestyle (or the failure to do so) could be imagined as a sequence (Figure 2). According to the literature, this sequence starts with motivation driven by multiple factors which could then be translated into a positive attitude towards the device (acceptance), followed by having an intention to adopt the device (adoption intention) before the act of actual *adoption* and *use*. Use varies in its nature, intensity and efficacy and can be over a long or short period of time which may end by the abandonment of the device. The figure below illustrates this process which, in reality is not so linear, and the published research on each of these phases will be discussed below (Figure 2; Attig & Franke, 2020; Canhoto & Arp, 2017; Chuah, 2019; Dehghani, 2018; Jarrahi et al., 2018; Kim & Shin, 2015; Shin, Jarrahi, et al., 2019).

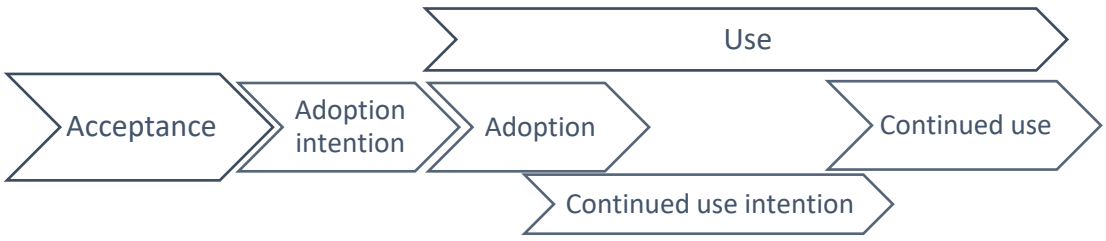

Figure 2: The process of WST integration and use

2.3.1 Adoption and Adoption intention of wearables

It has been argued that behavioural intentions determine the enactment of behaviours (Marakhimov & Joo, 2017). Most publications on self-tracking, whether academic or commercial, have paid significant attention to motives, and determinants of adoption intention and the act of adoption but have often failed to consider the unconventional ways people come to use these devices (e.g., acquiring an old tracking device of a family member). It is likely that the wide interest in adoption (intention) is underpinned by the assumption that adoption is a determining factor for sustained use and hence, is critical to the future and growth of the industry of (wearables) self-trackers beyond its current avenues (Piwek *et al*, 2016; Dehghani, 2018; Lee and Lee, 2018; Shin *et al*, 2019). However, the growing number of publications reporting slowing adoption rates (Casselman et al., 2017), short periodic use (Dehghani, 2018; Godfrey et al., 2018), and high rates of abandonment (Attig & Franke, 2020; Chuah, 2019) indicate that adoption and use are not directly proportional. In other words, the initial acceptance and adoption intention of WSTs is a fundamental step, however, it is not an indication of the sustained use often required to reap the promised rewards of self-tracking (Piwek et al., 2016; Stiglbauer et al., 2019).

In terms of the theoretical underpinnings of this body of literature, most empirical studies view the phenomenon as a simple new technology acceptance and/or use situation (Table 2). The most commonly applied theoretical framework is the Technology Acceptance Model (TAM) and other iterations of it which are deeply rooted in psychology (Davis, 1989). TAM is a theoretical model that considers how and why people come to accept a particular technology (Davis, 1989). Popular theoretical approaches include the Unified Theory Of Acceptance And Use (UTOAU), the Unified Theory of Acceptance and Use of Technology (UTAUT2), Theory of Planned Behaviour, The Coping Theory, Conformity and Reference Group Theory and the Theory of Perceived Affordance amongst others (for example: Jarrahi et al., 2018; Krey et al., 2019; Lee & Lee, 2018; Tamilmani et al., 2019; Zhang et al., 2017). Some researchers even designed WST-specific TAM models (Kim & Shin, 2015). However, they all fell short by viewing WST as another static digital technology similar to a personal computer, or a mobile phone, and subsequently focusing on the *wearers'* perspective. As such, the adoption and early use literature not only focus on the user's acceptance and perception of technology, but it also assumes that all technological innovations are static, neglecting the features and interactive capabilities of smart technologies such as WST (see 2.5 The Design and Capabilities of Wearables).

Findings from the adoption (intention) literature were generally similar, with the exception of studies conducted in non-western contexts, for example in studies conducted in Asia, vanity, and aesthetic

appeal were more commonly reported as reasons for adoption than those done in the west. Overall, self-efficacy, health awareness, enjoyment, usability, security, and design of the device were commonly reported as factors that influenced the adoption decision (table 2)

2.3.2 Use and continued use intention of wearables

Similar to adoption, whilst use and continued use intention were explored as overlapping constructs in the literature research on actual *continued use* is still scarce (Lunney, Cunningham and Eastin, 2016; Canhoto and Arp, 2017; Marakhimov and Joo, 2017; Shin, Feng, *et al*, 2019). While a growing number of researchers point at this gap (e.g. Canhoto & Arp, 2017; Matt et al., 2019), others go further, critiquing the literature by questioning the value of adoption research in the rise of the adoption-abandonment phenomenon (Windasari et al., 2021). Continued (or prolonged) use refers to use beyond the early novelty period (Canhoto & Arp, 2017; Windasari et al., 2021). To the best of my knowledge, apart from a few small-scale exceptions, such as Canhoto and Arp (2017), no other researchers address the lifestyle use[9] of WST beyond the first two months of use (Meyer et al., 2017; Shin, Feng, et al., 2019; Stiglbauer et al., 2019). This is problematic as it not only leaves the most common type of self-tracking unexplored, but also these studies are a reflection of novelty use, and early evidence suggests that over a third of new WST users stop using their devices after 3 months with less than a half still using their WSTs after a year (Canhoto & Arp, 2017; Casselman et al., 2017; Stiglbauer et al., 2019). As such, I argue that exploring the use in the first two months does not necessarily tell us how long-term users interact with their devices or whether they would continue to use them even if they indicated so then.

Further, similar to adoption the use of wearables and continuance intention is largely studied from a perspective of technology acceptance and usability (Chuah, 2019; Nascimento et al., 2018) (Table 3). This highly human-focused, individualistic framework overlooks the various external factors that may be influencing use such as the social environment and the device itself.

Common themes and constructs from the study of the use of WST were similar to those observed in the study of adoption (Table 3). Perceived ease-of-use, perceived usefulness, functionality, social image and perceived enjoyment were reported repeatedly (Canhoto & Arp, 2017; Dehghani et al., 2018; Matt et al., 2019; Shin, Feng, et al., 2019). While wearables' compatibility with other smart devices was a far more crucial determining factor for continuous use intention than for adoption (Dehghani, 2018; Dehghani et al., 2018). There is still limited knowledge on WST use beyond the first six months of use despite the multiple calls in the literature to explore the activities and practices

[9] Meaning voluntary, non-athletic, and non-medical use of WST (Kerner & Goodyear, 2017).

associated with prolonged use (Canhoto & Arp, 2017; Piwek et al., 2016; Stiglbauer et al., 2019). Table 2 below lists the empirical studies focused on use (adoption and continued use) which were included in this review. As shown, the majority of these studies utilised TAM, or other psychology-based theoretical approaches, which leaves an evident gap in the literature in terms of the theoretical understanding of the phenomenon.

Table 2: Wearable self-trackers' use literature review

Publication	Purpose	Summary	Main theory
(Canhoto & Arp, 2017)	Adoption and continued use (2 months)	Empirical study of the factors influencing the adoption and sustained use of wearables among the general public. The study specifically looks at the factors related to the user, the society and the context of use.	A reconciliation of the Unified theory of acceptance and use of technology (UTAUT) (user-focused), and the social shaping theory (society and context-focused)
(Choi & Kim, 2016)	Adoption	The paper explores whether fashion-related factors affect the adoption intention of smart wearable devices	Technology Acceptance Model (TAM)
(Chua*h et al*, 2016)	Adoption intention	Investigating the underlying psychological factors driving adoption intention	Advancement on the TAM
(Chuah, 2019)	Continuous use intention	The study examines the lifestyle incongruence effect on the continuous use intention	A framework based on The Net Valence Framework and supplemented by the Technology Acceptance Model (TAM)
(Dehghani & Kim, 2019)	Adoption	The study investigates the role of the aesthetic design features of smart wearables on the behaviour of current users and the adoption intention of potential users	No theory specified
(Jarrahi et al., 2018)	Adoption	In this study the authors investigate the impact or prior motivation influence the adoption of wearable devices	The Theory of Perceived Affordance
(Jung et al., 2016)	Adoption	The study examines potential consumers' perceptions on smartwatch attributes impact on the decision to start using the device	Conjoint analysis method of alternatives (grouping alternatives-72 characteristics are grouped into 18)

(Kim & Shin, 2015)	Adoption	To identify the key psychological factors that influence the adoption of wearables and to integrate these findings to generate a wearables-specific version of Technology Acceptance Model (TAM) framework	Technology Acceptance Model (TAM)
(Krey *et al*, 2019)	Adoption	The study examines advertisement (both functional and emotional) of smartwatches' influence on the adoption of the devices	A model based on: -TAM -the elaboration likelihood model -the schema incongruity theory
(Lee & Lee, 2018)	Adoption intention	The aim of this study is to examine factors that influence an individual's intention to adopt a wearable fitness tracker	Theory Of Planned Behaviour
(Lunney et al., 2016)	Adoption and use intention	The study examines TAM variables (plus perceived health outcomes) influence on acceptance and use	Technology acceptance model (TAM)
(Matt et al., 2019)	Continuous use intention	This study investigates the potential positive and negative attributes that users associate with smartwatches and how these attributes influence the intention of continuous use	Constructs were based on: -Unified theory of acceptance and use of technology (UTAUT 2) -Health information technology acceptance model (HITAM) -Health information privacy concerns model (HIPC)
(Michaelis et al., 2016)	Adoption	The goal of the study was to conduct a usability analysis on online reviews for wearable fitness devices to determine which factors were important in determining product acceptance and user experience	No theory specified
(Nascimento et al., 2018)	Continuous use intention	The researchers study wearables' continuous use intention and its determinants	The study suggests the continuous theory framework based on the expectation-confirmation model and technology acceptance model (TAM)

(Nasir & Yurder, 2015)	Adoption motivation	To identify the perceptions of users as well as physicians about wearable health technologies. In addition to provide further understanding of what motivates individuals to adopt wearables	Advancement on the TAM
(Shin, Feng, et al., 2019)	Adoption and use	This study explores the impact of the novelty effect on activity tracker adoption and the motivation for sustained use beyond the novelty period	No theory specified
(Yang *et al.*, 2016b)	Acceptance	The study examines the user acceptance of wearable devices	The study developed a theoretical model based on the Customer Value Perception
(Zhang et al., 2017)	Adoption	The study examines the influence of three themes of attributes on users' adoption intention towards wearables. They are namely, technical attributes, health attributes and consumer attributes	An integration of: -TAM -Health belief model -snob effect theory -conformity and reference group theory

2.4 SELF-TRACKERS AND BEHAVIOUR CHANGE

From the early beginnings of self-tracking and the emergence of wearables, they have been associated with a propensity to impact behaviour change (Yardley et al., 2016). Wearable self-trackers are marketed as tools that could assist people to be healthier and more active (Harrison et al., 2014). In fact, the design of the vast majority of self-tracking tools, including Fitbit (see section 3.5), is based on well-known behaviour change techniques such as goal-setting, focus on past success, rewards, social comparison etc. (Abraham & Michie, 2008; Lyons et al., 2014; Mercer et al., 2016), and is grounded in popular Behaviour Change Theory, for instance, Social-cognitive theory and Control theory (Bandura, 1989; Abraham & Michie, 2008; Grundy, 2022; Mercer et al., 2016). Hence it is only natural for a substantial body of literature to emerge on WST and behaviour change.

While it has been suggested that a connection is present between the use of WST and health behaviour change, it is still unclear how WSTs can sustainably support the change of users' health and physical activity behaviours (Chuah, 2019; Lee & Lee, 2018; Stiglbauer et al., 2019). This, combined with the scarcity of research on prolonged use of WST make these said benefits appear speculative (Canhoto & Arp, 2017; Stiglbauer et al., 2019). In the same vein, there is an unbalanced emphasis in the literature on initiating behaviour change through WST rather than maintaining it despite evidence of disjuncture between initiating behaviours, and maintaining them (Kersten-Van Dijk et al., 2017; Sheeran, 2002), and the growing cases of behavioural relapse (Kwasnicka et al., 2016). Therefore, behaviour change literature on wearables mirrors that on use (see section 2.3.1 and 2.3.2 above) in that it overlooks the activities and behaviours that occur (or emerge) after the initial novelty period of use (Canhoto & Arp, 2017).

Behaviour change theories are inherently individualistic, viewing users as predictable, rational entities that are completely segregated from the materialistic world surrounding them, neglecting not only interpersonal variations but also the impact of the socio-materialistic world in which behaviours take place (Burke et al., 2009; Spotswood et al., 2019; Warde, 2014). Critical scholars have noted that the common view of behaviours as distinct, homogenous and universal entities is equally troublesome. This view ignores the routinised, and seemingly mundane, practices in everyday situations where the behaviour is taking place (Hargreaves, 2011), and the influence of other (animate and inanimate) entities on the phenomenon (Burke et al., 2009; Hekler et al., 2016; Perski et al., 2017). As such, this approach fails to provide critical insights into *what people actually do and why* (Cohn, 2014).

In addition to that, most behaviour change theoretical models emerged in the pre-smart-tech era hence they fall short in considering the unique capabilities of smart digital technology (Patrick et al.,

2016; Perski et al., 2017). However, smart digital technology is distinctive in that it is capable of collating, interpreting, and pushing data in meaningful ways (see section 2.5). To date, the majority of (digital) behaviour change models overlook the impact of these features of smart devices (e.g., WST) and their ability to ignite a form of reflexivity and deliberation on personal behaviours against a host of elements such as social norms, personal goals, and the person's physical and mental position at a given time (Hekler et al., 2016). This leaves a gap in the literature which, if addressed, could provide valuable knowledge on the role wearables (and similar smart technologies) play in (re)shaping behaviours. A tabulated summary of the key studies discussed above on WST and behaviour change can be found below in table 3.

Table 3: Wearables and behaviour change literature review

Publication	Purpose	Summary	Main theory
(Attig & Franke, 2019)	Behaviour change (increased physical activity)	This study investigated the role wearable fitness-trackers play in motivating/ de-motivating users to be physically active	Self-Determination Theory
(Fotopoulou & O'Riordan, 2017)	Behaviour change (self-care)	The study focuses on how users learn to self-care using wearable technologies. Specifically, through the adaptation of new micro-practices of self-caring	This study uses The Framework of Biopedagogy
(Jakicic et al., 2016)	Behaviour change (weight loss)	The study explores the impact of combining dietary changes with the adoption of a wearable device for weight loss in obese patients	No theory specified
(Kinney et al., 2019)	Behaviour change (physical activity)	The study investigates college students' perceptions of wearable fitness trackers' impact on physical activity and self-efficacy	No theory specified
(Nelson et al., 2016)	Behaviour change (health goal achievement)	The study examines the correlation between wearing smart wristbands and the empowerment of users to committing to specific health goals.	The study suggests a theoretical model based on The Self-Regulation Theory of Psychology
(Owens & Cribb, 2017)	Behaviour change (health autonomy)	This research addresses the question whether wearable fitness-trackers play a role in promoting	No theory specified

		personal health autonomy	
(Stiglbauer et al., 2019)	Behaviour change (increased health consciousness)	The study tackles the question of whether the user's health benefits from using a wearable device or not	The study draws on several theoretical perspectives such as: -Self-regulation -Self-determination -health consciousness -Perceived Physical Health and Psychological Well-Being

2.5 The Design and Capabilities of Wearables

In this part of the thesis, I outline the key facts and features related to the design and technological capabilities of WSTs. Drawing on information technology (IT) and sociology literature I demonstrate the importance of considering the influence of smart technology on human behaviours, practices, and cognitive and emotional processes.

2.5.1 The algorithms of WST

'Algorithms are opinions embedded in code' declares O'Neil (2016) in her pertinent best-seller book Weapons of Math Destruction (O'Neil, 2016). Algorithms, in the form of Artificial Intelligence (AI) drive most of our digitally mediated activities and are instrumental in how digital data are collected, deployed, used and sold (Ameen et al., 2021). Algorithms today help organisations manage their business operations, marketing activities and, even people with little human input (Calvard, 2019; Lupton, 2017). However, algorithms develop over time, usually by various coders, which often leads to 'black box' type algorithms whose capabilities and impact are impossible to fully unpack (Godfrey et al., 2018).

This issue of algorithm transparency is often discussed in contexts relevant to corporates (e.g. Calvard, 2019), social media (e.g., Milan, 2015) and surveillance societies (e.g., Lupton, 2016b; Lupton & Michael, 2017). Yet, despite the intimate nature of self-tracking, the algorithms of self-tracking systems, how they decipher data, and which data are translated into feedback/prompts remain underexplored (Nafus, 2014). Not understanding how self-tracking data are processed and fed-back is a serious issue, as through feedback loops and push notifications the device is inevitably influencing users' behaviours. This is, after all, what it is designed to do (i.e., the behaviour change rooted design). This is particularly concerning as it raises questions of agency, such as who (or what) has agency, and how is that translated into use. Perhaps one of the biggest ethical concerns here is WSTs allowing potential third parties to manipulate consumers towards more economically, or commercially favourable behaviours, yet thus far, many of these aspects remain unclear.

Smart devices algorithmic design and capability to interpret the data collected and push it back to the user in various actionable forms is how *agency* of smart technology has been originally defined in the early days of its emergence (Franklin & Graesser, 1996). The agency of smart 'things' has been hypothesised across several disciplines since, yet perhaps due to the multidisciplinary interest in these objects, definitions varied greatly. Franklin and Graesser's (1996) attempt to create a unified taxonomy of 'autonomous agents' signals a long-standing need for clearer definitions. Naturally, as smart technology proliferated since, further definitions appeared, and more confusion infiltrated the

literature on what can be considered an agentic object. It is therefore important to take this opportunity to define agency as is understood in this thesis.

Agency is hereby defined as the quality and capacity of an entity (human or non-human) to sense the surrounding environment, gather and process data (or information), and produce an outcome that could affect the order of the surrounding world (Hoffman & Novak, 2018; Sillar, 2009). It is worth noting that while *Agency* could be generally and objectively defined, human agency is a particularly specific form of it, as the salient, cognitive, and moral consciousness of humans play a pivotal role in shaping their actions, and consequently their prospective influence (Rossiter, 2007; Sillar, 2009). That is not to relegate the agency of things to a lower, less important level, but instead, it is to distinguish between the different forms of agency one could observe within a smart device usage system.

2.5.2 The data of WST

Under the proliferation of digital technology, it has been argued the modern consumer is embedded within a nexus of smart 'things' that are constantly collecting data about various aspects of their lives (Jovanov, 2019; Puntoni et al., 2021). From social media activity, to the ubiquitous CCTV devices, to their own voluntary tracking of health and fitness, data is constantly gathered, and is regarded as the most valuable *commodity* of the 21st century (Nafus & Neff, 2016). On the other hand, data security, exploitation, and surveillance (or dataveillance (Lupton 2016)) are a research 'hot topic', mainly due to the lack of understanding of how personal (big) data are processed and stored, and who has access to them (Godfrey et al., 2018; Segura Anaya et al., 2018). Despite efforts to create, and implement strict regulations regarding personal data handling, processing, and use, the opacity of algorithms and interconnectedness of the web can lead to private data being (mis)used intentionally and/or unintentionally (Godfrey et al., 2018).

The literature suggests that the average consumer was less alarmed about their data security and utilisation so long as it is not (obviously or immediately) being exploited (Lupton & Michael, 2017). However, Lupton and Michael (2017) later found that this changes once consumers are asked to track all the points at which they are giving their personal data. Building on this, I argue that users of WSTs are not fully aware of how much data they are giving away, and what it is being used for. On this note, the trust users have in corporations (e.g., Fitbit) is alarming, users seem to 'trust' that their data will be handled ethically as long as a famous big brand is doing that (Lupton & Michael, 2017). For example, upon installing the Fitbit App, users must consent for the use of their 'unidentifiable' data by the parent company (Google) which almost everyone happily agrees to in order to use the App (Millington, 2016; Fitbit, 2022). It is yet to be reported that people decided not to use a WST due to such statements.

This all raise concerns regarding data privacy, and ethical handling especially, as WSTs sales skyrocket over the years (Statista, 2021). Data exploitation and misuse does not always happen in an obvious manner and may not have immediate noticeable implications on the consumer. For example, should the device have an influence on users' health behaviours and activities then the wealth of data collected on the user could result in highly persuasive cues from their WST which could subconsciously push them beyond their physical abilities or negatively influence their mental health. Users' general laxed attitude towards self-tracking data privacy means that their seemingly harmless self-tracking may pose dangerous implications on their health and wellbeing which contradicts the health promises of wearable's developers.

2.5.3 WST impact on the user

Smart wearable technology has been around for over a decade, long enough for us to begin to notice their impact on the consumer. As mentioned in the introduction, until the beginning of the digital, hyper-connected fitness boom, fitness and health activities were a private matter, practiced individually or within small social circles (Millington, 2016). Today, these activities are logged into various corporate clouds, broadcasted on social media and are often mediated by smart technology such as fitness apps and wearable self-trackers (Millington, 2016; Statista, 2019). The uniqueness of this phenomenon is that for the first time in history 'things' are able to seamlessly, and automatically collate, respond to, and feedback on people's activities (Crawford et al., 2015; Jovanov, 2019; Lupton, 2019). Hence, despite the fact that wearables are promoted as tools that can support autonomy (Owens & Cribb, 2017), one cannot help but question how truly autonomous an individual's actions are when interacting with their device. These tools are sensor-enabled and are specifically designed on behaviour change techniques (BCT) which permit them unique capabilities to nudge, or alter behaviours (Harrison et al., 2014; Lyons et al., 2014). In recent literature, the relationship between agency (the ability to perceive surroundings and act upon the data) and autonomy (to act independently without other agents' intervention) has been theorised, discussed and debated (e.g. Hoffman & Novak, 2018). However, there is a lack of knowledge about the general impact of non-human smart technology devices on people's behaviours and practices. As several researchers have noted, more needs to be understood about the impact this digital proliferation has on users' behaviours to ensure ethical, responsible, and sustainable use of (self-) tracking technology (e.g., Ellis & Piwek, 2018; Paluch & Tuzovic, 2019). It is however challenging to ensure data is used responsibly as, in the absence of regulations around algorithms and automated data (re)use, there is inevitably a risk that users will be vulnerable to manipulation, cyber security breaches, and data misuse.

Further, the accuracy of self-tracking tools has often been questioned and it is argued that accurate tracking is limited to certain postures, activities and 'standard' movement (Feehan et al., 2018;

Harrison et al., 2014). And whilst WST are becoming more accurate and sophisticated, inaccurate numbers could have dangerous implications, particularly on 'hard-core' users of WST (Lomborg et al., 2018) or those who are less versed in technology by setting unrealistic, excessive, or unsuitable goals for them based on inaccurate tracking information.

The ability of tracking tech to push, interrupt and elicit behaviour gives it a unique form of authority that perhaps changes the way health and fitness is practiced for good (Crawford et al., 2015; Lupton, 2019; Owens & Cribb, 2017). After all, this is the first point in history where humans (i.e., individuals, and medical professionals) are not the sole or most authoritative source of information about one's health (Crawford et al., 2015). The problem with this lies in portraying (or marketing) these devices as impartial tools that are merely designed to quantify health and fitness. This may lead to various negative consequences on people's psychological and mental wellbeing especially with personal health and fitness positioned as an individual responsibility and moral obligation (Brown, 2018; Kudaieva, 2019; Levinson et al., 2017; Linardon & Messer, 2019). Although self-trackers' developers pitch their devices as customisable and adaptable, they also encourage people to aim for the pre-set goals (e.g., 10k steps per day) implying that this is a 'good', socially acceptable, target to aim for. By doing so, they are putting psychological pressure on users to aim for those targets, which could lead to a host of negative thoughts and emotions if not reached, especially amongst vulnerable individuals (e.g. young women, and those with history of mental illness) (Berry et al., 2021; Kanstrup et al., 2018). In short, there is evident discrepancies between self-trackers default goal, users' personal capabilities, and data profiles[10] which could have serious consequences on people's physical health (e.g., stop exercising) and /or psychological wellbeing (e.g., developing an eating disorder).

To summarise, there is a growing debate around self-tracking using smart (wearable) devices. While some believe in the immensely positive impact of them (e.g., Owens & Cribb, 2017), others warn about the potential consequences of smart devices' unique capabilities on users psychological and emotional wellbeing (e.g., Berry et al., 2021). In reality, there is truth to both sides, yet at this early stage of research on WST a verdict is yet to be reached

2.6 The Gap

From this review of multidisciplinary literature on wearable self-trackers the gaps in the literature become evident. Academic literature is focused on the adoption, and initial novelty-period of WST use, as opposed to what happens after. It is also clear that the scholarly literature is largely

[10] A data profile is a virtual persona of someone created from the data captured on their online activities and/or from using smart devices (Lupton, 2021a)

underpinned by two extremes, first the individualistic psychology-based approach of the Technology Acceptance Model (TAM) and the sister, Unified Theory of Acceptance And Use of Technology (UTAUT) (Shin, Jarrahi, et al., 2019) which is predominantly a human-centered, and individualistic body of literature. Second, the sociological approach which places the emphasis on the dynamics of the socio-cultural phenomenon assuming a form of uniformity in the way people use WST e.g., the work of sociologist Deborah Lupton on the quantified-self movement (Lupton, 2016a, 2021b). As such, there is an emphasis on the human across the WST literature implying that the sophisticated, smart wearable devices, are mere tools and are largely uninfluential in the WST usage context. This seems odd especially after discussing the literature from IT (see section 2.5) and considering early evidence from Lupton's work (Lupton, 2014) which clearly point at a probable form of influence, and potential impact, of WST on various aspects of one's life.

Over the past decade, critical theorists in the WST and the wider self-tracking and digital behaviour change literary body have called for research on continued use of wearables (e.g. Canhoto & Arp, 2017; Meyer et al., 2020; Windasari et al., 2021) and utilisation of alternative theoretical approaches (e.g. Cohn, 2014; Hargreaves, 2011). Yet, despite these calls, the literature remains dominated by the same theoretical conventions.

To summarise, this research intends to address three gaps in the literature on wearable self-trackers. Namely 1) the lack of knowledge of the activities and practices associated with the prolonged use of wearables, 2) the dominance of human-centric approaches that overlook the capabilities and unique design features of smart devices, and 3) the overwhelming assumption that WST use is a highly cognitive and universal experience.

2.7 PRACTICE THEORY

In this thesis, the phenomenon of self-tracking via wearable technology is viewed through the lens of practice theory. Practice Theory offers the theoretical tools necessary to de-emphasise the human as a unit of analysis by drawing focus on the usage practices themselves and hence help filling one of the gaps identified in the literature (Spotswood, 2021; Spurling et al., 2013).

Generally, practice theory posits that *behaviours* are the observable part of a constellation of personal, external and contextual factors that underpin their emergence and hence, rejects the assumption of uniformity (Schau et al., 2009; Shove & Pantzar, 2005). Practice theorists agree that there are various benefits to viewing phenomena from a practice theory stance, despite their lack of agreement on one grand, unified theory of practice (Nicolini, 2017; Warde, 2014). The key benefit proposed is the theoretical capacity practice theory offers that enable researchers to encompass various elements (internal and external to the practice performer), and agents (human and non-human) into their conceptualisation (empirical examples: Schau et al., 2009; Shove & Pantzar, 2005; Spotswood et al., 2019). Hence, with practice theory it is possible to propose a multidirectional and dynamic relationship amongst agents and reject the notion of individualism and human hierarchy prevalent in the literature.

Core to the 'practice turn' (Schatzki et al., 2001) is admitting the role and/or agency of *things*, as such allowing researchers to investigate phenomena (i.e. consumption) in a post-humanist manner taking into account the role of the body (as a materialistic entity), the tools, and the spatial arrangements of a practice (Maller, 2015; Reckwitz, 2002; Shove et al., 2012; Spotswood et al., 2019; Warde, 2014, 2016). Further, practice theory focuses on understanding the philosophical, social significance of human activities proposing that these activities are organised, recognised and (re)enacted as 'practices' that may have personal, social, cultural or even universal significance (Nicolini, 2017; Schatzki et al., 2001; Shove et al., 2012; Warde, 2005).

That is not to say that practice theory ignores individuality, as it accounts for it by acknowledging the instrumental role of individual competencies, know-how and skills in the enactment of practices (Schau et al., 2009; Spurling et al., 2013; Warde, 2016). While practice theory gives priority to mechanisms and performances it also recognises the role of deliberation and reflexivity (Schau et al., 2009; Spurling et al., 2013; Warde, 2016). Historically, practice theory put less emphasis on deliberation, however, in Warde's school of practice theory, researchers argue that it is impossible to fully de-humanise practices and deny any form of mental reflection (Warde, 2016). Reflection, and

reflexivity[11] are hereby believed to occur in practices' performance when something 'goes wrong' or when individuals are 'called upon' to justify their performances as such implying an external trigger (Warde, 2016).

Shove and colleagues also consider the human by stressing their role in practice (re)formation (Shove et al., 2012). They suggest that the elements practices are comprised of are generally the same, yet the way in which these elements are connected is uniquely orchestrated by each individual when performed (Shove et al., 2012).

2.7.1 Practice theory in relevant literature

Practice theory is a theoretical orientation and not a single theoretical model (Nicolini, 2017). This approach defines *practices* as configurations of activities that have significant meanings in specific sociocultural settings (e.g., users' communities). Practices are performed individually in the pursuit of value; however, they usually emerge as part of a nexus or bundle of multiple practices (Shove et al., 2012, 2014).

A practice is conceptualised as an *entity* that is composed of specific, observable elements and underpinning elements which give it a distinctive *anatomy* (Schau et al., 2009). As practices exist beyond particular individuals, they are also often discussed as *performances* (e.g., driving is a practice regardless of who the driver is). While a census is yet to be reached regarding the exact elements that constitute practices-as-entities, looking at the literature the elements of practices can generally be summarised under; a) (observable) procedures, rules and principles of the practice b) skills, competencies and know-how that facilitate the enactment of the practice and c) meanings, used interchangeably with 'engagement' and 'ends and purposes' in the literature (Schau et al., 2009; Shove et al., 2012; Spurling et al., 2013). Shove also adds 'materials' to the elements of a practice explaining that the physical material needed for the enactment of a practice (e.g. driving) are an inherent part of practices as entities (Shove et al., 2012).

Schatzki announced the 'practice turn' in the early 2000s (Schatzki et al., 2001), and since then practice theory has been applied in the study of social phenomena (e.g. Shove & Pantzar, 2005; Warde, 2016), health and wellbeing (e.g. Blue et al., 2016; Maller, 2015), and more sparsely in marketing and consumer behaviour (e.g. Moraes et al., 2017; Skålén & Gummerus, 2022). In this, certain iterations of practice theory remained more popular in certain fields, for instance, Shove's 'three element'

[11] Reflexivity is defined as the *awareness of the self within the world* (Akaka & Schau, 2019)

theoretical model in public health research and Schau's in Marketing (Schau et al., 2009; Shove & Pantzar, 2005).

Yet simultaneously other models and advancements on practice theory emerged, especially in cross- and inter-disciplinary research (Nicolini, 2017; Warde, 2014). To this end, it must be noted that the absence of a unified, or universal 'Practice Theory' has not prevented the emergence of robust and important empirical practice theory research in various disciplines (Warde, 2014). In fact, it can be argued that this theoretical flexibility encourages inter-disciplinary, conceptual dialogues amongst practice theory enthusiasts which could be seen as a unique trait of strength.

In the self-tracking and wearables literature scholars at the intersection of sociology and technology are starting to direct their research towards viewing self- and health- care personal-use technologies (e.g., wearable technology) as more than just a tool to deliver an outcome or achieve a goal and more of an active agent, and participant, in practice formation and continuity (Henwood & Marent, 2019; Lupton, 2019).

On the whole, practice theorists are in agreement when it comes to the proposition that studying 'behaviours' is incomplete (Cohn, 2014; Hargreaves, 2011). Particularly, within the digital realm where practices are likely to be multifaceted, interconnected and influenced by technology. In Marketing, researchers implement various versions of practice theory to study the activities of consumers (Echeverri & Skalen, 2011; Melvin et al., 2020; Moraes et al., 2017; Schau et al., 2009; Skålén & Gummerus, 2022; Spurling et al., 2013; Woermann & Rokka, 2015). Of those, the few recent applications of practice theory in self-tracking literature have all utilised collective, social psychology versions of practice theory (Esmonde, 2020; Spotswood et al., 2020; Wilkinson, 2020). Albeit important developments, these still fall short when it comes to showing the full underpinning elements of self-tracking related practices such as addressing the mental and emotional activities, and the *recursive reflexivity* of users who engage in prolonged self-tracking (Akaka & Schau, 2019; Kristensen & Ruckenstein, 2018).

Whilst Wilkinson (2020) studies tracking ovulation in women trying to conceive, both Esmonde and Spotswood et al (2020) study the self-tracking practices of professional and/or regular runners. As such, there is still a lack of studies focused on studying WST usage practices for general health and fitness self-tracking in the general population.

Interactive practices are evidently special, particularly when the interaction is between humans and technology. Studies on interactive phenomena are focused on interaction as a value formation exchange (Echeverri & Skalen, 2011; Luyen et al., 2021). This narrow, purely human-centric view of

interactive phenomena (such as self-tracking (Luyen et al., 2021)) risks overlooking important aspects related the multidimensionality of said occurrences, such as the context in which the interaction takes place, and the role each entity (animate and inanimate) plays in it.

In the sociology of health, researchers addressed the continued (re)emergence of practices and how they take place. A good example is Blue (2017) where the author argues that in our contemporary world practices often evolve as bundles, together, over time. He argues that individually performed practices compete for priority in the practitioner's life and, as such, the dominance of one practice (he gives the example of going to MMA training) is at the expense of other daily practices (i.e., spending time with family). In other words, Blue suggests that routine practices are perpetually negotiated, replicated and recognised within the social and temporal spheres of everyday life which indirectly imply a form of deliberation despite that not being explicitly addressed (Blue, 2017). Akaka and Schau (2019) also investigate practice continuity, this time in the context of surfing. The authors view surfing as a prolonged consumption journey and 'identity-project' (Akaka & Schau, 2019). Their main proposition is that consumers are constantly reflecting on the (mis)alignment of each individual practice with their perceived, and/or desired identities. This, they argue, governs practices' fate in the long run which can fall under one of the following: adaptation, innovation, immersion or dissolution (Akaka & Schau, 2019). Hence, it can be argued that practices of a personal nature, and subjective importance (e.g., self-tracking) involve a higher level of reflection and deliberation (E. Banister et al., 2020; Moraes et al., 2017).

A tabulated summary of the relevant practice theory literature (i.e., marketing, consumption, physical activity, self-tracking, and self-care literature) can be found in table 4. As shown, none of the relevant studies i.e., in marketing, self-tracking, or value formation literature, focuses on WSTs alone, and take a theoretical stance that allow the emphasis of the role and/or agency of the device albeit the concept is discussed independently in various contexts e.g., eating, Nordic walking etc.

Table 4: Relevant empirical practice theory based studies.

Publication	Discipline	Purpose	Theoretical framework / approach	Key findings
(Akaka & Schau, 2019)	Marketing	Consumption journeys in the context of surfing	Schau's model: -procedures -skills and know-how -emotional commitment	They identify a connection between the value-creation practices and recursive reflexivity on one's identity within the world. Their findings support the notion that consumption experiences are "identity projects"

(Banister et al, 2020)	Marketing	Luxury consumption	Shove and Pantzar (2005): Skills, stuff, images	They identify and discuss practices of luxury consumption with an explicit focus on the human (i.e., seeking a "human-centric understanding of the meaning of luxury")
(Beatson et al., 2020)	Social Marketing	Green consumption	Shove and Pantzer's (2005) Skills, stuff, images	6 social practices themes of green consumption
(Blue, 2017; Blue et al., 2016)	Sociology	Health practices (MMA Exercise, and smoking respectively)	Shove et al (2012) images, materials, skills	Understanding (un)healthy practices (i.e. exercising and smoking, respectively)
(Brewster & Cox, 2019)	Medicine	Digital self-care practices	Shove et al (2012) images, materials, skills	They conceptualise the practice of taking one digital Photo-a-day as a practice of self-care
(Echeverri & Skalen, 2011)	Marketing	Interactive value formation in the context of public transport use	Schau's model: -procedures -skills and know-how -emotional commitment	They identify 12 interactive value formation practices that vary between value co-creation and value co-destruction practices
(Korkman, 2006)	Marketing	Value formation practices in the context of family practices on cruise ships	Schau's model: -procedures -skills and know-how -emotional commitment	Korkman identifies a number of practices of families, parents and children on cruise ships
(Kristensen & Ruckenstein, 2018)	Marketing	Gym culture self-tracking practices They emphasise 'fitness practitioners' and how tech allow humans to 'co-evolve'	Not explicitly specified	They emphasise 'fitness practitioners' and how tech allow humans to 'co-evolve'.
(Lupton, 2014, 2016b, 2020a)	Sociology	Self-tracking (apps and devices)	Lupton uses the terminology of Practice Theory yet never explicitly states what model/framework is used (or if any is being used)	Data logging, Quantified-self practice (singular), Digital technologies use practices for self-tracking.
(Luyen et al., 2021)	Marketing	Interaction with Technology-based self-	Practices are: Bodily, mental, know-how,	12 resource integration practices (RIPs). Categorised in 3 bundles (core, internal

		services (apps and devices)	emotional aspects (Reckwitz, 2002)	complementary, external complementary) then differentiate them by 'type of engagement with practices'.
(Melvin et al., 2020)	Marketing	Family tourism practices	Schau's model: -procedures -skills and know-how -emotional commitment	The authors find 7 practices which families engage in at historic attractions
(Moraes et al., 2017)	Marketing	Luxury consumption	Magaudda's circuit practice framework (based on Shove and Pantzar 2005 practice scheme) They understand shove' practice breakdown as: Objects Doings Meanings	They identify and discuss the practice of ethical diamond consumption
(Nairn & Spotswood, 2015)	Marketing	Consumption in children	Shove et al (2012) images, materials, skills	Children's consumption is a specific practice. Emphasis on the materiality of consumption.
(Narvanen et al., 2008)	Management	Online communities' consumption practices	Schau's model: -procedures -skills and know-how -emotional commitment	They identify 11 discursive practices. They further find a connection between 'lifestyle identity' and the evolvement of the community practices.
(Schau et al., 2009)	Marketing	Value creating practices	Their own model. Schau et al (2009): Practices have anatomy that consist of: -procedures -skills, tacit knowledge and know-how -emotional commitments	They identify 12 value creation practices categorised under 4 themes
(Shove et al., 2012; Shove & Pantzar, 2005)	Sociology	Everyday practices (driving, eating toast for breakfast etc); and Nordic Walking	Shove and Pantzer's (2005) Skills, stuff, images	Various conceptual contributions related to practices-as-entities, relationships between elements of practices, role of materials in the practice, and the temporal development of practices.

(Skålén & Gummerus, 2022)	Marketing	Value co-creation practices in the context of the Swedish music market	Schau's model: -procedures -skills and know-how -emotional commitment	They propose a framework that conceptualises services in terms of value cocreation practices, and propose that by (re)integrating elements of practices in new ways, users initiate service innovation.
(Spotswood et al., 2015, 2019, 2020)	Social Marketing	Cycling, Primary school children physical activity, running and self-tracking, respectively.	Shove et al (2012) images, materials, skills	Identify various practices related to each context. Emphasis on the role of 'material'
(Warde, 2005)	Sociology	Consumption	Shove's model of social practice	Practice of eating
(Wilkinson, 2020)	Sociology (Self-tracking)	Women's practices of ovulation self-tracking	Not specified	They identify a number of 'practices' associated with ovulation and fertility

2.7.2 Practice theory in this thesis: the iceberg model

As mentioned above, it is now generally suggested that practices constitute of the observable part or *practices as performances* and the underpinning part or *practices as entities* (Shove et al., 2012; Spurling et al., 2013). While this conceptualisation was first proposed by Shove, Spurling et al (2013) later popularised it via their iceberg illustrative model (Figure 3). The model suggests that practices are underpinned by three types of factors a) tools and material objects b) knowledge and skills, and 3) meanings (via emotional and cognitive procedures).

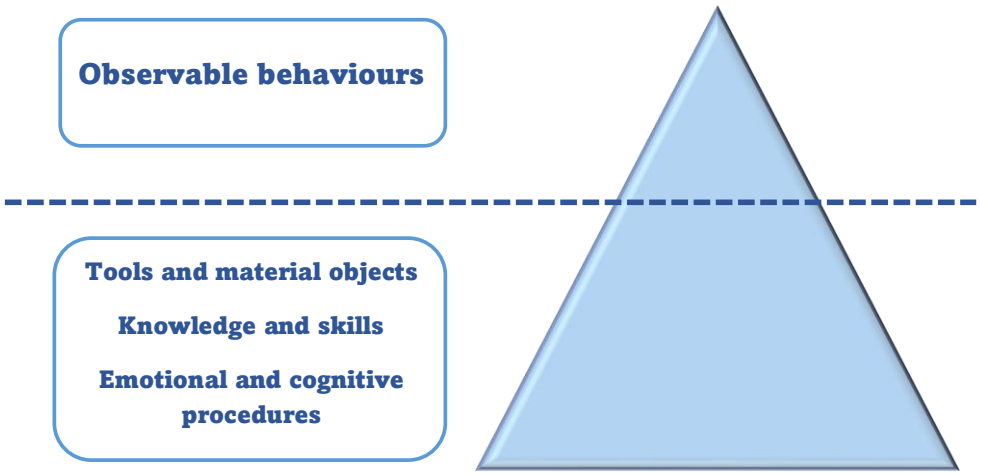

Figure 3: the iceberg practice theory model (adopted from Spurling et al., 2013)

In this thesis I utilise Spurling and colleagues' model for a variety of reasons, one being taking material objects into account and hence the conceptual compatibility with the suggested post-humanist approach (RQ3). Further, the iceberg model admits that practices are shaped and are influenced by actors' knowledge, experiences and competencies which suggests that performances are reflexive and unique to the performer which facilitate the uncovering of different patterns of use (RQ4).

The model has an additional advantage that could enrich the analysis which is the emphasis on *the meanings* associated with practices which relates to a host of cognitive, and emotional procedures, such as perceptions, cultural believes, sense of self and/or the social conventions (Shove et al., 2012; Spurling et al., 2013; Warde, 2016). As 'meanings' is loosely defined in the literature of practice theory, to avoid confusing this with *shared social meaning*s (e.g. as in Shove et al., 2012), in this thesis I will be referring to 'meanings' as *cognitive and emotional engagement* for consistency and clarity.

This theoretical position aligns with the aims of this research to apply practice theory to understand the practices associated with prolonged WST use, as well as the role of the human and the non-human agents in shaping the practices and the patterns by which they appear. It further allows for the exploration of subsequent cerebral processes such as reflection, deliberation, and reflexivity[12] which is less common with the practice theory sphere (Warde, 2016).

2.8 CHAPTER SUMMARY

In this chapter, relevant literature on WST was critically reviewed and discussed to highlight the gap this thesis is aiming to fill. First, the literature on WST adoption and (continued) use was reviewed before following up with behaviour change literature that looked at WST as tools that can assist in behaviour change. In this part of the review, the main gap identified were that little is known about the prolonged use of wearables which is argued to be crucial for obtaining WSTs' promised health benefits. Theoretically, the literature seems dominated by two extremes, the individualistic psychology-based theory (e.g., TAM), and sociology theory (e.g., Lupton's work) which again emphasises users (as a collective) and assumes a uniform way of use. Both of these focus on the human, ascribing it superior importance and hierarchy over other entities that may influence the activities and practices of use e.g., the device itself. Hence, I identify a gap with regards to understanding the role of WSTs in prolonged use, and the way users' practices align or diverge in such context.

[12] Definitions of these terms can be found in the Glossary table on page 196.

Based on the interest in illuminating the role of the device, the literature on the design and capabilities of WSTs was also reviewed critically. While the design is conceptually clear, the impact of opaque 'Blackbox' algorithms and data use on the user is still not fully understood. This is problematic as research on the potential harmful impact of smart technology on its users is emerging. This leaves another gap in the literature in terms of understanding the role of wearables in (re)shaping the usage practices and/or triggering deliberation.

To address the identified gaps, I take a practice theory approach which focuses on the practices of use themselves, while considering all the underpinning factors, as well as the human and non-human entities that play a role in shaping them. To justify this and demonstrate the theoretical compatibility of this approach with the aims of this thesis, I review the relevant practice theory literature before arriving at the specific model I operationalise in this study. Building on this, in the following chapter, the methodological choices are discussed.

CHAPTER 3: METHODOLOGY

3.1 CHAPTER INTRODUCTION

As outlined in the introductory chapter, the purpose of this study is to investigate the prolonged use of wearable self-trackers (WST) The aims of this empirical research are to a) understand the practices associated with the prolonged use of wearable self-trackers (WST) and reveal the role of wearables (and associated technology) in this context, and b) uncover the similarities and/or differences in the way users utilise their WST.

To address the research aims, the study utilises stimulus-driven in-depth interviews where traditional, semi-structured interviews, are combined with a discussion of visual graphs and histograms generated from the users' activity records' data. This chapter discusses the New Materialism, Post-humanist philosophical foundation of this research, where I discuss the principles of this approach and its compatibility with emphasising the role and influence of technology (if any) in the usage experience. The chapter also provides an overview of the research design and data collection strategy; justifies the sampling approach; and lastly, outlines the inductive data analysis approach.

3.2 RESEARCH PHILOSOPHY: NEW MATERIALISM

This thesis takes a new materialism, post-humanist stance which allows the examination of "life itself" considering all animate and inanimate entities within the modern societies we live in (Coole et al., 2010; Fox & Alldred, 2017). The overarching term 'New Materialism' refers to the contemporary turn to materiality of the world that started to become more prevalent in arts, humanities and social science in the 80s and the 90s (Ferrando, 2013; Fox & Alldred, 2017). Hereby, it is important to not confuse *New* Materialism with Marx's historical Materialism (Fox & Alldred, 2017).

In essence, New Materialism recognises the capacity of material objects to impact the world whilst suggesting that even abstract concepts such as thoughts, memories, and imagination could have similar '*material effects*' (Coole & Frost, 2010). As there is no universal definition of what is considered 'matter' or 'material', in this research when 'material' is mentioned, the word is referring to matter that has specific form, features and content (Edenheim, 2016). Other terms such as 'material-like' might be used as well, this time to describe other entities (e.g., digital software) with specific, observable and/or tangible consequences (i.e., material-effect) but no specific tangible physical form (Fox, 2016). To reiterate, this research is concerned mainly with digital matter which can be either or both hardware (material) and software (material-like) digital systems of one or more sperate entities (one or more self-tracking devices).

New materialism falls under the paradigm of Critical Theory. Critical Theory is a relatively modern approach that encompasses several philosophical propositions that view reality as a changeable product of relational and interactive forces (Fox & Alldred, 2017; Guba & Lincoln, 1994). Despite the existence of numerous research paradigms, business and management research is often associated with four philosophical conventions: Positivism, Post-positivism, Constructivism and Critical Theory, summarised in Table 5 below. As shown in this table, the ontological and epistemological assumptions are the defining components of any philosophical paradigm as they govern the research design and the subsequent methodological choices (Guba & Lincoln, 1994). Traditionally, philosophical paradigms are defined by their ontological and epistemological assumptions which in turn should explain the overarching ideology of the paradigm. Ontology is concerned with the nature of reality whilst epistemology seeks to provide insights on how to gain knowledge about reality and what constitutes 'legitimate knowledge' about reality (Guba & Lincoln, 1994; Saunders et al., 2019a).

In general, one can argue that in business and management studies, research philosophies form a continuum from pure realism (positivist approach) to mere relativism (constructivism) (Saunders et al., 2019a). Although in contemporary marketing research, researchers seem to have higher affinity towards the critical and constructivist end of that continuum especially given the nature of the modern world where non-human factors and/or entities are ubiquitous (Gummesson, 2001; Hunt, 1983).

Table 5: Research Philosophies in Business and Management (Braidotti, 2006; Coole & Frost, 2010; Coole, Frost & Braidotti (2010); Peters et al., 2013; Saunders et al., 2019a; Sayer, 1997, 2000)

Paradigm	Positivism	Post-positivism	Critical Theory	Constructivism
Ontology	One real, independent reality	Hypotheses that are probable facts or laws	Reality is shaped by various forces over time such as processes, experiences, and practices	Reality is socially constructed
Epistemology	Observable and measurable knowledge	Observable and measurable knowledge	Subjective, experiential	What counts as the truth is determined by dominant social ideologies

For New Materialists, the debate is ongoing regarding the ontological and the epistemological approaches best suited for the paradigm (Fox & Alldred, 2017). Some argue that reality is relative to the assemblage of actors under research and hence, there is a unique reality for each encounter between the assemblage's human, and non-human actors (Lupton, 2020b). Others propose that it is impossible to separate ontology from epistemology and suggest the concept of "onto-epistemology" that became popular in feminist theory and gender studies (Barad, 2003). Barad's onto-epistemology implies that phenomena are entirely context-specific, and therefore, there is no absolute reality (Barad, 2003).

In this research however, I adopt Rosi Braidotti's conceptualisation of reality. Braidotti argues that reality is flat and "monist" which belongs to both the human, and the non-human entities of the phenomenon (Braidotti, 2006). This conceptualisation suggests that reality is emergent, and *one* where aspects of it are constructed by the human, others by the non-human and some by both, simultaneously. As such, a monist reality conceptualisation rejects the 'stratified reality' proposition made by critical realists, which posits that those different strata (i.e., levels) of reality emerge with/by various agents, generally, overlooking non-human entities (Gorski & Bhaskar, 2013). Further, this ontological approach also rejects the conventional "dualist" ontology that differentiate between the human and the non-human, and the mind and matter (Braidotti, 2006). Braidotti conceptualises reality as 'an ecology of the human and the non-human' where hierarchy does not exist and 'the real' cannot be fully understood unless examining the two *together* (Braidotti, 2006). In summary, the ontology of this research portrays reality as a dynamic collective of agents (human and non-human) and events, where there is no constant structure or definitive systems (Braidotti, 2006; Coole & Frost, 2010; Fox & Alldred, 2017; Lupton, 2020). As such, reality is shaped by the sociocultural context and the actors' (human and non-human) overt and covert actions, capabilities, and characteristics.

New materialism emphasises ontology over epistemology hence unsurprisingly, there has not been an agreement amongst scholars on a universal new materialist epistemology (Fox & Alldred, 2017). In this research, I propose a subjective approach to epistemology arguing that knowledge about reality is relative, experiential, and transient. As such, reality is uniquely (de)constructed and (re)formed upon the interactions amongst the entities in the system and so is our knowledge of it. According to this view, reality is contextual, and is not independent from the surrounding materialistic and sociocultural forces.

As explained in the previous chapters, this research takes an alternative theoretical approach in investigating the usage of wearables. While the literature predominantly emphasises human thoughts and behaviours, this research looks into the phenomenon through the lens of practice theory which allows consideration of the observable behaviours of the human, while considering a host of underlying elements that include skills, knowledge, tools, and/or emotional and cognitive procedures (Schau et al., 2009; Shove & Pantzar, 2005; Spurling et al., 2013). Similar to the new materialist approach, practice theory allows the inquiry into practices as complex entities admitting the role of all agents, the human and the non-human, in the (re)formation and (re)enactment of practices (for examples see: Shove et al., 2012; Spotswood et al., 2019). One of the key features of this thesis is the emphasis on the role and agency of non-human, digital devices (i.e., wearable fitness-trackers) in constructing reality. Hence, appropriately this thesis takes a post-humanist approach (Bolter, 2016; Maller, 2015; Shove et al., 2012).

'Post-humanism' is a newly popularised proposition to understanding the human subjects experiences within the world; however, it has been noticed that the exact term is used in different disciplines to refer to very different concepts (Bolter, 2016). In this research, 'post-humanism' is referring to the post-humanist subcategory of New Materialism which views reality as relational and contingent on events that result from the non-hierarchical interactions between the human and the non-human (Coole & Frost, 2010; Fox, 2016). Post-humanism therefore recognises that objects such as activity-trackers have the capabilities to contribute to the construction of reality (Fox, 2016; Maller, 2015).

The recent wave of post-humanism literature is often attributed to the widespread use of 'smart' technology which is an obvious representation of non-human entities with agentic capacity (Bolter, 2016; Ferrando, 2013; Hoffman & Novak, 2018). Today, smart technology devices (i.e., wearable trackers) can generate push notifications, feedback loops and reminders to communicate with the user and the user and has the potential to influence and/or alter their reality (Hoffman & Novak, 2018; Jovanov, 2019). Nonetheless, the agency of technology does not simply suggest a replacement of

human agency; instead, it suggests the beginning of a post-supremacy, post-exclusivism era (Ferrando, 2013).

To conclude, in this research, I take an exploratory post-humanist approach to investigate the prolonged use of WST. The New Materialism and the post-humanist stance suggest that reality is collaboratively constructed by human and non-human agents (monist, post-humanist ontology) and that reality is relative, relational, and contingent (subjective epistemology). As explained, the ontological and epistemological approach of this paradigm is methodologically flexible and compatible with a wide range of theoretical approaches, particularly, practice theory. It is for this reason, alongside its conceptual suitability with addressing the research questions, that a new materialism approach was adopted for this study. This philosophical approach, I argue, could help better understand the complexities of smart technologies (including WST), and their influence on the order of the world surrounding their use in a more vivid way.

3.3 RESEARCH METHODS

The methodological choice for the research was determined based on the aims of the study, the philosophical approach, and the exploratory nature of this research. This research utilises a stimulus-driven qualitative method, which combines semi-structured interviews with visual stimuli to prompt more personal discussions and reveal different aspects of the experiences that are otherwise inaccessible (Orr & Phoenix, 2015). To create the images used in the interviews, I leveraged the participants' tracker-generated data aiming to use these to tap into otherwise hidden accounts and stimulate natural, informative conversations.

In-depth, semi-structured interviews are widely adopted in qualitative inquiry (Doody & Noonan, 2013; Silverman, 2004; Turner, 2010). Qualitative methods facilitate uncovering realities that would otherwise remain inaccessible, for that, they are believed to be ideal for growing research areas where depth is appreciated over breadth and 'reality' is subjective and transient (Coole & Frost, 2010; Denzin & Lincoln, 2005). Recently, similar to marketing studies, there has been a movement towards qualitative research in traditionally quantitative domains such as health research, perhaps due to the growing interest in understanding people's lived experiences (Al-Busaidi, 2008; Bartesaghi, 2017; Rabionet, 2009). As this research is concerned with self-tracking, which is often habitual and ingrained into people's lives (e.g., activities of tracking may be difficult to define and/or articulate), and due to the subjective approach to epistemology taken here where reality is viewed as personal and experiential, a qualitative research method was deemed suitable.

Qualitative methods ought to assist in knowledge building by examining the data, and consequently deducing knowledge from it to advance on, disprove, or develop theoretical propositions (Belk, 2006). As I am taking an inductive approach in inquiry, I argue that this methodological choice will help reconcile the empirical findings with the philosophical approach adopted in this research (i.e., understand the role of the device), and the theoretical propositions explained in section number 2.7 (Gummesson, 2001). As the aim is theory-building, positivist, quantitative methods are deemed inappropriate for they are associated with testing rather than building theory (Saunders et al., 2019b). That said, a mixed-methods approach could become useful in the future after initial theoretical knowledge about how users use with their devices and/or what influences this interaction has been established (Silverman, 2004). However, as of yet, scholarly literature on wearables is still in its early stages with many aspects of the use still unexplored (Shin, Feng, et al., 2019; Shin, Jarrahi, et al., 2019).

Focus groups are an alternative form of qualitative methods that has been considered, yet ruled out early in the research design stage, as deemed problematic for this context. Having emerged in the consumer research doctrine, focus groups have been successful time-effective methods to canvass

opinions in areas such as consumption, health and exercise sociology (for example see (Berry & Bendapudi, 2007; Lupton, 2020a). Focus groups are thought to be an ideal setting to stimulate conversations amongst participants which often proved to reveal new, interesting, or unexpected insights about personal experiences (Saunders, Lewis and Thornhill, 2019b). Despite its advantages, this approach is not suitable in this research, since this study took place at the time of the Covid-19 pandemic and is partly tailored around the discussion of private data (Fitbit records). Hence to ensure confidentiality, and allow participants privacy to discuss their records freely, the decision was made to interview the participants separately (Boyce and Neale, 2006).

3.3.1 Semi-structured interviews

Semi-structured interviews are a well-established qualitative method in business and management research (Burns and Bush, 2014; Saunders, Lewis and Thornhill, 2019b). It allows greater understanding of the subjective meanings and experiences associated with phenomena and gives a platform for more elaborative discussions (Pope, van Royen and Baker, 2002; Saunders, Lewis and Thornhill, 2019). However, like any other method, semi-structured interviews have a few disadvantages. For example, they can be time-consuming, subjected to subconscious biases and generate long transcripts, which may take several hours of laborious analysis (Boyce & Neale, 2006; Denzin & Lincoln, 2005; Doody & Noonan, 2013; Saunders et al., 2019b). Interviews are not only physically demanding but also, as they result in transcripts of spoken words, they inevitably carry a certain degree of ambiguity and the interpretation thereof is a taxing mental process (Denzin & Lincoln, 2005). Moreover, human errors are common when collecting and analysing qualitative data, both on the part of the participant and the researcher (Doody & Noonan, 2013; Saunders et al., 2019b). These may include but are not limited to, omitting certain information, false answers, forgetfulness and/ or miscommunication (Denzin & Lincoln, 2005; Saunders et al., 2019b).

Conventionally, semi-structured interviews are utilised in exploratory research and are informed by an interview guide which helps mitigate some of the disadvantages mentioned by creating a general scope for the interviews and hence enable the collection of reliable and comparable data. The questions in these guides are typically designed to test the relevant theoretical propositions found in the literature whilst allowing others to emerge by enabling participants to elaborate, recollect and reflect on their experiences in their own ways (Bhattacherjee, 2012; Luca, 2015). The interview guide for this research and the rationale behind its design will be discussed further in a dedicated part below (section 3.6.1).

In short, in-depth semi-structured interviews are a powerful tool to explore emerging phenomena whilst giving significant consideration to the subjectivity of experience, and the contextual factors that play a role in shaping these experiences. Since it is the responsibility of researchers to ensure a robust research design and rigorous interviewing process, pilot interviews were undertaken. Further details on the pilot study will be discussed below (section 3.8).

3.3.2 Device-generated data

Wearables collect over 250,000 measurements per person per day[13], however, these myriads of data remain insufficiently leveraged in scholarly research. Device-generate data are often believed to be a quantified representation of its user's physical activity (Lupton, 2021a). Nevertheless, their interpretation, without putting them in context, could be misleading (i.e., a period of reduced activity may be associated with having an injury or a major life event such as giving birth), and such occurrences can normally only be uncovered qualitatively.

The aim here is to leverage the device-generated data to overcome some of the shortcomings of semi-structured interviews. Thus, a discussion of visual presentations of the data was incorporated into each of the research interviews. Another aim of this method is to understand how personal tracking data is interpreted and rationalised by the user with a goal to stimulate deliberation and reflection on usage practices to elicit richer, or alternative facts about one's WST usage pattern and physical activity practices.

Hence, the suggested research method could be particularly informative in comparison to semi-structured interviews alone. In other words, physical activity records' fluctuations, plateaus and trends captured in the data and examined with the data owners can draw richer accounts of their experiences, the practices they perform and the elements underpinning those performances, which are sometimes impossible to discover through conventional qualitative interviews (Orr & Phoenix, 2015; Prosser & Loxley, 2008; Spurling et al., 2013). This posits a particular benefit to access such data at a time where social contact was highly restricted.

Figure 4 shows an example of Fitbit's monthly activity records (Figure 4). Activity records are the device-generated data of the user's physical movement and exercise when the device is attached to the body. A typical record includes step-count, active minutes, and the caloric burn estimates. In section 3.5.2, the selection, processing, and utilisation of these records will be discussed including examples of how records were visually presented in interviews.

[13] Fingas, J., 2020. Stanford, Scripps and Fitbit Try Using Wearables to Detect Infections. [online] Engadget.com. Available at: <https://tinyurl.com/y794bzue> [Accessed 16 April 2020].

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Activities												
2	Date	Calories B	Steps	Distance	Floors	Minutes S	Minutes L	Minutes F	Minutes Very Active			Activity Calories	
3	02/07/2019	2,379	12,714	8.98	27	605	275	16	54	70	345	1,244	
4	03/07/2019	2,262	11,802	8.33	16	659	229	24	47	71	300	1,080	
5	04/07/2019	3,072	24,525	17.32	49	541	261	61	122	183	444	2,019	
6	05/07/2019	2,352	12,589	8.89	23	634	257	25	41	66	323	1,186	
7	06/07/2019	2,297	13,186	9.31	16	622	246	23	24	47	293	1,108	
8	07/07/2019	1,970	5,680	4.01	3	699	233	8	0	8	241	740	
9	08/07/2019	2,700	19,885	14.81	33	1,057	286	23	74	97	383	1,599	
10	09/07/2019	2,301	12,447	8.79	19	611	242	27	41	68	310	1,133	
11	10/07/2019	2,580	17,602	13.15	24	555	252	25	78	103	355	1,452	
12	11/07/2019	2,604	16,144	11.45	23	666	242	33	81	114	356	1,475	
13	12/07/2019	2,493	15,673	11.07	23	584	304	43	29	72	376	1,379	
14	13/07/2019	2,532	16,687	11.76	13	499	270	56	44	100	370	1,422	
15	14/07/2019	2,282	12,186	8.6	14	629	256	20	30	50	306	1,109	
16	15/07/2019	2,273	12,817	10.21	11	667	178	2	57	59	237	1,022	
17	16/07/2019	2,688	20,700	14.67	77	670	207	75	82	157	364	1,573	
18	17/07/2019	2,172	11,693	8.54	30	686	189	22	29	51	240	941	
19	18/07/2019	2,124	10,949	7.85	28	755	199	9	29	38	237	893	
20	19/07/2019	2,167	12,283	8.65	14	708	156	28	43	71	227	924	
21	20/07/2019	2,245	8,230	5.79	13	521	284	9	13	22	306	1,083	
22	21/07/2019	1,985	6,380	4.51	3	682	219	8	7	15	234	728	
23	22/07/2019	2,632	16,967	12.69	24	636	305	25	59	84	389	1,533	
24	23/07/2019	2,309	11,551	8.16	30	561	247	30	37	67	314	1,133	
25	24/07/2019	2,332	11,641	8.22	15	569	292	33	30	63	355	1,202	
26	25/07/2019	2,836	22,210	15.68	26	505	280	62	89	151	431	1,779	
27	26/07/2019	1,866	3,504	2.47	3	728	210	0	0	0	210	586	
28	27/07/2019	2,507	16,421	11.52	14	443	295	13	48	61	356	1,386	
29	28/07/2019	2,175	8,127	5.91	8	670	261	18	8	26	287	977	
30	29/07/2019	2,763	20,706	15.43	28	561	248	51	82	133	381	1,659	
31	30/07/2019	2,316	11,589	8.17	22	665	237	35	43	78	315	1,138	
32	31/07/2019	2,235	10,460	7.39	17	661	216	29	39	68	284	1,026	
33	01/08/2019	2,522	15,544	10.98	25	600	230	30	70	100	330	1,370	
34													

Figure 4: Example of Fitbit Activity Records

3.4 Research Design Approach

This thesis aims to investigate the prolonged use of WSTs with a focus on uncovering the role of the device in it, and how the usage patterns align or diverge across the sample. It is a qualitative, exploratory and inductive research study (Saunders et al., 2019b).

While a qualitative approach was deemed appropriate for the nature of the study, the usual limitations to conventional qualitative methods needed to be considered for a more effective research design. For example, the issue of maintaining privacy and confidentiality in focus groups, and problems of misinformation, forgetfulness, omitting some facts common in interviews. As such, the challenge was to design this research such that it would effectively utilise semi-structured interviews with minimal problems.

Since the beginning of this research project, I saw an opportunity in utilising the device-generated data qualitatively in interviews. Particularly, as they have not yet been used in such a way in research, and that they constitute a rich resource of daily physical activity data that could help stimulate the participants' memory and prompt deeper and/or alternative conversations during the interview (Prosser & Loxley, 2008). As such, potentially minimising forgetfulness, and misinformation on the part

of the participant all whilst allowing the researcher to closely understand the particularities of each participant's experience. Further, this approach is conceptually compatible with the post-humanist philosophy adopted in this thesis as the design would enable the researcher to explore the user perspective of the user-device interaction whilst also exploring their 'data profiles' (Lupton, 2021a) which could stimulate reflection as well.

In essence, the numerical records were converted into a form of *visual methods* where images, graphs, diagrams and other forms of visuals are typically used to collect qualitative data (Prosser & Loxley, 2008). In this thesis, visual methods are combined with interviews to stimulate the participants' memory and delve into the details of their physical activity, data and tracking practices in a non-intrusive manner (Orr & Phoenix, 2015; Prosser & Loxley, 2008). Combining visual stimuli with conventional semi-structured interviews allowed the researcher to follow on points of interest and delve deeper into specific events, time periods and/or practices that the participants discussed in the first part of the interview. Having the opportunity to visually view the tracking journey together with the participant, meant that they could confirm or contrast trends in the data, as well as tell stories associated with life events, that might not have otherwise been discussed, for example, tracking practices when someone is at a music festival or when 'taking a break'.

As this research is concerned with prolonged use of WSTs, another alternative to this research design would be a longitudinal study; defined as a study that employs *repeated measures* to follow particular individuals or phenomena over a prolonged period of time (Caruana et al., 2015; Saunders et al., 2019b; Silverman, 2004). While longitudinal methods could add to our understanding of self-tracking, the benefit of the chosen research design over a longitudinal study is the ability to obtain temporal accounts of self-tracking in a cost-effective and time-efficient way and avoid dropout rates. Thus, the research design mitigates the disadvantages of longitudinal studies whilst eliciting some truth about the practices of prolonged WST use which is lacking in the literature (Canhoto & Arp, 2017; Caruana et al., 2015; Jaakkola et al., 2016; Piwek et al., 2016; Shin, Feng, et al., 2019).

The sequence in which the interview sessions were designed was created to allow the participants to elaborate on their usage experience to help establish a story and rapport before discussing their private records. This enabled the researcher to follow up on points or statements that emerged from the earlier conversation with the participant, and ask further questions to prob for further information on particularly interesting parts e.g. related to a certain practice the participant engaged in, a change of behaviour etc.

In addition to informing the participants about the details of the study and obtaining their informed consent (Appendix 1: Consent form template), prior to the interview, the researcher also supplied participants with a *Participant Manual* containing instructions for downloading and sharing activity-

trackers' records and completing the 'Features Checklist' (Appendix 2: Features checklist template). The reason for creating the Features Checklist is to enable the interviewer to formulate a comprehensive picture of the health, physical activity, and lifestyles of the selected participants and outline a more personalised interview to each of the participants. More details about this can be found under 3.5.1. Features Checklist.

To summarise, this exploratory, inductive research operationalise a creative stimuli-driven qualitative method where semi-structured interviews are combined with a discussion of the interviewee's personal fitness-tracker activity records presented in graphs, charts, and histograms. The research design is summarised below in the form of Saunder's 'research onion' to help the reader visualise the multiple layers of the design as well as their connections and conceptual compatibility (Figure 5; Saunders & Tosey, 2013; Saunders et al., 2019b)

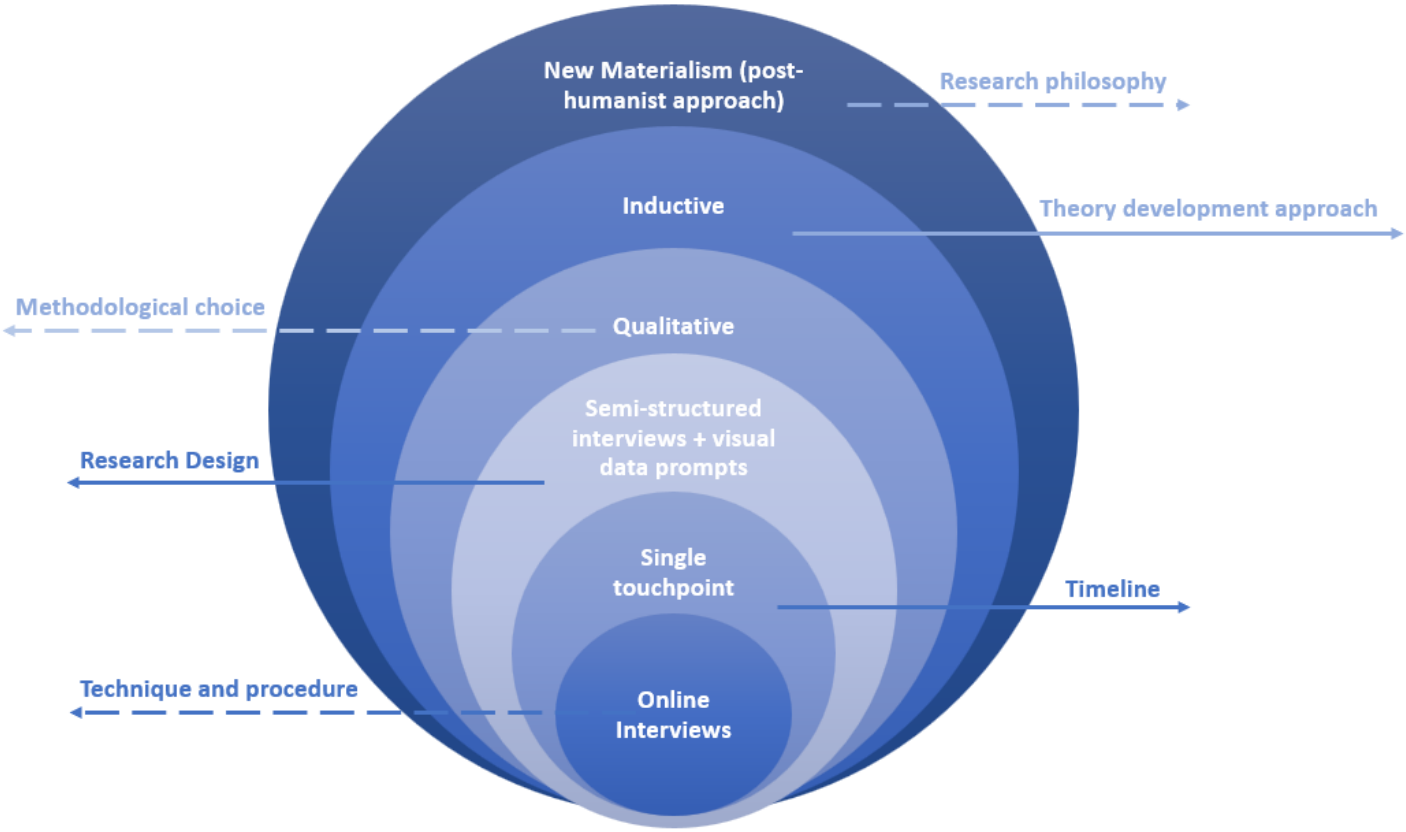

Figure 5: The Research Onion

3.4.1 Impact of the pandemic on research design

The research design stage took place at the beginning of 2020, with a vision to start data collection in the summer of 2020. However, the global pandemic and the state of uncertainty in March 2020, put the researcher in a position where a decision needed to be made promptly to mitigate potential issues with data collection.

Being interested in physical activity, the lockdown and restrictions on exercise and time spent outside posed a real threat to the validity of the data, in particular should it become long-term with continued restriction and with people adjusting to the 'new normal', and/or forgetting about their regular pre-lockdown lifestyles. Thus, a decision was made to start the empirical work sooner than planned to avoid jeopardising the quality of the collected data.

The empirical part of the study started in April 2020 and finished in November 2020. This coincided with the first wave of the novel COVID-19 virus outbreak and the consequent national, and later on, regional lockdown measures in the United Kingdom (Institute of Government Analysis, 2021). The legislation around social distancing banned social contact. As a result, all prospective contact with participants (i.e., recruitment, conducting the interviews… etc.) had to change from face-to-face to virtual forms. Although, in terms of quality and reliability of the data both approaches are largely equal (Bryman, 2008); this change meant that extra attention had to be paid to the wording of the informed consent form, choosing the software medium through which the interviews are to be conducted (for security reasons), and selecting the sample as with the adapted design, participants' digital literacy was especially important to reduce errors and mishaps (i.e. successfully download the records, access the meeting link etc).

In summary, after adapting to the situation, the research design involved the following:

- Using a digital signature software to allow participants to sign the consent forms virtually.
- Converting the features checklist to an online survey created via Google Forms
- Interviewing participants via a video conference software
- Recording the interviews using the built-in recording feature and later extracting the voice-only recordings in an MP3 format to be used for transcribing.

Additionally, some other adaptive, ad-hoc measures were taken in the advertising and recruitment process as well which will be elaborated on further in the Participants Recruitment part (section 3.9.2.).

A summary of the finalised data collection stages is shown in the table below (table 6). In which, the empirical research is divided into pre-interview, interview, and post-interview stages. Each of these stages will be discussed in detail in this chapter as per the section numbers outlined in the table.

Table 6: Data Collection Stages Summary

Phase	Stages	Responsibility	Key activities
Participation	Participant selection and suitability assessment	Researcher	Examining prospective participants characteristics against participation requirements
	Share the participation instructions and obtain informed consents	Researcher	Email the participants the study information sheet, participation requirements and the consent form for their signature.
Data collection: Pre-interview	Complete the features checklist. (Section 3.5.1)	Participant	After receiving their consent, participants were asked to complete a pre-interview questionnaire titled 'Features checklist' (see Appendix 2)
	Extract and share Fitbit records (Section 3.5 and 3.5.2)	Participant	After receiving their consent and completed Features checklist, participants were asked to share 12 months of their Fitbit Activity Records in Excel format with the researcher
	Data processing (Section 3.10.1)	Researcher	Calculate participants Body Mass Index (BMI) and Basic Metabolic Rate (BMR) Calculate the average daily and monthly steps and active minutes for each participant.
	Create visuals (Section 3.3.2)	Researcher	Use GraphPad to convert the Excel format data into graphs and diagrams.
Data collection: interview	Interview-part 1: introductions, background and general lifestyle (Section 3.6)	Both	Interview questions Q1-Q8

	Interview-part 2: Adoption, use, tracking and physical activity. (Section 3.6)	Both	Interview questions Q9-Q24
	Interview-part 3: Discussion of the visual artefacts (Section 3.6)	Both	Last 15-20 minutes of the interview (a typical interview lasted for about an hour)
Data collection: post-interview	(occasional) Follow up emails to provide or request information	Participants	KM, GC, PSA, VS followed up with providing more information about their tracking practices and/or their physical activity after the interview. In the interview, VS talked about her daily walk from her house to the mailbox (rural setting), after the interview she sent photos of the path via email.

3.5 FITBIT

To ensure comparability and consistency, I limit this study to the use of Fitbit. Fitbit is one of the most popular wearable self-trackers in the world boasting over 30 million active users (Prophet, 2019; Statista, 2021). Fitbit is the only WST brand that allows its users to access, visualise and download their full tracking records in an accessible format. Although Fitbit developers position it as a healthy living device that can 'motivate you to reach your health and fitness goals' and 'boost your mind, and wellbeing' [14], Fitbit is used in a variety of ways that integrate the device into various non-exercise or health activities such as making contactless-payments, streaming music, and even to complement a fashionable style (Choi and Kim, 2016; Piwek *et al.*, 2016; Dehghani and Kim, 2019). Today, Fitbit offers smartwatches, trackers, and a collection of complementary accessories and positions itself as a *lifestyle* brand (unlike other *sports* brands such as Garmin)[15].

Depending on users' personal needs, a preference for a certain type of 'lifestyle' or 'hardcore' tracking device might develop (Lomborg et al., 2018). The key difference between smartwatches and fitness-

[14] Fitbit.com homepage message in 2018 and 2022 respectively.

[15] Garmin's Homepage

trackers is the extent of lifestyle functionalities it offers, for example, unlike fitness-trackers, most Fitbit smartwatches are Near-field communication (NFC) [16] chip enabled which allows making contactless-payments (NearFieldCommunication.org, 2017). Yet, apart from that, other functionalities are the same. To understand this, table 7 is included to provide an outline of each feature available on Fitbit along with its mechanism of work, and the devices that support the feature.

[16] NFC chips is a short-range wireless connectivity technology that allow the communication between two devices

Table 7: Functions of Fitbit

Feature	Definition	Popularity
Step-count	Pedometer via sensors embedded in the device (can also access step-count from smart phone's built-in sensors)	Standard in all devices
Heartrate (HR)	Heartrate monitoring	All HR sensor enabled devices
AFib assessment (and Fitbit ECG app)	Irregular heart rhythm notifications	Only compatible with Sense 2, Sense, Versa 4, Versa 3, Versa 2, Versa Lite, Charge 5, Charge 4, Charge 3, Luxe, Inspire 3 and Inspire 2
Zone minutes	A calculation of minutes spent in 'active' heartrate zones. 1x zone minute = HR 116-139 2x zone minutes= HR 140+	All HR sensor enabled devices
Distance	Kilometers or Miles taken per day	Standard in all devices
Floors	Flights of stairs climbed per day (elevation)	Standard in all devices
Calories burned	Estimation of calories burned based on type of activity, duration and basal Metabolic Rate[17] (Diabetes.co.uk, 2022)	Standard in all devices
Active hours	Hours where more than 250 steps were taken. This is a feature associated with the Reminders to move	Standard in all devices
Active days	Days where a certain exercise activity was performed for longer than 10 minutes (automatically or manually logged)	All HR sensor enabled devices
Sleep tracking	Tracking sleep patterns through HR and motion detection	All HR sensor enabled devices
Stress management	HR and breathing pattern monitoring	Electrodermal and HR sensor enabled devices only
Nutrition tracking	Track daily dietary intake and corresponding calories	Manual input through the app
Hydration tracking	Track cups of water drank per day	Manual input through the app
Women's health	Menstrual cycle and fertility tracking	Manual input through the app
Extra features: Fitbit Challenges	Set individual or social (with other Fitbit users) physical activity challenges	Manually through the Forum space in the app

[17] BMR is the number of calories the body needs to achieve the most basic life-sustaining functions, it depends on weight, height, age, and gender.

As mentioned in the literature review (see 2.4), the design of Fitbit is largely grounded in behaviour change theory such as Social-cognitive theory and Control Theory (Abraham & Michie, 2008; Grundy, 2022; Mercer et al., 2016). The device (and combined technology) intensely utilise a host of behaviour change techniques commonly associated with these theories such as allowing goal-setting and review of behavioural goals, creating feedback loops by sending prompts and notifications, provide opportunities for social comparison and motivation, and set tasks and reward good performance (Abraham & Michie, 2008; Mercer et al., 2016). Goal setting is possible for a variety of parameters such as steps, distances, flights of stairs taken, sleep etc., and the prompts and reminders designed to help achieving these goals could be enabled (or disabled) through the app. These reminders are in the form of push notifications and/or vibrations that pop up on phone screens as well as Fitbit WST screens. Reminders to move can also be enabled to come up on Fitbit's screen to prompt users to do their 'hourly steps' and prevent them from being sedentary for long periods of time, however, these can be easily ignored by a simple 'tap' motion on the screen. Rewards are virtual tokens that are often associated with achieving goals, answering to the reminders to move by doing the hourly steps (set at 250 steps/hours), or as a reward for longer-term achievements e.g., the *Nile badge* for walking the distance that it takes to walk the length of the Nile River (Figure 6). In terms of social motivation, Fitbit integrates a social element into its App and website portals through specialised forums based on demographics or common interests e.g., Active Seniors for active people aged 60+, and Yoga Lovers for those who practice physical activity in the form of yoga. Screen-captures of Fitbit's app (and forums) interface designs are included below to give examples (Figure 7).

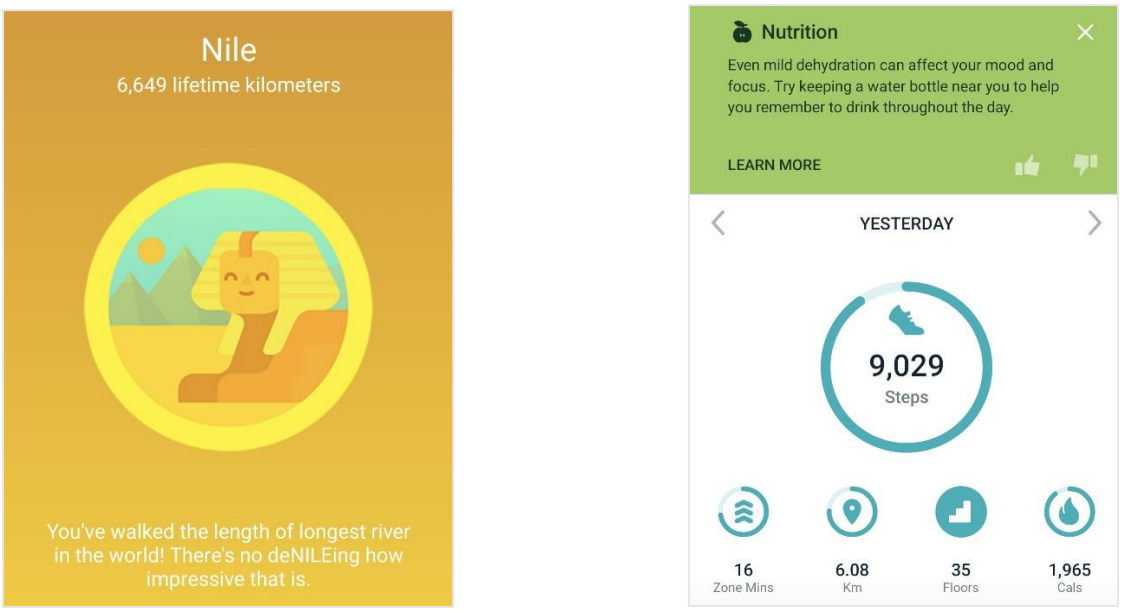

Figure 6: Fitbit reward- Nile Badge (left), and Fitbit App Dashboard (right)

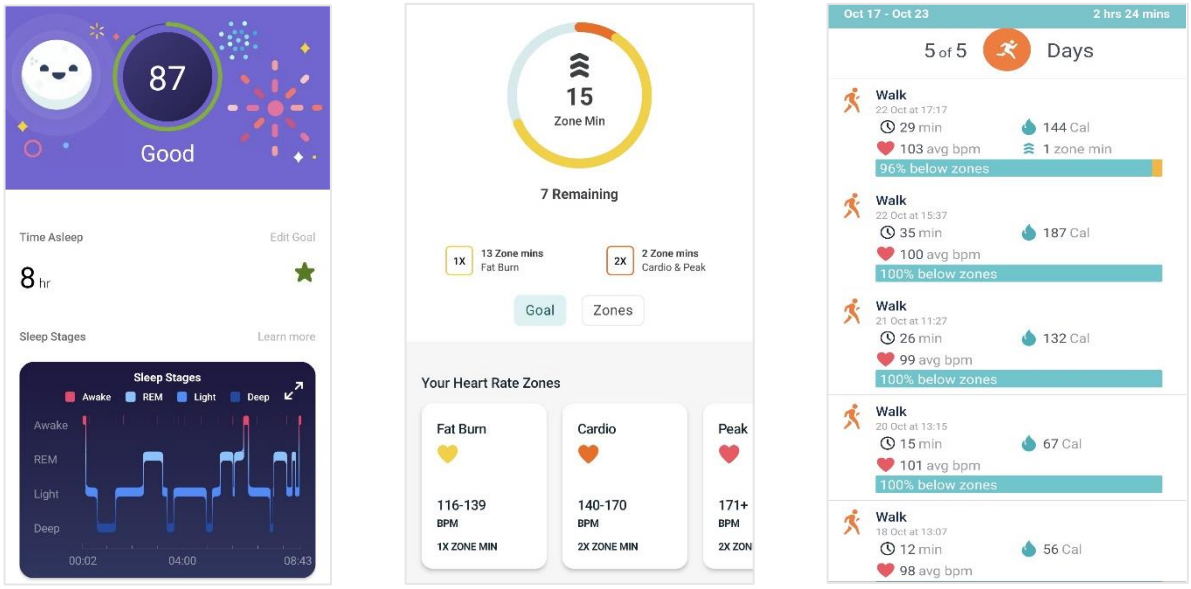

Figure 7: (from left to right) Sleep score breakdown, Zone Minutes breakdown, and Active days per week breakdown on Fitbit App

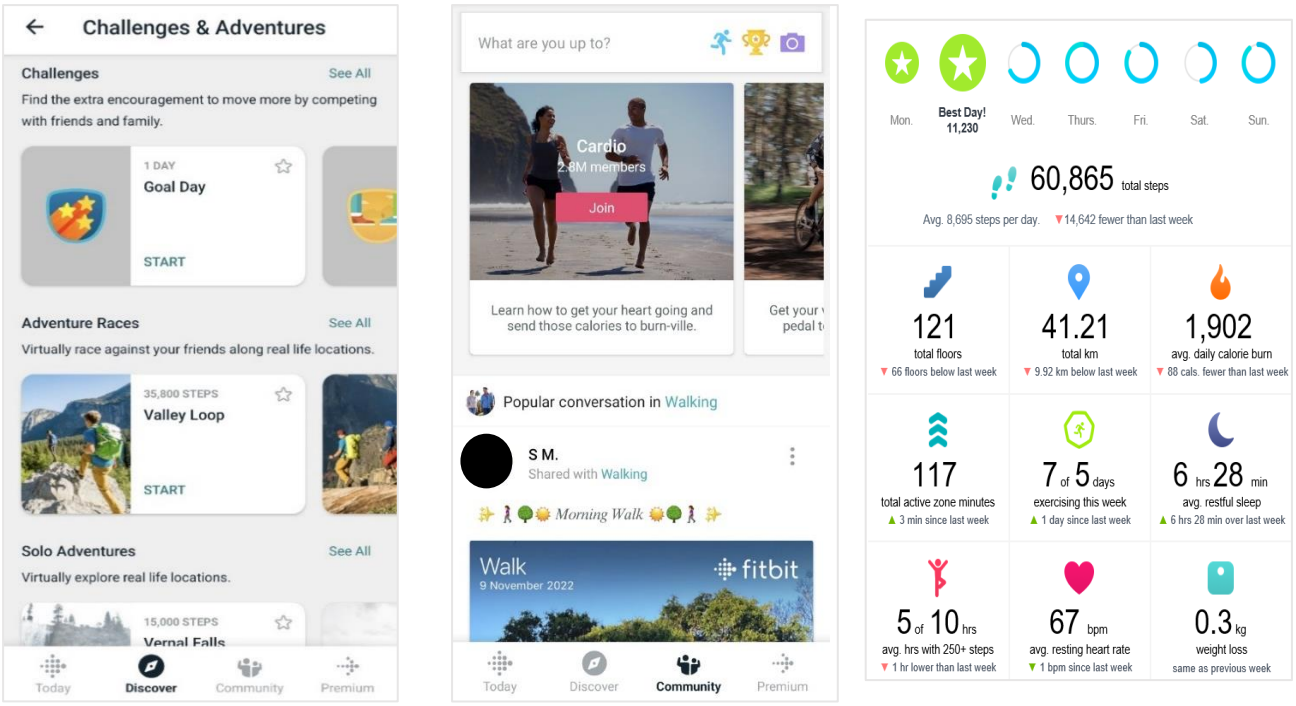

Figure 8: (from left to right) Fitbit Challenges landing page, Fitbit Communities landing page, and an example of a Progress Report email.

Fitbit is operated mainly via a companion app and the company also offers smart weighing scales and a coaching and advice service (Fitbit Premium). Hence, integration and synchrony are crucial for the performance of the Fitbit 'system' which includes wearables, app(s) (Fitbit's and/or others), and smartphones (which nowadays are also equipped with fitness-tracking apps e.g., Samsung Health). As such, despite Fitbit being known as a wearable self-trackers company the companion apps and the algorithms behind it are the core of Fitbit. It is after all where data is stored, aggregated, and analysed, and where feedback (i.e., notifications, progress reports and reminders) is initiated.

Fitbit users receive *progress reports* weekly via email which are essentially summaries of users' weekly performance, sleep, and other tracked parameters (Figure 8). It is still unclear how personal data are stored by Fitbit, and how personal data is processed to generate progress reports (or similar records). This all is based on the design of feedback loops which are entirely governed by Fitbit's highly confidential algorithms (see section 2.5.1 The Algorithms of WST).

To reiterate, it is of no doubt that Fitbit (and similar tracking technology) is initiating a paradigm shift in the way we understand our bodies, care for ourselves and practice physical activity. However, many aspects related to the impact of their design on the users, and the role they play in the usage process is still generally unknown.

3.5.1 Features checklist

Prior to the interview, participants were asked to complete an online checklist to indicate the features which they do or do not use. The list included all features offered by Fitbit and the companion App (Appendix 2: Features checklist). The participants were asked to choose (Yes) if they are, or ever have, used a certain feature, and (No) if they have not. The purpose of this was to collate a preliminary usage profile of each participant prior to the interview to ensure sample diversity, and to prepare further probes specific to each user. Due to the pandemic and transitioning to online data collection (see 3.4.1 above), the features checklist was created as an online survey using Google forms. Upon the receipt of the participant's informed consent, a URL link was shared with each participant privately via email. After they completed the Features list, identifiable information was removed from their surveys' entries before the forms were downloaded to a password protected cloud file and online versions were permanently deleted.

Individuals' answers to the features checklist were brought up during the interview at various points and discussed with the participant (e.g., Interview Q.15). However, the aim was to also understand what features are more popular, and why, which in turn informed the analysis of the practices (e.g., T3 Tracking steps as proxy) and perceptions about Fitbit among the sample. The table below depicts a summary of the results of the features checklist step (Table 8)

Table 8: Features Checklist Results

Participant	Premium user	Step-count (100% Y)	Caloric burn	HR (90% Y)	Weekly goal	Daily goal	Reminders	Distance	Floors climbed	Sleep tracking	Nutrition tracking	Hydration tracking	Women's health tracking	Count (out of 12)
AH	N	Y	N	Y	N	Y	Y	Y	Y	Y	N	N	N	**7**
AN	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	**11**
CB	N	Y	N	Y	Y	Y	Y	Y	Y	Y	N	N	N	**8**
CG	N	Y	N	Y	Y	N	N	Y	Y	Y	N	N	N	**6**
CJ	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N/A	**10**
CL	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**12**
FO	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	**10**
GC	N	Y	N	N	N	N	Y	N	N	N	N	N	N	**2**

GK	N	Y	Y	N	Y	N	Y	N	N	Y	N	Y	Y	**7**
GS	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	**11**
HD	N	Y	Y	Y	Y	Y	Y	N	N	Y	N	N	N/A	**7**
JB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**12**
JNM	N	Y	N	Y	N	N	N	N	N	N	N	N	N	**2**
JMG	N	Y	N	Y	Y	N	Y	N	Y	Y	N	N	N/A	**6**
KM	N	Y	Y	Y	Y	Y	Y	N	N	Y	N	N	N	**7**
LA	N	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N	**9**
LM	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	N/A	**8**
MA	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N/A	**11**
MEQ	N	Y	N	Y	Y	N	N	Y	N	Y	N	N	N/A	**5**
MK	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	**11**
NVV	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	N	N/A	**8**
NW	N	Y	N	N	N	N	Y	N	N	Y	N	N	N/A	**3**
OSC	N	Y	Y	Y	Y	N	N	Y	Y	Y	N	N	N/A	**7**
PSA	N	Y	N	Y	Y	Y	N	N	N	Y	N	N	N/A	**5**
RA	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	**10**
RND	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	**8**
SG	N	Y	N	Y	Y	N	Y	Y	Y	Y	N	N	N	**7**
SH	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	**10**
VS	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N/A	**9**
YAP	N	Y	N	Y	Y	N	N	N	N	Y	N	N	N	**4**
	7	**30**	**17**	**27**	**25**	**20**	**22**	**21**	**21**	**28**	**7**	**6**	**9**	

3.5.2 Fitbit records

According to Fitbit's official website, the device automatically collects information about "number of steps you take, your distance travelled, calories burned, weight, heart rate, sleep stages, active minutes, and location"[18]. Fitbit also allows its users to record other data manually such as their menstrual cycle, mood, sexual health information, and food intake. For the purpose of this research, only *activity records* were collected (Example in Figure 9), those included steps, distance, and floors taken, as well as the active minutes and caloric burn associated with the activities. This decision was deliberate to avoid obtaining sensitive data such as sexual activity history or menstruation records.

As this research is concerned with prolonged use, to avoid novelty use, and to standardise the interview structure, all participants were actual users of a minimum of 6 months. Participants were asked to share 12-months of activity data with the researcher before their interviews. Those who had been tracking for less than 12 months were asked to extract and send their entire activity record

[18] Fitbit (2022) Fitbit Legal: Privacy. Available at: https://www.fitbit.com/global/us/legal/privacy-summary (Accessed: February 17, 2023).

library, while those who had been using the device for over 12 months were asked to send the activity records from the first 6 month of using the device as well as the most recent 6 months of their data.

The 6-months minimum usage requirement was reached after reviewing the literature as according to the literature review findings, 50% of device abandonment happens in the first 6 month of use (Canhoto & Arp, 2017; Casselman et al., 2017; Stiglbauer et al., 2019). As such, requesting the first 6 months' records allow the researcher to observe and discuss with the participants the events and practices that are possibly associated with long-term use of WST. On the other hand, there is anecdotal evidence that after the first 6 months, the usage starts to become more embedded into people's lives and hence requesting the first and latest 6 months of use will give a good indication of the difference between novelty-driven and habitual interaction with the device, respectively.

As described in the research design section, the activity data obtained were analysed and converted into visual artefacts using a data visualisation software (i.e., GraphPad) aiming to utilise them to stimulate conversation; and prompt deeper, or more meaningful reflections on these users' experiences (Orr & Phoenix, 2015; Prosser & Loxley, 2008). This approach may also have additional advantages such as overcoming the validity and superficiality issues associated to qualitative research (Golafshani, 2003; Orr & Phoenix, 2015; Prosser & Loxley, 2008). Examples of how the data was presented in the interviews are included below (Figure 10, 11, 12).

Date	Calories Burned	Steps	Distance	Floors	Minutes Sedentary	Minutes Lightly Active	Minutes Fairly Active	Minutes Very Active	Activity Calories
01/04/2020	1,146	0	0	0	1,440	0	0	0	0
02/04/2020	1,146	0	0	0	1,440	0	0	0	0
03/04/2020	1,471	5,470	4.18	4	1,440	0	0	0	0
04/04/2020	1,146	0	0	0	1,440	0	0	0	0
05/04/2020	1,531	7,263	5.28	3	1,440	0	0	0	0
06/04/2020	1,146	0	0	0	1,440	0	0	0	0
07/04/2020	1,146	0	0	0	1,440	0	0	0	0
08/04/2020	1,146	0	0	0	1,440	0	0	0	0
09/04/2020	1,408	5,222	3.84	5	1,440	0	0	0	0
10/04/2020	1,225	896	0.57	4	1,440	0	0	0	0
11/04/2020	1,371	4,880	3.75	4	1,397	13	2	28	259
12/04/2020	1,146	0	0	0	1,440	0	0	0	0
13/04/2020	1,146	0	0	0	1,440	0	0	0	0
14/04/2020	1,146	0	0	0	1,440	0	0	0	0
15/04/2020	1,146	0	0	0	1,440	0	0	0	0
16/04/2020	1,365	4,890	3.74	10	1,395	13	2	30	250
17/04/2020	1,146	0	0	0	1,440	0	0	0	0
18/04/2020	1,146	0	0	0	1,440	0	0	0	0
19/04/2020	1,146	0	0	0	1,440	0	0	0	0
20/04/2020	1,146	0	0	0	1,440	0	0	0	0
21/04/2020	1,165	206	0.13	2	1,431	9	0	0	26
22/04/2020	1,316	2,644	1.69	11	739	52	6	9	209
23/04/2020	1,173	213	0.14	0	1,382	14	0	0	29
24/04/2020	1,966	7,345	5.22	7	1,234	129	9	68	969
25/04/2020	1,379	5,024	3.34	22	1,267	43	13	20	289
26/04/2020	1,544	7,792	5.02	15	1,439	1	0	0	2
27/04/2020	1,466	4,453	3.43	2	1,440	0	0	0	0
28/04/2020	1,698	8,996	6.72	14	1,440	0	0	0	0
29/04/2020	1,192	402	0.26	1	1,440	0	0	0	0
30/04/2020	1,501	7,438	5.53	15	1,440	0	0	0	0

Figure 9: Example of The Activity Records Received

The first graph (Figure 11) shows the step-count and active-minutes averages for each month across the whole 12 months of records received, this was the first image to be shown in the interviews with the aim to initiate a dialogue about the wearable-use experience as a whole and the participant's lifestyle and personal circumstances during those two periods of use. The demonstration of both parameters on the same page was purposeful to encourage a conversation on the difference between step-count and physical activity (often used interchangeably during the first part of the interview); and what each may inform us about the different aspects of the user's lifestyle (e.g., prompt discussions about activities such as cycling, taking the device off, weightlifting etc). For instance, high step-count may reflect the nature of one's work rather than a form of exercise (e.g., working in retail which requires standing and walking for long hours), whilst low steps and high number of active-minutes can inform us more about the person's fitness routine (e.g., using cycling as the main form of exercise).

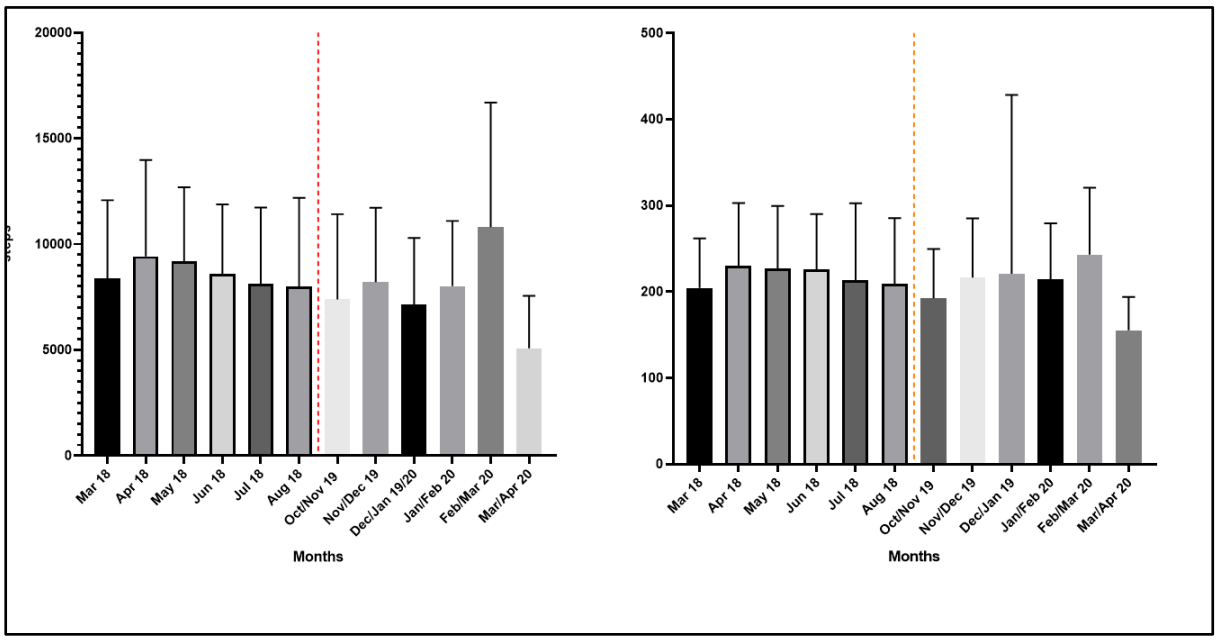

Figure 10: Example of Steps and Active minutes averages (12 month's records)

In the next figure (Figure 12), after classifying active minutes under moderate-vigorous activity (blue line), and light activity (green line), 6 monthly active minutes accounts were presented to the participants in the form of 2 slideshow pages. This type of visual aid was aimed to help stimulate more specific conversations about daily physical activity practices, more intricate patterns of use, and in some cases, anomalies.

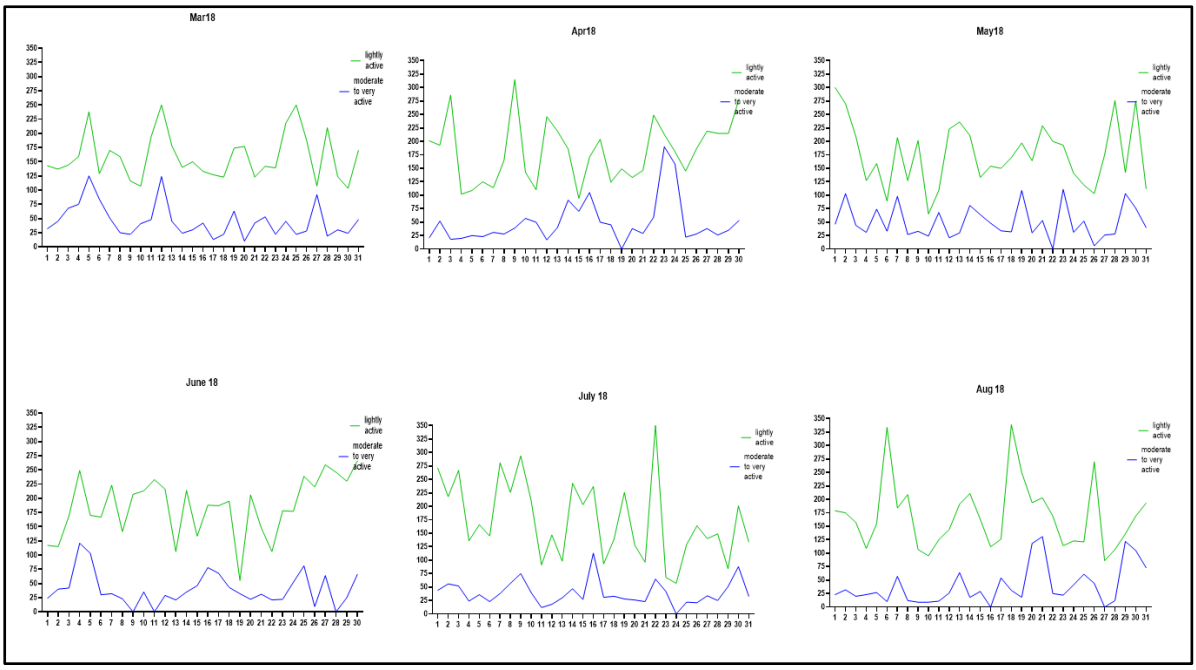

Figure 11: example of 6 months of active minutes data breakdown

Finally, participants' monthly step-count and active minutes averages are shown in the form of a graph in figure 13. This type of image was presented last to help the participant reflect on their tracking journey as documented by the device, and to recollect any events, experiences or activities that may have not discussed in the interview. Generally, at this stage, I would just ask the participant to 'make sense' of the image themselves or to explain what 'this image tells them', with minimal prompts or questions. The reason for that is to invite more elaborate answers and allow the participants to articulate their feelings and reflections in their own words, unguided.

Naturally, these examples varied from one participant to another, depending on the participant's lifestyle, usage pattern and duration of use.

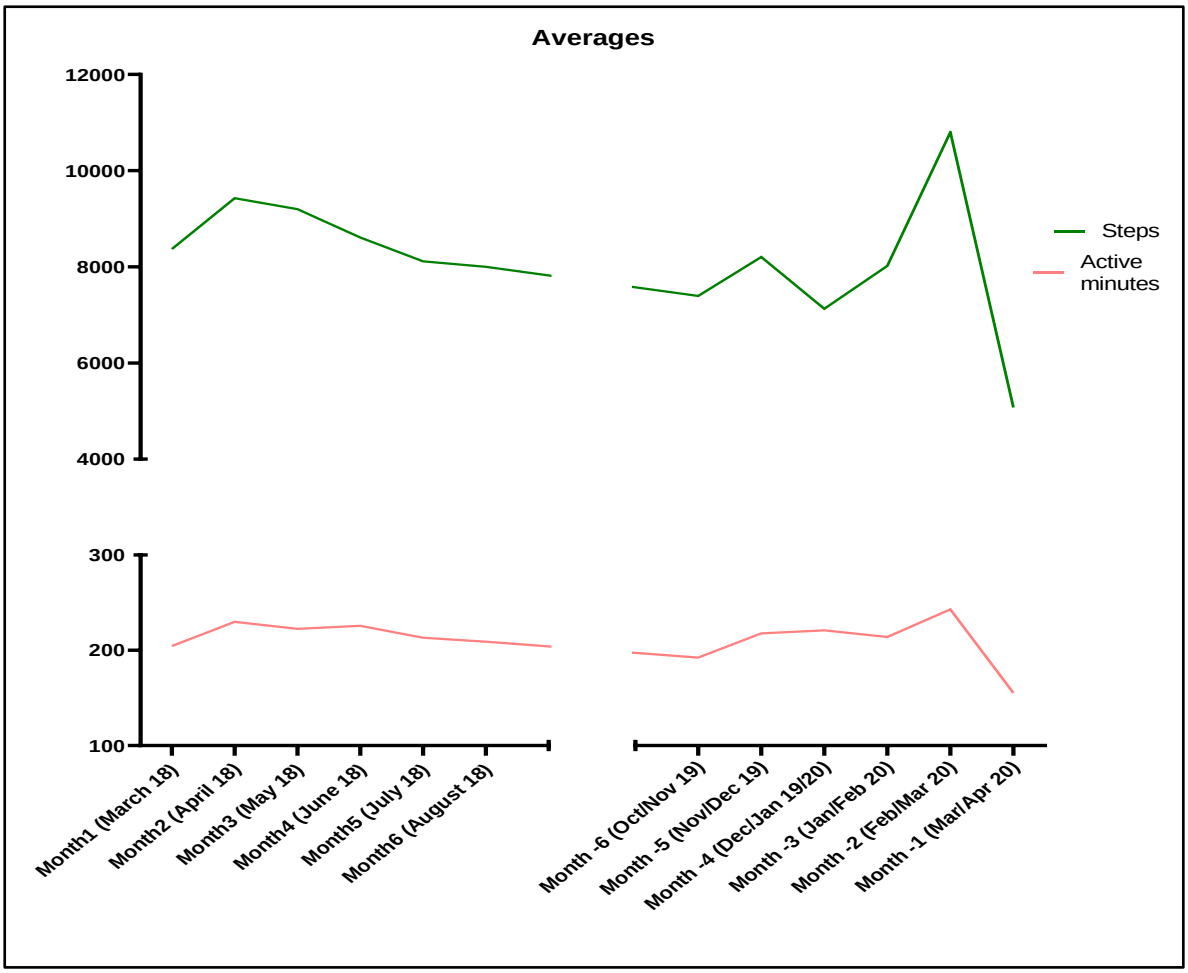

Figure 12: Example of Steps and Active Minutes Trends Across a Participant's Data

As mentioned above, the study was limited to Fitbit users only which has been declared the most popular fitness tracker in most western countries, including the UK (Mintel, 2019; Statista, 2021). This condition was put in place to govern the format of the device-data across the sample (i.e., devices having similar sensors, features and algorithms) and allow the interviews to be structurally comparable. Fitbit, unlike many big brands, allow its users to export their "activity" records separately (i.e., to exclude sleep, nutrition, and female health records) and in an accessible CSV format (Microsoft excel sheets). This ensured that the data obtained were relevant, comparable, and coherent. One disadvantage to choosing Fitbit, is in order to obtain full activity records, Fitbit requires the export of each individual month's data separately, which could be a time-intensive procedure and in a few cases led to participants dropping out after initially agreeing to take part in the study. Another issue with that was receiving incomplete or fragmented data sets (a total of 2). The quotes below depicts two scenarios which those participants used to justify not sending the records requested.

1) Instructions were not clear:

NW: 'I think it's just the instructions [you] didn't precisely say the first six months… so I just sent ones of when I first used it generally rather than the first, the actual first, 6 months.'.

2) I was not using the device consistently beforehand:

   Quote from AN who shared her records from January 2020 whilst she mentioned owning the device from November 2019.

   AN: 'Um, I think it was from January when I started using it properly, but like I think prior to January, I was very like, on and off with it. Because like obviously during January, I was like, you know, I need to take [it] seriously like, start a New Year's resolution kind of thing.'

It is probably appropriate to note that other than these cases, no other participants had any issues sending their records as instructed.

3.6 INTERVIEWS

The interviews took place online via a secure video conferencing software. The selection of the software was based on its security, ease of access (no account or registration needed), and compatibility with various digital devices (i.e., smart phones) knowing that not all the research participants have access to a computer which most other video conferencing platforms require. Prior to an interview, a private invitation link was generated and sent to the participant with instructions on how to join on the day. Generally, apart from minor internet connectivity issues, no major access or technology issues were encountered throughout.

At the start of each interview, and after asking the participant if they still consent, recording would start. I would then reiterate that the participant has the option to turn off their camera if they wish and summarise the purpose of the study and the scope of the interview. I would then allow time to take and answer any questions before I started the interview by following the pre-designed interview guide.

3.6.1 Interview Guide: purpose and design

Conventionally, semi-structured interviews are often informed by a guide engineered to govern the structure of the interview and ensure that all interviews held are comparable and consistent (Doody & Noonan, 2013; Saunders et al., 2019b). The study aims to infer credible and valid conclusions that answer the research questions and contribute to the growing body of literature on self-tracking and the use of wearable technology (Golafshani, 2003). Hence, participants were encouraged to elaborate and use their own words to inform the research from which direct, and indirect indicators were deduced to answer the questions of the study (Bhattacherjee, 2012). To reiterate, the research

questions are open-ended using 'How', 'What' and 'Why' questions which is standard for qualitative, exploratory research questions (Saunders et al., 2019b).

A simplified version of the interview guide is shown below (Table 9), however the full interview guide which includes explanation of the rationale behind each question (column 2) and the research question(s) that could be informed by each interview question (column 3) is attached as an Appendix (appendix 3). As mentioned, this is only a roadmap to ensure findings are comparable. However, in the interviews, the researcher tailored the questions and prompts to the individual's usage informed by the Features Checklist, and their WST use experiences. The 24-question interview guide was constructed to explore the theoretical propositions explained in the introduction chapter, namely, it is focused on prolonged use activities and practices, and how they are developed, reformed, and performed for long-term users and the factors, situations and/or characteristics that may shape these performances.

In line with the post-humanist research philosophy, the interview guide further explored the role of technology in the long-term wearables use experience (e.g., questions 11, 12, 14, 15 and 16). Scholars and philosophers theorised about today's digital technology as an entity capable of mediating, cocreating and/or influencing the behaviour of human agents within the system (see section 2.5 The Design and Capabilities of WST). This exceptional power is thought to be due to smart digital devices' ability to form feedback loops, collect and present personal data, and create virtual-extensions of the self (e.g. from Belk (2013) form a reservoir for the "distributed" memory, allow digital re-embodiment via Avatars, and co-construct the self) (Belk, 2016; Hoffman & Novak, 2018; Maller, 2015). This proposition sets forth a whole constellation of questions related to the design, usability, and value proposition of wearable technology which I attempt to address in this study (Table 9).

The first part of the interview guide was designed to enable participants to reflect on their physical activity and fitness activities, habits and rituals illuminating some aspect that are conventionally associated with personality and self-perception (Anderson et al., 2001; Anderson & Cychosz, 1994). For instant, participants were asked about their exercise routine, what sports they play(ed), the general importance of physical activity for them, their families, and their communities (i.e., Question 2- 8). During this part of the interview, most participants elaborated spontaneously often reflecting on their feelings, conceptions and rationale behind the decisions related to their physical activity practices. Afterwards, the interview guide shifted to focus more on self-tracking and the use of WSTs.

As the phenomenon is viewed through the lens of practice theory, the interview guide as a whole (i.e. main questions, follow-ups and prompts) was designed in a way that would elicit knowledge about the observable practices, the 'doings', of individuals as well as the underlying factors that constitute

practices as entities (Schau et al., 2009; Shove et al., 2012; Spurling et al., 2013). These may be the skills and know-how of the practice (e.g. question 4, 14 and 16) (Schau et al., 2009); the surrounding physical arrangements (e.g. question 3 and 4) (Spotswood et al., 2019); or even the social meanings associated with the practice (i.e. question 21) (Woermann & Rokka, 2015). Further details on the rationale behind each question is incorporated in the Interview Guide (Appendix 3).

Table 9: The Interview Guide Questions

Number	Question
Lifestyle	
1.	**Could you please confirm your name? And would you mind telling me your age and occupation?**
2.	**Could you please describe your lifestyle? Is physical activity important for you?** (Probe: what do you enjoy doing; who do you live with; any children; do you have any illnesses, conditions that affect your lifestyle; what are your hobbies; do you have any friends you share your hobbies with; what types of facilities for physical activity are available to you)
3.	**You said you work/study X, can you describe a typical workday of yours?** (Probe: what do your mornings look like, how do you travel to/from your destinations, do you sit at a desk most of the day, what do you do in the evenings)
4.	**How do you travel to work?** (Probe: drive, cycle, walk, public transport) **Has that changed since you started using your fitness tracker?** (Probe: walking more, started cycling, does the weather impact your choice of mean of travel)
5.	**How do you typically spend your weekends?** **Do your activity levels differ between workdays and weekends?** (Probe: any specific hobbies you practice, are you active or chill; if mentioned specific sport or hobby earlier in the interview, follow up on that)
6.	**How is your social life like?** (Probe: Do you socialise?, do you spend any time with friends?) **If yes; could you tell me more about what you do together?** (Probe: spend time together after work, go to a pub/restaurant together, go to the gym together, do activities together such as hiking, cycling, paintball…etc) **If no; how do you spend your free time?** (probe: watching TV, reading, going out alone or with family)
7.	**What do you do when you're taking time off (i.e. holidays, Christmas break… etc)** (Probe: do you just chill, take it easy or do you go on active/adventure kind of holidays?; do you spend your time with family or friends, or do you like to take time off for yourself)
8.	**Do you exercise or participate in sports?** If yes, **what type of exercise do you participate in?** (Probe: do you go to the gym, run, swim, part of a sports team) If no, **what activities do you use your Fitbit to track and why?**
Use	
9.	**Was your fitness-tracker a present or did you buy it yourself?** (Probe: Why did you buy it? OR Have you expressed interest in fitness-trackers before? Did you start wearing your Fitbit immediately after you got it?

	If not immediately, why?
10.	**Why did you start using the Fitbit?** (Probe: curiosity, to be more active; medical reason, family history of chronic disease)
11.	**Do you enjoy using your Fitbit?** (Probe: would you say you have fun tracking your activity) If yes, **why do you find it enjoyable?** If no**, has it always been not enjoyable for you? Please elaborate.** (Probe: do you use it exclusively for the health benefits, is it more like a "chore", do you use it because someone else (i.e. family member or a friend) uses it)
12.	**Do you wear your device regularly?** (Probe: how many days a week)
13.	**Do you sometimes forget to wear your device?** If yes, **tell me what do you do When this happens?** (Probe: do you just go normally about your day, do you do anything about it, does it matter to you, do you manually log in your activity i.e. long walk, gym session etc) If no, **what makes you so consistent in wearing your device?** (probe: does it motivate you, friends are competing with you, do you participate in online challenges, habit)
14.	**Can you describe to me how you use your Fitbit on a typical day?** (Probe: track steps, reminder to move, log activity information)
15.	**On the Functionality checklist, you ticked x, y, z …etc.** (Lyons et al., 2014; Piwek et al., 2016) **Why do you use these functions?** **(follow-up questions:** why do you use x/y/z function?; do they help you stay on track with your physical activity lifestyle; do you compare performance (in x/y/z) across weeks/months?; **have you always used the same functions since adoption of the device?**; how do you use this specific function?- *probe: input data, record before you start an activity…etc-* ; **are you interested in trying a function but don't know how?)**
16.	**Did you ever customise the device default goals to match your own?** (Probe: the device suggests 10000 steps per day, 7 days of exercise per week, 8 active hours per day and so on. have you changed these?) If yes**, why?** If no, **how do you asses your activity level?**
17.	**How often do you check the device's (companion) App?** **What for?** (Probe: look at stats, check caloric burn associated with specific activity, participate in community forums, input data manually) **Do you think that has changed from when you first started using your tracker and now?**
18.	**Have you noticed any changes in your overall fitness/physique since you started wearing your activity tracker?** If yes, **do you think your Fitbit played a role in that? How?** If no, **why do you continue to use the device then?** (Probe: do you feel better, has your appearance improved, have your mental health improved, is it other people's or encouragement)
19.	**Have you learnt any interesting or concerning facts about your health/ physical activity since you started tracking?** (Probe: have you visited a doctor or got professional advice due to readings recorded on your device, have you realised that your health is actually better than you thought it is, have you learnt that you can be more active that you currently are)
20.	**Do you notice any difference regarding your physical activity on days where you're wearing the tracker vs. on days where you're not?** **Can you elaborate on why is that?** (Probe: is there a difference at all, do you walk more, do you go out of your way to hit your goals, do you ever get bored of tracking, any specific feature that motivates you, do device positive feedback and reward badges matter to you)
21.	**Do you know others who use fitness trackers?**

	If yes, **do you compare your activity statistics with others (i.e. steps taken over the weekend, how intense was your run last week)?** (why/ why not) (Probe: are you competitive, is it just small talk, do you like to share your achievements with others you care about- for example friends, partner, family; do you go on walks/runs together; do you challenge each other on the App;) If not, **do you share your results with non-users?** (why/why not) (Probe: is it for small talk, conversation starter, sharing something you are proud of)
22.	**Have you ever considered switching brands or upgrading to the next Fitbit model? Explain why please.** (Probe: any features that you are interested in that your device don't offer?; better design, aesthetics, better provider)
23.	**You have been using the tracker for [specify months or years]. In your opinion what made you stick to wearing your tracker until now?**
24.	**In your opinion, are there any features in the device that can be improved to help more people continue to use their Fitbits?** **Finally, if I asked you to give a general piece of advice to someone who is considering buying a Fitbit, what would it be?** (Probe: warnings, tips, features that you like, activities they should try)

3.7 Research Ethics

Ethical approval was obtained from the Nottingham University Business School (NUBS) Research Ethics Committee (Ref. 201819063). The research follows the Institutional code of research conduct which governs the safety and confidentiality of the participants and their data. As such, lawful data collection and storage measures were in place in compliance with the General Data Protection Regulations (GDPR) act (2018) and in terms with the University of Nottingham Royal Charter.

To encourage participation, especially at a time of global distress, £10 Amazon gift vouchers were offered as an inconvenience allowance. Whilst monetary incentives in research recruitment is a common practice to enhance the response rate (especially in Health and Psychology research); there is an equally common ethical concern associated with it amongst searchers (Head, 2009). Head (2009) gives the example of doing research that involves recruiting homeless women, proposing that in such cases, monetary incentives could be viewed as an act of exploitation of vulnerable participants and hence it may induce skewed data and bias. Whilst the author's views are valid, I argue that these disadvantages can be avoided. As such, to protect the participants wellbeing, and to ensure the validity of the data, they were informing and reminded of their legal rights and the code of practice in British higher education institutions both in the detailed *Participant Information Sheet* and at the start of the interview. Further, given the sampling criteria (detailed in the upcoming section), it is unlikely that this research participants would be particularly vulnerable or financially deprived as we are looking at users of commercial, digital devices that cost £100-£300 on average.

With regards to data storage and handling, all the data collected are kept strictly confidential by being stored in a password protected Drive at the University of Nottingham. As per NUBS's research conduct guidelines, participants activity-records and interviews recordings/transcripts may be stored for no less than 7 years and up to 25 years after the project finishes. The researcher's measures to safeguard stored data also includes anonymising transcripts and omitting personally identifiable data when sharing outside the named research team i.e., in publications.

3.8 PILOT STUDY

To test the effectiveness of the research design, data collection began by conducting a pilot study which included two pilot interviews, after which the interview guide was edited, and restructured slightly to improve its suitability to the study. Pilot interviewees were PSA, 32-year-old, male who has been a user for 6 months, and MK, a 28-year-old, female who has been using her Fitbit for nearly 5 years. Following the research design plan, pilot study participants were required to give informed consent and complete the Features Checklist survey. PSA was asked to share all his Fitbit data (6 months) whilst MK was asked to share the first and latest 6 months of her data, a total of 12 months, as per research design. Both interviews took place virtually as in April 2020, it was the beginning of the COVID-19 pandemic, and the UK was under strict, full lockdown. This meant that inevitably the impact of the pandemic and the subsequent restrictions were discussed at various points in the interviews. This was not originally planned to be covered in the study, but as a result of the pilot study, it was incorporated. The rationale behind it, is as with any (semi-)permanent change of circumstances, it will undoubtedly have an impact on people's daily practices (i.e. Life chances (Cockerham, 2005)), and prospectively, their ability to perform their usual exercise and fitness routine. Pandemic-induced changes include the closure of gyms, ban on practicing team-sports, and limiting individual exercise time to 1 hour per day, to name a few (Institute of Government Analysis, 2021).

The interview guide was mainly amended to modify questions to make them more specific (Table 9). For instance, instead of asking 'could you describe your lifestyle', the guide was amended to include follow-up questions such as 'is physical activity important to you? how do you describe a typical work day?; how do you travel to work?; what do you do when you take time off (e.g., holiday)?'. This way the questions are focused about understanding the person's routines, practices and cognitive processes as opposed to their subjective interpretation of a 'lifestyle'.

Appendix 3 shows the final version of the interview guide used in this research interviews. Specific follow-up questions and edits that were added as a result of the pilot study are highlighted in green and red for clarity.

3.9 SAMPLE

3.9.1 Sampling method

For this exploratory study a non-probability, purposive sampling approach was chosen (Saunders, Lewis and Thornhill, 2019). From the literature, it is known that the abandonment of WSTs usually occurs within the first 6 months of use (Canhoto & Arp, 2017; Stiglbauer et al., 2019). Therefore, being interested in long-term trackers, participation was restricted to WST users of 6+ months. This assisted in avoiding the 'honeymoon' usage period and focus on sustainable use where rituals, conceptions and routinised practices start to form (Canhoto & Arp, 2017; Shin, Feng, et al., 2019).

Further, this study could add invaluable knowledge to the literature as the longest 'continued use' study observed users of 2 months (Shin, Feng, et al., 2019). As such, the extant literature arguably only covers the initial 'honeymoon' use period.

There is good evidence in the literature that supports the impact of behavioural and demographic factors on levels of fitness and engagement with the device (e.g., fitness-oriented individuals are likely to commit to long-term self-monitoring (Hardey, 2019)). Therefore, the aim was to recruit a diverse sample with regards to gender, occupation, living situation and fitness-orientation.

Recruitment criteria were:

- English-speaking
- Adult (over the age of 18)
- User of Fitbit for a minimum of 6 months
- Informed consent to participate in the study

3.9.2 Participants Recruitment

Participants were recruited through a multitude of channels, however, as the majority of recruitment took place during the first national lockdown in the UK, most of it was via online channels. This introduced challenges such as difficulty reaching less active, and older individuals. Trying to minimise this problem, I took a purposive approach where the study was advertised specifically to target these demographics e.g., posting in Fitbit 'Active Seniors' forum. The visible nature of the device made it possible to identify users on the streets. I approached users[19] in Nottingham city centre shops and cafés using the device as a casual conversation starter and inviting them to take part, if they were

[19] I generally approached people outdoors, in queues (i.e., collecting cafés takeaway), and in supermarkets, keeping a 2-meter distance in line with the social distancing guidelines at the time.

interested. For months from June 2020 onwards, I always carried a few study brochures with me when I went shopping and I successfully recruited six older (45+), less active participants this way.

Listed below are the channels through which at least one participant was successfully recruited:

- Internal email circulated to NUBS staff and students.
- 4 calls for participants on the researcher's personal Twitter account (1-month intervals)
- Advert published on www.callforparticipants.com.
- Email to staff in Edinburgh University and an NHS trust in London (through friends)
- Posts in Nottinghamshire towns' groups on Facebook
- Post in Fitbit 'Active Seniors' forum
- Brochures printed and distributed in Nottingham city centre cafés (post-lockdown, June onwards)
- Approaching people in person in Nottingham city centre shops and cafés (post-lockdown; June onwards)
- Snowball method (friends and family members of participants) (Goodman, 1961; Noy, 2008)

I had also been in contact with Fitbit Research but the call for participants advert was never published. The recruitment phase lasted from April 2020 to November 2020.

3.9.3 Sample characteristics

Thirty participants were recruited in total of which one third were male and the rest were female. Participants' age ranged from 20 and 72 years old (see Figure 13 for a breakdown).

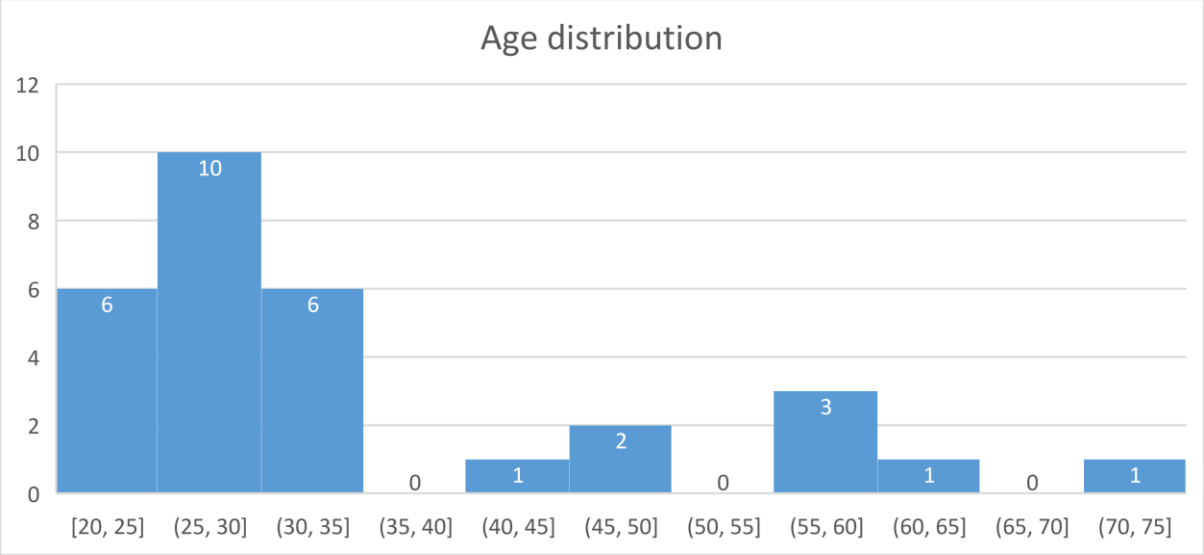

Figure 13: Respondents' Age Distribution

The Body Mass Index[20] (BMI) was calculated for all respondents. It was used to gain a better understanding of individuals' current fitness levels and whether weight-loss might be a reason for tracking. According to the British National Health Service (NHS), for most adults, a good BMI range is from 18.5-24.9, BMI between 25-29.9 is considered overweight, and a BMI that exceeds 30 is considered obese[3]. While 17 of the participants were within the normal range, nearly half of interviewees were either overweight or obese based on their BMI score. The graph below shows the BMI distribution across the research sample (Figure 14).

[20] Information about the BMI, how it is calculated and its levels can be found here https://www.nhs.uk/common-health-questions/lifestyle/what-is-the-body-mass-index-bmi/ [Accessed on 05/10/2022]

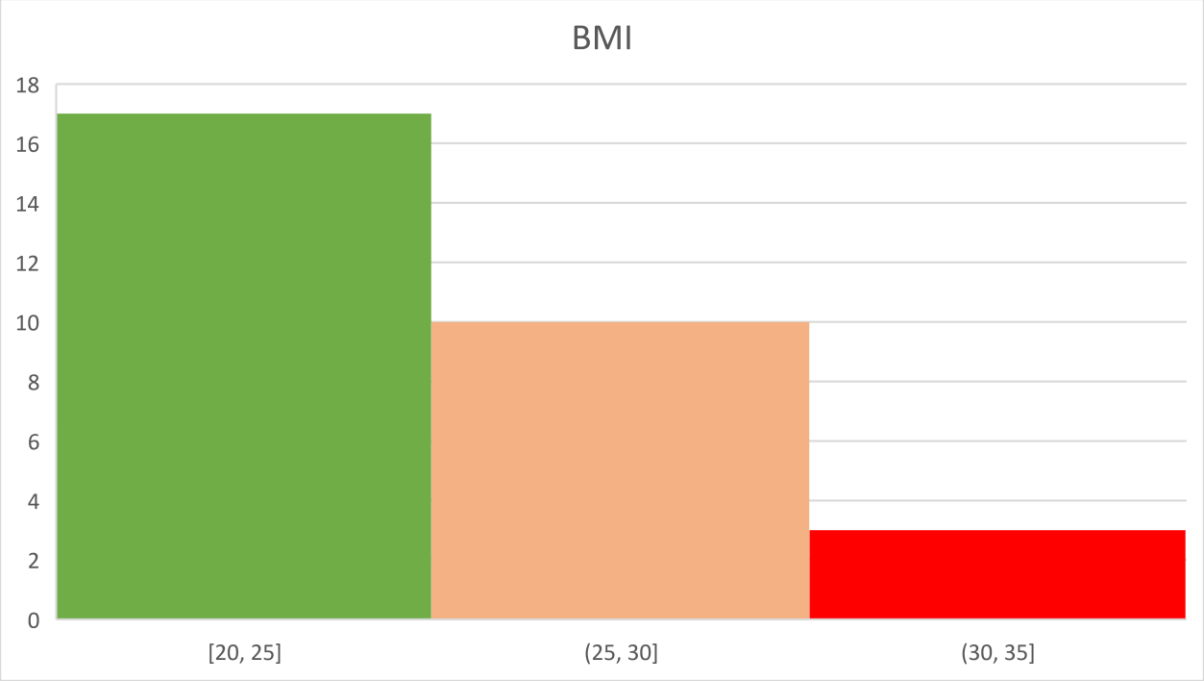

Figure 14: Sample BMI Distribution

Albeit only indictive, the availability of activity records allowed me to also characterise participants based on their level of 'physical activity', i.e., their average minutes of medium to vigorous activity performed per day. Using the public health authorities' recommendation of 30-60 active minutes (AM) per day, respondents were grouped into three categories: Low or below the recommended range (less than 30 AM/day), Average or within the recommended rage (30-60 AM/day) and High or above the recommended range (over 60 AM/day).

The table below summarises the sample and is colour coded in orange, yellow and green to reflect the physical activity categories above, respectively (see legend below Table 10).

Table 10: Research Sample Demographics

Name	Age	BMI	Gender	Living location	Occupation	Activity level according to Fitbit data
FO	29	29.10	Female	City	PhD researcher	Low
NVV	35	20.20	Male	Small town	Senior lecturer	Low
CB	45	24.50	Female	Small town	Administrative Staff at a university	Low
CG	29	27.80	Female	Home- rural/ Student-city	PhD researcher	Low
CL	29	20.00	Female	City	Post-Doctoral researcher	Low

GS	27	26.00	Female	City	PhD researcher/ Local Gov. admin staff	Low
HD	20	24.30	Male	Home- rural/ Student-city	Student	Low
JB	28	27.70	Female	City	Technology consultant	Low
NW	59	30.10	Female	Small town	Civil servant	Low
AN	22	27.90	Female	City	Student	Average
GK	25	23.20	Female	City	environmental advisor	Average
LM	49	23.00	Female	Small town	Teacher/ Local authority officer	Average
OSC	30	26.60	Male	City	Post-Doctoral researcher	Average
RA	26	24.00	Female	City	Physiotherapist	Average
VS	72	20.30	Female	Rural	Retired teacher	Average
CJ	24	27.50	Male	City	PhD researcher	Average
GC	62	20.20	Female	Small town	Retired Pharmacist	Average
JMG	35	23.60	Male	Rural	Travel agent	High
KM	22	23.10	Female	Home- rural/ Student-city	Student	High
LA	57	20.60	Female	Rural	Cleaner/carer	High
MA	20	24.00	Male	City	Student	High
MK	28	23.20	Not specified	City	PhD researcher	High
PSA	33	26.50	Male	City	Post-Doctoral researcher	High
RND	34	25.10	Female	City	Research associate	High
SH	28	21.80	Female	City	PhD researcher	High
YAP	31	29.10	Female	City	PhD researcher	High
MQ	31	33.00	Male	City	PhD researcher	High
SG	26	22.10	Male	City	Market Research Company employee	High
JNM	47	30.90	Female	City	Driving instructor	-
AH	58	20.60	Female	Suburban	Homemaker	-

Table legend

- Active minutes average below 30 minutes/day.
- Active minutes average between 60-30 minutes/day.
- Active minutes average above 60 minutes/day.
- Fitbit data were received empty or seriously fragmented

3.10 ANALYSIS APPROACH

To analyse the qualitative data I took an inductive theory-building approach (Bhattacherjee, 2012; Locke, 2007). Inductive data analysis is a common approach in the investigation of new or emerging behaviours and phenomena that are less theoretically conceptualised (Burnard et al., 2008; Pope et al., 2000). As detailed earlier the literature on wearable self-trackers, it is multidisciplinary, fragmented and lacks theoretical insights on prolonged WSTs use. Thus, to address the research questions, an inductive thematic analysis approach was adopted (Braun & Clarke, 2006; Clarke & Braun, 2017), complemented by an idiosyncratic typology generation approach (Fournier, 1998; Pelham, 1993).

Thematic analysis is an analytical procedure aimed to infer themes *from* the data. The procedure begins with 'Open Coding'; a technique used to label the data under an indefinite number of preliminary *codes* to make it easier to digest, categorise, and later, gather into themes (Clarke & Braun, 2017; Pope et al., 2000; Saunders et al., 2019b). Idiosyncratic analysis on the other hand, is an analytical approach developed in psychology research which aims to understand the personality and/or self-concept of individuals from the unique traits, habits, perceptions, and cognitive processes (such as making decisions) (Fournier, 1998; Pelham, 1993). Here, it must be mentioned that both approaches are compatible with the overarching bottom-up, inductive approach of this thesis. As can be noticed from the Analysis Stages table below (Table 11). The Idiosyncratic analysis phase took place later in the analysis process as elements of personality, self-view and self-perception started to emerge from the data. This piqued the researcher's interest in potential personality[21] or identity typologies related to patterns of continued WSTs use and initiated the next cycle of in-depth impressionistic reading of the transcripts. In the following sections, I will elaborate on each of the stages in detail (Sections 3.10.2, 3.10.3).

[21] Personality is viewed here as a set of traits and characteristics through which people *express* themselves and is not synonymous to Identity which is a cognitive concept of the self (Brinkmann, 2010; Schouten, 1991).

Table 11: Summary of Data Analysis Stages

Phase	Stage	Key activities
Features checklist: Sample characteristics	Extract anonymous answers from Google forms	- Download individual submissions and organise in password protected files. - Use the findings of each submission in the corresponding participant's interview
	Compile for the whole sample	- Compile in a Microsoft Excel format - Convert into visual presentations of data.
Data preparation	Record and prepare the interview for transcription	- Interviews conducted via a video conferencing software and were recorded (video and audio) - Audio extracted from the recording and saved in MP3 format
	Transcribe	- Audio files uploaded onto Otter.ai transcription tool. - Auto- transcribing (process ran from 2-5 hours depending on the length of the interview and the internet connection) - Transcripts manually 'cleaned' and edited for accuracy.
Analysis stages	Thematic analysis: **Free** coding	- Granular 'open' or 'free' coding where an indefinite number of initial codes is generated to make the qualitative data more comprehendible
	Thematic analysis: **Axial** coding	- Axial coding to categorise the open codes into themes. At the stage coding was being done based on observable actions, feelings, cognitive processes, circumstances and attributes. - At a later stage, axial codes were 'cleaned' to remove duplicated and technical faults (empty nodes)
	Thematic analysis: theme building or 2nd level grouping (Practices)	- Axial codes are grouped under practices. 26 practices were initially created then gradually reduced to 18 to minimise duplicates and nuances. - Other 2nd level groups included 'moderating/influential factors' and 'others' which mostly constituted of identity cues and findings that indicate interesting or relevant facts to the theoretical and/or philosophical approach (e.g., agency of technology)
	Idiosyncratic analysis: stage 1	- Reading the transcripts with a fresh outlook practicing Open Coding for usage activities, as well as personal, behavioural, cognitive, and psychological occurrences. - Identity manifestations were coded e.g., 'fitness oriented', 'on a health-kick', 'recently got fit', and 'struggle to stay active'. - Independent usage patterns of the 30 participants were generated

	Idiosyncratic analysis: stage 2 cross-person analysis (typology generation)	- Cross-sample examination was performed. Axial coding was across the sample to conclude what 'types' or patterns of use were found - Three WST usage patterns were concluded in the thesis. - Users who engaged in each usage pattern shared similar perception of self-identity which was evident through the way they perceived and expressed themselves

3.10.1 Data preparation

To begin, the collected data must be appropriately prepared for analysis. As mentioned in the research design section above, all interviews were conducted online via a video-conferencing software. This software allowed us to record the interviews automatically and save the recordings on a local, password protected computer cloud. Over 33 hours of video recordings were obtained.

Audio-only files were extracted, anonymised and saved for transcription. These files were saved under code names which were then uploaded to an automated, GDPR compliant, artificial intelligence (AI) auto-transcription software. The reason for using this AI transcription method was to generate timely transcripts in comparison to human transcribing, allowing more time to attend to recruiting research participants which was extremely challenging given the first UK national lockdown and a state of uncertainty at the time (see 3.4.1 Impact of the Pandemic on Research Design). The auto-generated transcripts were closely examined and then manually edited to ensure accuracy. This process was also an opportunity to become more deeply familiar with the raw data (Burnard, 1991; Pope et al., 2000). In total, over 400 pages of transcript were collected across 30 in-depth interviews.

Transcripts were then transferred to the computer software Nvivo and printed out in preparation for analysis. Nvivo was only utilised as a qualitative data organisational software tool rather than an analysis tool (Burnard et al., 2008).

3.10.2 Thematic Analysis

The data analysis method intended for this study is designed to assist in inductive theory-building. Inductive data analysis is a popular approach especially where emerging phenomena, with little to no predetermined theoretical information are investigated (Burnard et al., 2008; Locke, 2007; Pope et al., 2000). As such, this approach would assist in extracting practices through identifying recurrent themes within and across the sample, and recognising their various underpinning elements (i.e., emotions, procedures, skills etc) all whilst keeping an open mind about emergent themes beyond the theoretical interest. In other words, *inductive thematic analysis* is a truly exploratory approach which focuses highly on what the data reveal (Braun & Clarke, 2006).

Thematic analysis is a well-established qualitative data analysis procedure which typically starts with 'open coding' and builds up to a higher, more encompassing classification called 'Axial coding' before finally reaching the broad, overarching 'themes' (Clarke & Braun, 2017; Pope et al., 2000; Saunders et al., 2019b). According to Braun and Clarke, themes are 'buckets' of similar codes, they are not defined in size or breadth, they can be a single code, or a bundle of many (Clarke & Braun, 2017; Saunders et al., 2019b). As such, the researcher's interpretation and judgment play a key role in the thematic analysis process.

Thematic analysis is an iterative, malleable process that can be easily tailored to the aims(s) of the study. In this particular research, the thematic analysis consisted of three cyclical stages a) open coding or labelling b) Axial coding or first-level coding , and c) themes building or second-level grouping.

3.10.2.1 Coding approach:

Taking a bottom-up approach to thematic analysis means coding started at the most basic level of generating 'open' or 'free' codes. The free-coding stage is where an indefinite number of initial codes is generated to make a large amount of qualitative data more comprehendible (Pope, Ziebland and Mays, 2000; Clarke and Braun, 2017; Saunders, Lewis and Thornhill, 2019). Codes are usually words, or short sentences, associated to describe the longer, more colloquial raw data under analysis (Saunders, Lewis and Thornhill, 2019). Despite the theoretical and philosophical underpinnings of this thesis, in accordance with the Thematic Analysis approach, the free-coding stage was largely data-driven (Braun & Clarke, 2006).

Coding over 400 pages of raw data was challenging, especially in terms of keeping focused on answering the research questions. The researcher had to be careful not to digress and instead code relevant information (Saldana, 2016; Clarke and Braun, 2017). For example, in this study, coding was for 'observable' actions as well as underlying emotions, thoughts, perceptions and skills, in line with the practice theory perspective. Further, it is relevant to the post-humanist approach and the research questions to code for factors that could influence the use of WSTs with a special emphasis on the device itself (Saldana, 2016; Figure 156). Thus, in this inductive thematic analysis process, two coding strategies are simultaneously operationalised. Namely: a) Descriptive coding, where codes were

developed for performances and actions, and b) Emotional coding where inferences of the emotional and psychological underpinnings are drawn (Saldana, 2016; Rogers, 2018).

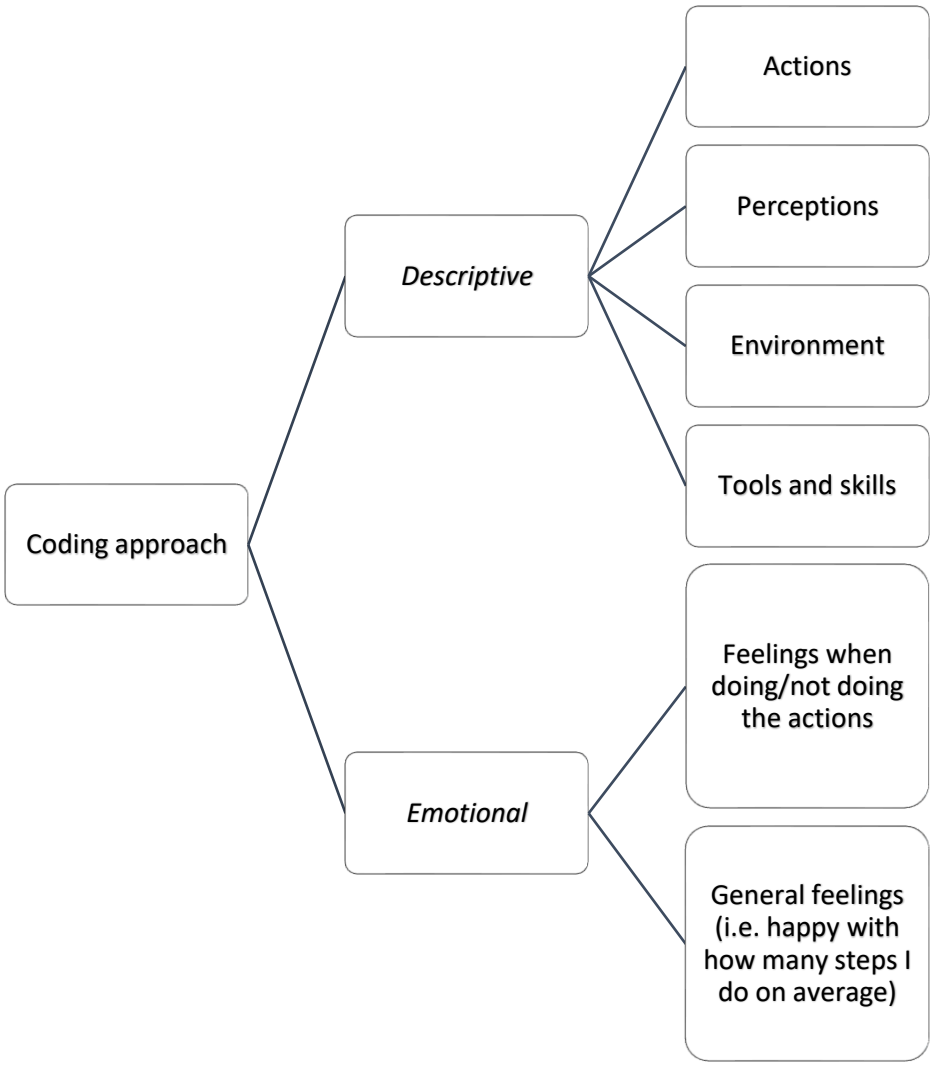

Figure 15: Coding approach

Nvivo was selected for it is a useful tool for coding that facilitates large data handling and management. At the end of the free-coding stage, 530 unique, first-order codes were generated. Following that, the extensive list of codes was revisited to minimise the number of codes to the lowest possible by merging conceptually similar codes together and deleting duplicated. The final list of free codes constituted of 412 unique codes.

Some examples of codes mergers are shown in table 12 below.

Table 12: Examples of Codes Merger

Code	Merged into
Careful engagement	Avoid too much engagement with the device
Desire to share active practices w/ friends	Friends push each other to exercise
Trying to build a habit	Exercise as a routine
Social tracking	Fitness communities
Seeking change	Started tracking to become more active
Persuade others to exercise with them	Friends push each other to exercise
Focus on 1 parameter	Learning to use Fitbit can be overwhelming. Learning through consistent tracking
Less active after certain life events	Low fitness-orientation
Changed attitude towards physical activity since lockdown	Restrictions/Cohn's 'life chances'
Tracking tools can be overwhelming or off-putting	Justifying using multiple tracking tools
Track nutrition when I'm eating well	Episodic tracking
Trackers is so good it should be prescribed or mandated	Positive outlook on self-tracking
Tracking as a necessity	Perceived usefulness
Being able to spot irregularities in HR, VO2 max etc	Learning through tracking
Don't leave the house if I don't have to	Low fitness-orientation
Do as the device tell me to do	Agency of tech

Later, the finalised list of free codes was revisited searching for commonalities that would form the basis of themes (Braun & Clarke, 2006). This was done by a cycle of Axial coding where codes were gathered under common titles. An example of how axial codes were presented is shown below (Table 13). Here a number of codes are classified under the axial code 'Life restrictions' which are the factors that respondents mentioned as restrictive to being physically active.

Table 13: Example of an Axial Code

Life restrictions (that respondents mention as impacting their physical activity)
Caring responsibilities or shielding
Childcare
Injury
Religious events (i.e., Ramadan)
Settings
Weather
Work

Next, codes were iteratively revisited for the purpose of theme generation (Saldana, 2016; Clarke and Braun, 2017). The themes were driven by the data and organised according to practice theory and the post-humanist approach underpinning this thesis. This resulted in the following three categories:

- Practices
- Additional forces
- Others (prospectively important constructs that did not relate to the practices anatomy directly)

A total of eighteen practices emerged from this analysis, which will be detailed in the next chapter. Themes grouped under the category 'Others' included important constructs such as: fitness-orientation, agency of things, agency of the human amongst others.

From the thematic analysis, patterns of WSTs use started to be noticed, and themes related to self-perception and identity were starting to emerge which suggested a potential link between the two categories. In a true inductive manner, this was an indicator for the researcher to start the idiosyncratic analysis procedure to explore whether usage patterns can be inferred and if users' unique characteristics and experiences could relate to specific patterns of WST use.

3.10.3 Idiosyncratic analysis

Idiosyncratic analysis is a form of qualitative analysis popularised in psychology where personal accounts are examined in-depth to outline the unique stories of their self-concept within the context of research (Pelham, 1993). This form of data analysis explores "patterned uniqueness" through the in-depth examination of personal qualitative accounts (Pelham, 1993). Thus, aiming to identify patterns of *behaviour*, *thought*, and *emotions* within an individual over time and contexts (Conner et al., 2009). Findings from this *intrapersonal* analysis are then typically cross-examined across the sample to develop 'typologies', which in this case are of WST use (Conner et al., 2009; Fournier, 1998).

In marketing research, researchers draw on this method in consumer research, specifically, when the aim is to infer patterns and/or typologies across a population or situation (e.g., Fournier, 1998). Following the emergence of distinct usage patterns and the prevalence of personality and self-perception codes in my thematic analysis, I re-read the transcripts of raw data with an Idiosyncratic approach in mind. The aim was to consider the personal account of each participant beyond the 'doings' in terms of self-defining personal, social and cultural concepts; importance of physical activity and performance, at several points of their lives (i.e., childhood, early adulthood, before tracking, after adopting WST, and most recently); and users self-view in the context of wearing self-trackers (Fournier, 1998; Ruvio & Belk, 2012).

After a lengthy and iterative process of examining individual transcripts, a cross-sample comparative analysis was conducted (Appendix 4). This approach resulted in identifying three distinct patterns of use that upon close examination were found to be related to the participants' sense of identity in

relation to fitness, which I refer to here as *fitness identities*. Findings of this stage of the analysis will be discussed in full in chapter 5.

3.11 Chapter Summary

To summarise, the objective of this chapter is to outline the methodological design of this research and to demonstrate rigour and conceptual coherence. To recapitulate, 30 stimuli-driven semi-structured interviews were conducted in total, all of which took place virtually due to the COIVID-19 pandemic. As an exploratory study, the researcher ensured that the research was designed in a way that would enable reflection, and in a way that would shed light on the key theoretical interests (i.e., practices) while allowing space for exploration. The accounts of the diverse research sample were analysed utilising an inductive, thematic analysis approach in combination with an idiosyncratic analysis. As such, taking a truly data-driven, inductive approach. The results of this analysis will be discussed in detail in chapter 4 and 5, respectively.

CHAPTER 4: THE PRACTICES OF PROLONGED WST USE

4.1 INTRODUCTION

Having discussed the methodological and analytical approach of this thesis, this findings chapter explains the findings of the thematic analysis stage. The chapter will define, and critically discuss the concept of device agency found to be closely related to the usage practices identified in this thesis before outlining the functional concept of device centrality. After that, the eighteen usage practices inferred from the analysis will be discussed according to their observable part, device agency and centrality, as well as a host of underpinning factors. This chapter lays the foundation for the next findings chapter (chapter 5) where these practices will be further analysed, bundled, and contextualised.

4.2 USAGE PRACTICES

As discussed in the previous chapter, the research design proved successful in stimulating participants' memory and unveiling new or alternative accounts about participants activity in a nonintrusive manner (Orr & Phoenix, 2015; Prosser & Loxley, 2008).

The analysis of the research data unveiled eighteen distinct Usage Practices (UPs) which, varied in nature from highly cognitive to predominantly physical. These usage practices (UPs) were characterised by dimensions that were determined qualitatively based on the predominant actions (physical or otherwise) users emphasised when reflecting on how they performed a given practice. The eighteen usage practices were subsequently grouped according to five dimensions: physical activity, tracking, social, cognitive, and emotional. While some dimensions encompassed a higher number of practices (i.e., 8 tracking practices) which at first may suggest dominance, or higher impact, other dimensions (i.e., cognitive practices) had fewer practices, but were an ongoing, more dominant, state of mind rather than an intermittent behaviour. As such other ways to further differentiate the dominance of practices were sought, from which Device agency and Device centrality emerged.

In this chapter, I describe the practices associated with each dimension in detail, thus providing the basis for the subsequent chapter (Chapter 5). To simplify in-text references, practices are coded based on their dominant dimension (P# for physical activity practices, T# for tracking practices, S# for social practices, C# for cognitive practices and E# for emotional practices), as shown in Table 14. This table categorises each practice (Dimension, code, and title), while the underpinning factors are listed in separate tables under each practice section.

Table 14: Summary of the Usage Practices (UPs) with codes

Dimension	Practice code	Practice title
Physical	P1	Getting the steps in
	P2	Chasing in-device targets
	P3	Taking rests
Tracking	T1	Full recording
	T2	Creating a multi-device 'tracking system'
	T3	Tracking steps as proxy
	T4	Episodic Tracking
	T5	Monitoring physical activity weekly
	T6	Personalising goals
	T7	Tracking sleep
	T8	Innovative wearing
Social	S1	Organising and participating in physically active social events
	S2	Sharing activity facts
	S3	Comparing steps
	S4	Social Signalling
Cognitive	C1	Selective tracking
	C2	Ignoring reminders
Emotional	E1	Seeking virtual reward

As a post-humanist study, the role of the device is instrumental to the way UPs are viewed and conceptualised. Hence, before delving into the details of the practices, the concepts of device-agency and device-centrality will be defined.

4.3 DEVICE AGENCY

Device-agency is a core concept to this research which is defined drawing on the general conceptualisation of 'agency' (see section 2.5.1) as the quality of power, and capacity of a wearable self-trackers to collect, process and feedback personal data to influence the user's practices (Hoffman & Novak, 2018; Rossiter, 2007; Sillar, 2009).

Such influence could be physical (i.e., practice observable procedure), cognitive and/or emotional (Pantzar & Ruckenstein, 2015; Rossiter, 2007). Put concisely, for an entity to be agentic, they must be able to modify the state of affairs by making a difference in the way things are enacted, perceived or interpreted (Rossiter, 2007). For humans, agency is often linked to qualities such as perceived competence, and self-differentiation and is communicated via 'meaning-making activities' (Hoffman & Novak, 2018; Rossiter, 2007). However, for self-tracking devices, agency is believed to be communicated via its display screens (i.e., notifications and feedback cues on WST screen, App interface and web dashboard) (Lomborg & Frandsen, 2016) and the effect of thereof varies depending on factors related to both the human and the non-human entities in the system (Latour, 2004). In this thesis the agency of the device varied across the dimensions the practices (i.e., whether it be a physical, emotional, or cognitive related practice), the context in which practices take place and the identity, and characteristics of the WST users themselves, all of which will be discussed in the next chapter.

It is important to note that agency is viewed here as a "chain of influences" involving the human and the nonhuman entities that are part of the WST use system (Rossiter, 2007). As such while I acknowledge the agency of all things (e.g., WST, exercise machines, bicycle etc) and entities (e.g., family and friends), the aim of this thesis is to explore the role of the WST devices in (re)shaping the use and/or triggering physical and/or mental activities (RQ3) and, as such, I focus my analysis on this particular construct.

In the following part of this chapter, each Usage Practice (UP) is coded a corresponding level of device-agency, or the level of authority afforded to the agentic smart device (Schweitzer et al., 2019; Appendix 6). I propose three levels of device agency, drawing on the data analysis and Rossiter's definition:

- High: the device is authoritative and able to influence the physical, emotional and/or mental activities of the user.
- Moderate: the device is somehow authoritative and mostly able to influence the physical, emotional and/or mental activities of the user.
- Low: the device has almost no authority over the use, unlikely to influence the physical, emotional, and/or mental activities of the user.

Examples that support and explain how each practice was coded in terms of Device Agency can be found below, under the description of each practice.

4.4 DEVICE CENTRALITY

In addition to device agency, this thesis posits a conceptualisation for the term 'device-centrality', which is defined as the *degree of functional importance* the tracking device, and related technology, plays in the enactment of the practice. In other words, it is a description of how integral the device is for a practice to take place. Drawing on the research participants' accounts, three levels of centrality are proposed:

- **Central:** interactions, deliberative thoughts and activities are organised around the tracking device (and associated technology) for the entire duration of performing a practice. As such, the device is integral for the observable part of the practice to take place.
- **Intermediate**: the tracking device (and associated technology) may initiate the practice or is necessary at a certain stage of performing the practice, but not continuously. As such, the device is only partially integral for the performance of the practice.
- **Peripheral**: the device is not integral for the performance of the practice. Instead, owning and/or wearing the device may be.

Each usage practice has been coded a level of centrality based on these definitions. The rationale is explained under each of the following practices' descriptions, and examples of how device centrality was described by the participants can also be found in the description of UPs below.

4.5 HOW TO READ THE PRACTICE DESCRIPTION

The eighteen Usage Practices are described in a similar format, consisting of roughly four parts including the practice definition and overall procedure, empirical data to support the key features and/or activities of the practice and, an explanation of the device agency and centrality levels within the practice. In addition, a table that lists the underpinning factors for each practice according to the practice theory model operationalised in this study (see section 2.7.2) is presented at the end of the description.

4.6 PHYSICAL ACTIVITY PRACTICES

Three predominantly physical practices were grouped under this category. I define these as practices which are exhibited mainly via physical, bodily performances. The 'P' practices are often reactive, and based on external factors e.g., the numbers displayed on the tracking device. Apart from P3, physical activity practices are characterised by an increase in physical movement. Conversely, P3 'taking rest' is a dissociative physical activity practice where physical activity and exercise are decreased as a result

of a personal decision i.e., tracking is not part of the holiday routine. Here, it is worth noting that this practice also involves a cognitive dimension. However, the most significant aspect of P3 is the deliberate reduction of performing physical activity.

4.6.1 P1: Getting the steps in

As a physical activity practice, this practice takes the form of a physical performance. As discussed, Fitbit builds on its predecessor the pedometer (see 3.5 Fitbit) and, despite having a whole host of functions to offer, step monitoring was by far the most popular functionality amongst this research sample, with 100% of participants reporting tracking their steps (see 3.5.1 Features Checklist). As such, many quantify their physical activity in terms of steps (e.g., T3: Tracking steps as a proxy). Participants who performed this practice said that they do not necessarily chase targets/step-goals however they do get (overtly or subconsciously) nudged to 'get the steps in'. This practice results in WSTs' users taking every opportunity during their day to be physically active, in a form that would increase their step-count, such as walking to destinations, break-time runs or taking the stairs instead of the lift.

MEQ (male, 31): '[at work] I like to walk as much as possible. I like to take [stutter] the stairs when there is [a] lift or elevator.'

Participants further explained that 'doing steps' or 'getting the steps in' becomes an ingrained habit and a task that they often went out of their way to complete, as SH (female, 28) explains: 'Fitbit has changed my behaviour about step count. So […] if I did some yoga for example, or did BodyPump […] then spend the rest of the day sat down so I didn't have very many steps even though I had done my kind of activity for the day, I would be very inclined to go and walk around some more to try and have my step count because it's on my Fitbit.'

Further, the majority of the users who reported doing this practice also said that they mostly did it not only to reach an in-device goal, but for personal gratification, or to 'beat' a personal-best (PB) record as in the following quote by SG (male,26)

SG: 'sometimes I have a really active day and I check in and 'Oh my god, I'm on 33,000', I think a part of me is like 'only another, you know, 6000 I'll beat my [best] record' or something… So when that happens, I, I feel like I want to kind of walk around for a little bit more just to see if I can kind of top myself.'

This practice is performed when the activity is being tracked which gives the device considerable centrality (or functional importance). However, the device has only a moderate level of agency in here, for whilst noticing the step count may trigger an activity (e.g., walking) the main agency remains

associated with the *doing of* the practice which is afforded to the human (e.g., whether they choose to go for a walk after checking their step count).

Further, the influence of the device (device agency) varied across this practice's performers, with some intentionally creating opportunities where they will do more steps than others. For example, CB (female,45).

CB: 'often I would try and park at one end of campus to walk up [to my office] just to kind of feel like I wasn't just sitting down door to door and then going straight in'.

Others were more reactive and relaxed about getting their steps in all the time, such as CL (female, 29).

CL: '[noticing my step count] is just a reminder that I have or have not gotten any amount of exercise today. So sometimes if I see around lunchtime that I haven't really gotten up away from my desk and done any steps today, I'll try and be more active like, I take the stairs instead of the lift for the rest of the day'.

Table 15 below outlines the underpinning factors of this practice.

Table 15: P1 underpinning factors.

P1: Getting the steps in	
Tools and material objects	- Owning a WST - Attaching the device to the body
Knowledge and skills	- Knowledge that incidental activity 'adds up'. - Awareness of personal level of activity and previous 'personal best'
Emotional and cognitive procedures	- Self-gratification - Sense of accomplishment
Device agency	Moderate
Device centrality	Central

4.6.2 P2: Chasing in-device targets

This practice is similar, yet distinctively different from P1. While both stem from an intrinsic desire to increase step count, P2 is specifically performed when the in-device target appears to be within reach. For instance, WST users become more active, seeking to increase their step count and achieve their pre-set targets as their goal gets closer. AN (female, 22) spoke about her experience becoming more inclined to walk when she feels like her step goal is within reach.

AN: 'It ends up being a bit annoying, I think, to other people, because I'm just like, 'oh, I'm gonna actually walk home, I have like, 500 steps to go to hit 10 K [steps]', like, I will just end up bringing it up and, [do] really annoying compulsive things sometimes where I'm like, 'Oh, no, no, no, I don't want to sit down, you can sit down, I'm just gonna, like walk around while we talk so I can hit my step goal'

This practice affords more agency to the tracking device and is centred around the specific number shown on the display screen, thus giving a high level of device centrality. The device-agency is especially evident in situations where there are physical barriers to being able to perform physical movement immediately (i.e., work or family commitment) despite the goal being within reach. CB (female, 45) explained what happens when she is at home, and unable to leave the house for a walk due to things like work (working from home) or family responsibilities.

CB: 'if I can see that I'm near [my goal] in steps, then I'll probably try and do something at home to increase my steps or run up and down the stairs a few times, just to add some on.'

To conclude, P2 is a practice that revolves around goal setting which is a key feature of WST. The following table explains the details of this practice further (Table 16).

Table 16: P2 underpinning factors.

P2: Chasing a target	
Tools and material objects	- Owning a WST - Attaching the device to the body
Knowledge and skills	- Ability to move (no environmental or bodily restrictions). - Monitoring steps
Emotional and cognitive procedures	- Aiming for a goal - Chasing a sense of accomplishment - Deep desire to hit targets
Device agency	High
Device centrality	Central

4.6.3 P3: Taking rest

This refers to the deliberate disengagement with the device when one is planning to rest. The practice is carried out over both short periods of time, and longer periods such as a few weeks of holiday. The performers of this practice associated *rest* with removing the WST from their lives to reduce the urge to become physically active. In contrast to the other physical activity (P) practices P3 refers to the reduction of physical activity, or doing less, rather than doing more physical movement as is the case in P1 and P2.

Rest was defined by the participants of this research in two ways, some defined it as the complete removal of the device from their everyday lives, whilst others described it as a cognitive disengagement from the device while still wearing it. The following quotes explain the two perspectives, respectively.

JB (female, 29):' [On holiday I'm] less likely to be wearing my watch to track my physical activity. So most times, a lot more less pressure to kind of hit any kind of targets and just kind of just go about just liv[ing] in some ways that are more relaxed, [I am] a lot more relaxed during those holiday periods, than it is [on] like a normal weekday.'

CJ (male, 24) is a semi-professional athlete who discussed the gaps in his records by explaining how he 'rests' by disengaging with the device after competition season.

CJ: 'tracking goes in cycles for me. So, the Judo competition calendar typically like determines that. So we have big competitions in February, summertime and November. [my physical activity] comes to a peak for those competitions. And then immediately after, I will take a lot more of a rest, I'll still go to training, but I'll be much less active… if I've done a long run or an intense run or something like that. I'm typically less active for the rest of the day'.

As per the JB's quote above, many P3 performers reported that their awareness that a device is recording put pressure on them to be active, and when they are not, then they may experience a feeling of guilt and disappointment in themselves. AH explains how even when she is willingly choosing to prioritise family time, seeing low numbers on her device still emotionally affects her:

AH (female, 58): '[when prioritising family, I am] constantly not achieving that goal… I find it quite depressing. I just find it depressing to see [my step count] written down.'

For users like AH and JB, rest, enjoyment, and freedom were perceived to be only fully experienced when the self-tracking device is removed from the equation.

SG highlights yet another point, this time it is related to security, a device is perceived as a 'luxury' item, and for SG being relaxed and on 'holiday mode' means wanting to not worry about the loss of expensive personal belongings.

SG (male, 26):'[I] went to a festival in September abroad in Croatia, and I didn't wear my Fitbit because now I'm in a festival somewhere. I'm not gonna wear like a fairly expensive watch on a beach somewhere. So, I didn't wear it for that week I was on holiday… also I'm on holiday! [saying referring to the freedom] I'm at festival so it's, you know, I'm kind of removed from my day to day… I'm in a completely different kind of setting and environment than I would be anyway. So my list of priorities were slightly different that week'.

Here, whilst the device is seemingly at the core of the practice, in reality, the possession of the device is. As such, it does not need to be worn for the practice to take place, one just needs to be a user. In other words, the device is peripheral for the performance of P3. Further, in this practice considerable human agency is needed to disengage from tracking physically or cognitively, as such the device agency was often low or completely missing. The components of this practice as listed below (Table 17).

Table 17: P3 underpinning factors.

P3: Taking rest	
Tools and material objects	- Being geographically or situationally removed from the day-to-day routine - Owning a WST
Knowledge and skills	- Ability to structure rest vs. activity. - View rest as important or essential - Associate 'time off' with no tracking
Emotional and cognitive procedures	- Feeling less pressured to be active - Psychologically removed from daily routine. - Avoiding disappointment
Device agency	Low
Device centrality	Peripheral

4.7 Tracking Practices

In this research, eight tracking practices were identified, this is the highest number of practices under a single dimension, which is not surprising given the main purpose of Fitbit i.e., being a self-tracking device. The main element to highlight with regards to tracking practices is that although WST are a key part of the practice, not all tracking practices are necessarily high device-agency practices as it was found that *tracking* is the key element of the practice, and not the device. As such, users modify their activities in ways to ensure that they are recorded by the WST device and perhaps innovate in the way they use the device to match their personal desired outcomes from tracking. For example, in T5 'Monitor physical activity weekly', after a period of daily monitoring, some users decided to increase the interval to weekly to better align monitoring with their lifestyles and avoid unnecessary pressure associated with daily monitoring.

4.7.1 T1: Full recording

Tracking is an essential behaviour of Fitbit users. Hence over time, many users deemed their physical activity pointless if not tracked and recorded just as CJ (male, 26) told the researcher, quote:

CJ: 'I like the fact that my [Fitbit] records, or [that] my activity is recorded. You sort of think to yourself, 'well, what's the point of doing it if it's not recorded?'

Similar to CJ, many others such as CL, LA and RA felt their physical activity is wasted if it is not recorded. For example:

RA (female, 26): 'if I'm lifting weights sometimes it doesn't register. And so I'll have to manually input what I've done… sometimes I know it's really bad to say, but if I haven't done, if I haven't got my watch on. I'm like 'Well, workout is pointless'.'

In fact, like RA the majority try and add the lost activity manually to their records afterward to rectify the error. It is done by manually inputting an estimated number and / or duration either based on a previous performance, or on a calculation of the actual activity made by another device of theirs (e.g., mobile phone) or that of a friend's (i.e., step-count of a friend they went on a walk with). The quote below gives an example of this:

LA (female, 57): 'sometimes if I've put [my Fitbit] on charge, it needs charging up, put it on charge. And then I go take the dog for a walk and I come back, and I suddenly realise ' Oh F***, I forgot to put my Fitbit back on before that long walk…but I'm lucky because I've got, on the phone, I've got Samsung Health. So, I take my phone with me it actually puts the steps up on the Fitbit App so I'm lucky I've discovered it don't actually lose too many steps.'

It Is typical in this practice for people to feel frustrated or deflated, if their attempts to record all their physical activity performances fail. That could be due to a technical error with the device or simple human forgetfulness. Breaking the momentum seems to have a considerable impact on the user's mood, self-belief and / or future T1 performances. CL is among the people who repeatedly reported their frustration with such incidents as quoted below.

CL (female, 29): 'It's like once you have a streak going of like, every day that you've gotten how[ever] much exercise you get in a day, but then to have that little blip in that one day that [appears as if] you didn't do a damn thing. [and I am like] "ugh, but I did!".'

This is a device-centric practice and, as the existence and functionality of the device impact the mood and behaviour of practice performers, it is a high device-agency practice. Below I describe the practice T1 in further detail (Table 18).

Table 18: T1 underpinning factors.

T1: Full recording	
Tools and material objects	- Wearing a WST - Additional tracking methods (i.e., mobile phone health app) - Fitbit companion App
Knowledge and skills	- Knowing personal averages - Programming the device for specific targets and/or challenges - Technological ability to log in extra unrecorded activity
Emotional and cognitive procedures	- Desire to generate complete records for personal gratification - Frustration and/or irritation when physical activity is missed
Device agency	High
Device centrality	Central

4.7.2 T2: Create a multi-device 'tracking system'

Tracking practices are the most populated category of practices identified. The vast majority of those who were interviewed reported tracking more than one parameter regularly, sometimes utilising several methods and / or technologies. As such, it was not uncommon for Fitbit users to use it as a part of a 'tracking system' where the fitness band is combined with other means of self-tracking such as mobile-phone apps, chest straps, ankle bands, and bike-mounted GPS trackers, to name a few.

These devices are usually synchronised together to create one central, comprehensive data repository for ease of use. NVV (male, 35) explains his cycling tracking system in this quote: 'I've got the Fitbit App and my Strava App talking to each other. The GPS unit [on mobile phone] records the session and then when I stop, it synchronises automatically in the background and then they talk to each other and it magically all happens… They definitely complement each other. Some do things that others don't do… the other App I use, the Strava app, allows you to compare [cycling] segments to each other [Fitbit doesn't]'

He later added: 'I used to exercise with a heartrate monitor. So, I had a chest strap which was linked to a different app, but not to Fitbit because they wouldn't talk to each other'.

That could also be related to participants' perceptions of Fitbit as many deemed Fitbit a 'lifestyle' tracker and when they performed a sport (or any high-intensity physical activity) they added other tracking technologies on. Example:

GC (female, 59): 'I see Fitbit as being something that just records your routine daily activities. Whereas Garmin is a sports watch… I don't wear my Garmin watch all the time. But I do wear my Fitbit all the time. I think they've got different purposes.'

This practice is orchestrated by the user as such this gives the device minimal agency yet intermediate centrality. This is because tracking is a central activity in T2, but different devices are utilised to track a host of different activities, hence the centrality of Fitbit is lower than in practices where Fitbit is the sole or main WST in use. The underpinning factors of T2 are listed in table 19.

Table 19: T2 underpinning factors.

T2: Create a multi-device 'tracking system'	
Tools and material objects	- Owning and wearing more than 1 tracking device - Access to the Fitbit App (or similar) where records are integrated.
Knowledge and skills	- Technological ability to access, interpret and analyse records - Ability to manually or automatically integrate the data obtained from each tracking device together.
Emotional and cognitive procedures	- Orientation towards quantification - Self-confidence - Mentally put tracking devices into different categories
Device agency	Low
Device centrality	Intermediate

4.7.3 T3: Tracking steps as proxy

As mentioned under P1, WST are designed to prompt and support step counting which is perhaps why all participants tracked their steps (see 3.5.1 Features Checklist). This practice is about those who go so far as quantifying their exercise and physical movement by steps. During the interviews many of the performers of this practice constantly answered questions about their physical activity using the word 'steps' as if the two are synonymous. For example, here is GC talking about her weekly physical activity:

GC (female, 62): 'every week, I will [stutters] look at my stats. And hope that I've achieved at least 10,000 [steps] a day. And actually hope that I sometimes, you know, hope that I've got a 100,000. That would be a really good week.'

Some justified that by explaining how it simplifies and quantifies physical activity for them, especially those who were learning how to become more physically active. CL (female, 29) had been struggling with finding the right method to keep herself active, she switched from Moov which is another WST that only tracks active minutes and energy expenditure, to Fitbit. On that, she said the following:

CL: 'I moved over to Fitbit and now I'm more into steps because I feel like that is more tangible'

Similarly, HD (male, 20) says: 'I'll see how many steps I've done because that's, I felt like, that was the main part of exercise'. While JB (female, 29) goes a step further, advising others to use step count as a proxy for physical activity. JB: '[I] always recommend it just because steps [are] just something that is like, it's a good umm… It's a good point to like, just have a look at and refer to, to see how active you've been during the day.'

Because they used steps as a proxy to their physical activity, performers of this practice often felt proud of their 'good' step count as if step-tracking, and 'better' physical activity level gave them a form of a higher social status. AN (female,22) talked about how *others* (i.e., friends, colleagues etc) perceived her as an 'active' person at several points during her interview. For example, she cheerfully told the researcher: 'sometimes what some of my friends like [do], they kind of use me as a proxy calculator. Because like, we'd be like spending the whole day together. They'd be like 'Oh, can you check how many steps you did? Because I probably did the same by that logic'. And I'm like, Yeah, sure [laughs]'.

The nature of this practice requires constant monitoring, which gives the WST a state of centrality. All actions performed as part of T3 revolve around increasing, monitoring, and interpreting the step count, as well as higher agency status for the numbers on the device's screen are enough to push some users to become more active. The underpinning factors for T3 are listed below (table 20).

Table 20: T3 underpinning factors

T3: Tracking steps as proxy	
Tools and material objects	- Wearing a WST - Physical space to walk or perform other step-generating activities
Knowledge and skills	- Step tracking - Self-awareness to be able to evaluate relatively how active they have been by looking at the step count - Understanding of the societal perception of 'good' physical activity practice
Emotional and cognitive procedures	- Seeking reward - Desire to feel 'good' and superior to others
Device agency	High
Device centrality	Central

4.7.4 T4: Episodic Tracking

The practice of episodic tracking is one of alternating on-off activity monitoring periods throughout the usage journey. Wearing a functional WST allows the device to collect activity data on the user. This practice is concerned with users that go through episodes of closely examining their activity records and others of minimal or no engagement with it at all. The disengagement episode is characterised by ignoring the tracking capability of the device by either using the device as a mere watch or removing it completely due to their lack of interest in the data during those "off" episodes. Many of T4 performers reported that they came to performing this practice at a later stage of device adoption once they gathered enough tracking information from it to have a baseline or an average range for their personal activity. JMG who has been using Fitbit for over 4 years said:

JMG (male, 35): 'when I first had [my Fitbit], and it was a bit of a novelty, I then used to, like, look at my sleep and stuff. And nowadays, I've got a rough idea [about my physical activity], so I don't look at it as much as I used to.'

Awareness is key for this practice, as is monitoring and examining personal records. LA (female, 57) is a full-time caregiver with a demanding life and is an episodic tracker. She talked to us about how when she does examine her records occasionally and sees that she is in a desirable range of steps she feels reassured and motivated to 'keep going'.

LA: 'it's nice to know that 'well, I'm more or less hitting the steps [-goal]', so I am still being fairly active. So yeah, it's reassuring.'

On the other hand, PSA (male, 33) disagrees. He believes that when he has an episode of tracking and sees that he is not only meeting his goal but going beyond it, this might have a negative effect on his physical activity levels thereafter.

PSA: 'it's just this thing where, you know, like, I've started using [my Fitbit] again, and then you know 'oh, okay, I'm doing all right', and then [I] dropped off and then in February 'Oh, god, no, I'm doing terrible' and picked it up again.'

From PSA's quote it can be noticed that positive tracking episodes could have a consequential negative effect on the user's activity. However, having perpetually negative tracking periods could be just the nudge some users need to pick up their physical activity levels again.

GC (female, 62): 'if it got to the point where I perpetually was not reaching 10,000 steps a day, then maybe I would be motivated to do something about it'.

It is possible to conclude that the WST has an intermediately central role in this practice as it is only used during the "on" episodes which are decided by the user based on their experiences, feelings or external life-events. On this note, it can also be concluded that the human assumes the majority of the agency power in this practice and hence T4 is a low device agency practice. The table below contains the details of this practice's anatomy (table 9).

Table 21: T4 underpinning factors

T4: Episodic Tracking	
Tools and material objects	- Owning a WST - Wearing a WST during the "on" episodes
Knowledge and skills	- High level of self-awareness - Understanding of reasons for lower physical activity - Good tech skills - Ability to interpret Fitbit physical activity records
Emotional and cognitive procedures	- Seeking confirmation that they are still 'doing okay' with regards to physical activity - Certain level of ego or self-assurance that one does not need a device to tell them what to do
Device agency	Low
Device centrality	Intermediate

4.7.5 T5: Monitoring physical activity weekly

There are different parameters one can monitor on Fitbit (see 3.5 Fitbit), and several ways of doing that. In this study, it has been found that most users prefer to monitor their self-tracking data on a weekly basis rather than daily. They may glance at the display screen of their watches during the day, or week, but the action of closely examining the records, most often on the companion app, is done once per week.

SG (male, 26) clarifies his tracking style here saying: 'it's not something I'm kind of consciously trying to be like, 'Oh my god, I need to hit my daily active hours', It's more like at the end of the week, I'll reflect and be like, 'Oh, it's been an active week'.'

A few of the performers of this practice took the receipt of Fitbit *weekly progress report* as a prompt to examine their weekly statistics. Whichever the method of monitoring, the purpose of T5 is to examine, analyse physical activity records, and to rectify 'bad' performances. However, the monitoring is not done for the purpose of creating radical changes, rather it is to keep 'an eye' on one's physical activity and wellbeing and incorporate a little more physical activity into their upcoming weeks if deemed necessary. For instance, HD (male, 20) explains: 'I get an email saying my *weekly report* I just find it interesting to see how my week's changed from last week, so I do tend to look at it…[I would] look at what it is and then, 'okay, I had a bit of an off week', but will try and get it back next week, but [I do]not feel like I've got to do more next week.'

Along the same lines VS (female, 72) said: 'I get the *weekly reports* and it tells me how, you know, if it's down or up- and it's often because of the weather. You know, I haven't got out because it's been rainy or especially when it's been too hot, I didn't do so much running obviously… Generally, [the weekly report] probably does help because I think 'I've not done much this week', I will get back to it next week. [it] helps me to keep on track, I think.'

It can be inferred from the quotes that weekly monitoring helps those users stay 'on track' yet it is also common for those users to get motivated to become incrementally more active over the weeks. The device is used only for the physical action of monitoring the practice however, the performer may be cognitively engaged with this practice for the entirety of the week (i.e., anticipating what the weekly report will look like). In conclusion, T5 is deemed a device-central practice whereas the device-agency appears to be moderate (i.e., 'a gentle prompt'). Table 22 depicts the components of T5.

Table 22:T5 underpinning factors

T5: Monitoring Physical Activity Weekly	
Tools and material objects	- Wearing a WST - Access to the companion App and/or receiving email reports
Knowledge and skills	- Logging into the App or personal email, weekly, to obtain physical activity records - Ability to read and make sense of weekly data - Knowledge of personal activity averages
Emotional and cognitive procedures	- Seeking affirmation - Derive motivation - Constant cognitive engagement knowing activity is being tracked
Device agency	Moderate
Device centrality	Central

4.7.6 T6: Personalising goals

After tracking a certain metric for a while, some users changed (increase, modify or decrease) their daily goals to either make them more suitable to their lifestyles, or to set themselves new, more challenging targets.

By continuously tracking, one becomes more familiar with their own records, abilities, and progress. Hence, they become better able to tailor the digital targets on their Fitbit to what they deem more appropriate, feature that many viewed favourably. AH explains this in the following quote:

AH (female, 58): 'You don't have to have [your Fitbit goal] set so that it's a non-achievable goal. And I think that's what I really like- that you can make it very personal.' AH then gives an example of how she changed her 'active hours' goal and why she has done so, saying: 'I did reset it to, I think it's 6? No, from nine o'clock in the morning till five o'clock at night… to match my day because I realised that after five o'clock or six o'clock, I'm not walking because I've got cooking and I'm doing different things'.

While AH might have changed her goal to match her lifestyle and avoid the disappointment of not reaching her active hours target, many others increased their targets seeking a little challenge. For example:

RND (female, 34): 'for the first time- which is again, part of me noticing that I've become a little bit more interested in my Fitbit. I changed [my goal] from 10 to 12 thousand steps [per day]. And that was like, a few weeks ago just because I thought like, well, I always do 10,000 steps.'

Similarly, LA's step goal was increased recently, however, it was her daughter (an NHS medical professional) who made this change to push her mother to become more active.

LA (female, 59): 'I had it on 10,000 steps a day when I first got it, because [daughter] set it all up for me… and then I was happy, I was quite happy on 10,000 but I was regularly hitting 10,000 and more. So, [daughter] decided a couple of years ago to put it up to 12,000'.

Here, it is worth mentioning that while most performers increased or amended their targets to match their lifestyles, some reduced their goals to avoid the constant feeling of pressure and/ or disappointment. For instant, RA (female, 26) an American football league player whose activity plummeted during the first covid-19 lockdown when her interview took place said: '[I] started at 11,000 [steps]. I thought I'd be ambitious, but [laughs] I *might* [22] have change it to 5000 during this lockdown, because I'm not reaching 11 thousand steps.'

In conclusion, the device in the context of this practice is of moderate agency, given that it may prompt feelings or desires but the decision to make a change, is made by the user (or the human). That said, the WST device play a central role in this practice for without it, targets cannot be accurately quantified, visualised or amended. The following table delineates the underpinning factors of T6 (Table 23).

Table 23: T6 underpinning factors

T6: Personalising goals	
Tools and material objects	- Owning and wearing a WST - Access to the Fitbit App
Knowledge and skills	- Technological ability to access, interpret and analyse Fitbit records - Self-knowledge - Understanding of what constitutes a 'good' target - Long-term tracking
Emotional and cognitive procedures	- Thinking about, and assessing, personal physical activity recursively while using. - Enjoy achieving targets
Device agency	Moderate
Device centrality	Central

[22] Emphasising the word

4.7.7 T7: Tracking sleep

Despite this practice being concerned with sleep, the majority of behaviours performed as part of this practice take place in the waking hours. Sleep tracking has been gaining traction in the world of self-tracking recently (e.g., Godino et al., 2020; Karasneh et al., 2022; Niemeijer et al., 2022), for medical use and general well-being. Sleep tracking allows WST users to step into the mystery of sleep, an activity that occupies almost third of our daily routine. This is perhaps why T7 was the second most popular practice of the eighteen after P1 *Getting the steps in* with 28/30 participant tracking their sleep.

The practice consists of 3 interrelated phases, starting with wearing the device to sleep or simply keeping it on, going to bed, and analysing the sleep data on the next day. Participants often stated that the motivation behind sleep tracking is either curiosity, or their own perception that they do not get enough sleep in general. Related to this point are the quotes below:

LM (female, 49): 'I do, a bit, obsess about recording the sleep… for women of my age, looking at your sleep patterns is very interesting.'

While for PSA (male, 33) it is more about his history of restless sleep: '[besides the steps tracking feature] other one I mainly use is probably the sleep tracking, your sleep scores, and things like that… I just tend to not sleep great. Historically, I usually never really got that much sleep. And so, when I started using [Fitbit] I realised how little sleep I got. So, I've actively been trying to get more sleep. hopefully then It'll have a knock-on effect and I'll feel better about myself, you know, be more active in the day, because it's easy to be less active when you've not slept well.'

It can be inferred that after a period of sleep tracking, it becomes a habit. The majority described sleep records monitoring (on the day after the night tracked) as a mindless, habitual activity. However, their interpretation of the records, and how they utilise their sleep scores, varied greatly. For example, MK (female, 28) tries to sleep better with a little help from her Fitbit.

MK: 'Sometimes you get up and then yeah, I feel I want to sleep and then I see [my sleep score and think] 'Actually, I only slept six hours. Let's do two more'. While RND (female, 34) and SH (female, 28) use their sleep scores to settle some of their relationships' debates.

SH spoke about how her competitive partner and herself compare their Fitbit data all the time: 'when I check [Fitbit app] first thing in the morning, it is a bit of a standing joke. My partner will be like, 'how did you sleep?' And I'll be like, let me check [my sleep score]'. In the same vein, RND jokingly said: 'the sleep data solved a lot of our arguments about who [my boyfriend or myself] sleeps better.'

These two quotes also relate to having higher level of trust in the device and the scores it shows than their own intuitions and/or perceptions.

Further, for some, like PSA (see above) who enjoyed tracking his sleep at the time of the interview, they gradually felt that perhaps tracking their sleep is not the best option for their wellbeing. The quote below was received by email from PSA 12 months after our initial interview.

PSA: 'I realised in the last year that using the sleep tracking/sleep score was having a detrimental effect on my day – I know when I've had a bad night's sleep, and usually the sleep score corroborated that, which was fine. But often I would feel I slept well, and find a rubbish sleep score, which would then change my mood. I would feel rubbish and have a bad day, telling myself I was 'tired' despite only a few minutes before, waking, and feeling good.'

As such, T7 is a practice that affords high levels device-agency to the extent where subjective perceptions are diminished just by seeing a sleep score on a digital screen, which does not correspond to that. It is also evidently very device central as in the absence of the device, sleep cannot be tracked. I describe the practice anatomy of T7 below in table 24.

Table 24: T7 underpinning factors

T7: Tracking sleep	
Tools and material objects	- Owning a more sophisticated version of Fitbit. - Wearing a WST to sleep
Knowledge and skills	- Technological ability to interpret and analyse sleep reports - Knowing what actions outside the time in bed to enhance sleep quality (i.e. being active in the gym, avoiding stress and caffeine in the evening etc)
Emotional and cognitive procedures	- Interest in better understanding oneself - Orientation towards quantification - Enjoyment
Device agency	High
Device centrality	Central

4.7.8 T8: Innovative wearing

Generally, users believed that to get the best out of your device, you must try and wear it all the time. However, participants often reported that they do not find the design of WSTs aesthetically attractive. In fact, this connection between WSTs aesthetic design and adoption and/or use is frequently discussed in the literature (e.g., Dehghani et al., 2018; Hsiao & Chen, 2018).

KM (female, 21) explained to the researcher how she was hesitant to adopt the device despite her interest in tracking, quote: 'I just thought they're quite ugly. I was a bit put off.'

This practice is concerned with attaching the device to the body in ways that are functional for tracking yet more aesthetically appealing assuming that WST are not the most attractive devices by design. Performers attached the tracker to their hips, around their neck in a necklace or even replaced the Fitbit band with a jewellery bracelet.

GC (Female, 62): 'I wear [my Fitbit] invisibly… I don't particularly want to wear a tracking device on my wrist, I wear it on my hip…I don't find them aesthetically particularly attractive. '

Similarly, KM decided to replace the standard rubber band with a golden metallic one to make it look more attractive.

KM: 'I've got this gold strap on it now [shows to camera] so it just looks less ugly…I did have the big black one on it. And I just thought, that's a bit... it's not very feminine or anything.'

While it might at first appear like a minor practice, it has been found that the aesthetic appearance of the device was a crucial underpinning factor for wearing the device and subsequently accumulating accurate physical activity records. As discussed earlier (see 2.5 The Design and Capabilities of WST), inaccurate records in turn could have a negative impact on users' perception of their physical activity levels and / or their mental health. 6 out of the 30 research participants admitted abandoning the device sometimes due to the way it looks. For example:

KM: 'When I had the black strap on it, I did take it off [occasionally]. But now I've got this [gold strap] I just leave it on because I don't really [pause], it's just it doesn't really look like a Fitbit. It looks like a normal watch.'

It is worth mentioning that this practice was only performed by female participants who looked at incorporating their own unique touch into it. The device, its functionality, and aesthetics were central in this practice, yet the device-agency was deemed low as the person using the WST directed how and when to wear it. The underpinning factors to this practice are outlined below (Table 25).

Table 25: T8 underpinning factors.

T8: Innovative wearing	
Tools and material objects	- Wearing a WST - Additional attachment accessories
Knowledge and skills	- Being creative - Market knowledge about which accessories are available for their Fitbits. - Access to purchasing these accessories (i.e., online shopping). - Good technological knowledge about the mechanism of tracking and how to wear it in ways that will not impact its accuracy (i.e., on the hip)
Emotional and cognitive procedures	- desire to maintain a feminine identity and wearing a 'sports watch' is deemed not feminine looking. - Enjoy wearing fashionable items.
Device agency	Low
Device centrality	Central

4.8 SOCIAL PRACTICES

This dimension of practices encompasses those that are performed with, amongst, and for the users' social surroundings. Four social practices were identified all of which depend on owning a WST, yet the role of the device in the observable procedure of the practice is minimal. As such, the personal status of being a *user* of WST is the enabler for those practices to be instigated and/or performed, and is the main point of commonality amongst the social practices' performers. It is also worth mentioning that apart from S2: social sharing, the majority of social practices took place offline with only occasional touchpoints via the device and/or companion app.

4.8.1 S1: Organising and participating in physically active social events

As seen in the literature review chapter (see 2.2 and 2.6) self-tracking has been extensively studied in a social context. It is generally believed that physical activity can be improved, and possibly maintained if practiced with others. This practice builds on this narrative. S1 is a social practice where performers organise, propose, and participate in physically active social events like running, hiking, walking, cycling and playing sports with friends and family to 'kill two birds with one stone' as CG puts it.

CG (female, 29): 'if I know a friend is wanting to keep fit, then I'd rather kill two birds with one stone go for a run while we talk. Well, I get her to kind of run out of breath [laughs]'. When asked if this is the only social physical activity, she did she answered: 'well I have my boyfriend and we do ParkRun

together on a Saturday morning with his sister. [We] might go for coffee with other park runners or maybe meet a friend just to go up for breakfast -the ones that don't want to do park run.'

CG further explains that sometimes she concludes her social physical activity events with an enjoyable experience to motivate herself, and friends, to join.

CG: 'I've got a friend who we like exercising together, we did a sprint triathlon last year together. So, a lot of our social activity ended up being 'Let's go for a bike ride.' 'Let's go swimming.' and then after we'd go to a spa or something to make it a bit nicer.'

There is a strong element of target chasing in those activities and it was often believed that enjoying those social activity makes it easier to hit targets. Below, NW (female, 59) explains how when she spends time in the countryside with long-distance partner, it is much easier to hit her steps target.

NW: '[Partner and I] decided that we will go away for two nights away a month. So we go away to the country, spend 90% of the time outdoors, and we'll go walking. We think that actually will be our most physical activity we will experience [in the month]. And that's easier and more pleasant for us to do than going out walking in the park'. She added: 'when I'm away in the countryside, I can do 10,000- that's easy. When I'm here. Some days, I think, I think the worst I had was 720 steps in a day… most walks in the park, I think, I look at [my Fitbit] and I think 'oh [just that]' and then I'll look halfway through I'm looking at it thinking 'God, I'm not making me steps there'.'

Those active, social gatherings differed not only in terms of vigorousness (i.e., walking vs. HIIT[23] sessions) but also the mode of the activity. For example, some took place synchronously in a local park while others were kept virtual on the Fitbit app. The latter naturally entailed a higher level of device centrality. However, regardless of whether the mode of the activity was online, offline or a mixture of the two, they all triggered a sense of belonging and were deemed enjoyable. To give an example, SH (female, 28) found that Fitbit challenges were an excellent way of connecting with her distant family especially when family weekend walks were part of their routine before the covid-19 national lockdown in the UK. She said: '[my parents and I] do lots of Fitbit competitions… every week we have a weekly Fitbit challenge… I would say [Fitbit challenges] is the main topic of conversation with my parents now. I think it's very useful. And so, it's really good. We use the challenge chat to talk all the time and in a way that we, like, we would never chat on like WhatsApp[24] or anything, but we will often post on there. And especially like my dad, who doesn't really engage in like small talk will post on [the

[23] HIIT abbreviation for High Intensity Interval Training

[24] Instant messaging software and mobile App owned by Meta

Fitbit challenge page]. I think that's really nice, and I think it definitely kind of motivated me to use it more and engage more with [the challenge]'.

Overall, this practice affords low device-agency levels, as generally it is an auxiliary object to the main event (i.e., socialising) which is orchestrated by the human. The degree of device centrality varies depending on the mode of the event as explained above. The underpinning factors of S1 are listed in table 26.

Table 26: S1 underpinning factors

S1: Organising and participating in physically active social events	
Tools and material objects	- Owning a WST - Access to the Fitbit App for virtual events - Social ties with a community of individuals interested in physical activity
Knowledge and skills	- Understanding of others' interests and physical activity preferences - Good interpersonal skills to organise social gatherings
Emotional and cognitive procedures	- Sense of accountability and belonging to a community. - Being externally motivated - Sense of enjoyment
Device agency	Low
Device centrality	Variable

4.8.2 S2: Sharing activity facts

In this practice, WST users utilise their ownership of the tracker to connect with likeminded people off- or on-line. Performers of S2 share particular parameters with others either as part of casual conversations, or via social media platforms. An example of each is quoted below:

JMG (male, 35) talking about socialising with his rugby teammates: 'we would usually talk about [physical activity]. [It is] one of the things we have in common… especially when I'm out with the rest of the rugby team, you see, quite a lot of us, have got like sort of various kinds of fitness trackers. And so, it almost always come[s] up'.

RA (female, 26): 'it [is] a way to progress and to monitor what I've done and sometimes put up on social media and stuff. I'm really quite bad at that [laughs]… on social media you have people sharing what they've been doing and then the steps. So, I think it's become quiet the norm to have one [referring to WSTs] on, then I think people use [social media] to try and like, prove to others what they're doing.'

Like RA and JMG discuss, social sharing is practiced not only as a form of celebrating achievements but also it is a form of 'bragging', a way of seeking validation from a society that views 'fit' people as morally superior beings (Brown, 2018).

My research participants also stressed the fact that they do not share 'serious' fitness goals, or seek fitness advice from others, it is instead just a way of making conversation with other WST owners.

CL (female, 29): 'We talk about that but not like serious fitness goals… it's more like, 'Oh, I walked as many steps as it takes to cross over to the Caribbean'. That kind of thing.'

Because this practice revolves around metrics, owning a device is essential. However, in the procedure of performing the practice, the device is considered peripheral for the tracking and monitoring are happening at different settings and time points, and the act of sharing is being done via other media (e.g., social media). Further, S2 has low device-agency as performers chose whether to share, what information to share, and who to share it with. This is with the exception of the occasional push notification from the device that may prompts the act of sharing e.g., a notification that informs the user that they have earned a new achievement badge.

The underpinning factors of S2 are listed in the following table (Table 27).

Table 27: S2 underpinning factors

S2: Sharing activity facts	
Tools and material objects	- Owning a WST - Access to a community (offline or online)
Knowledge and skills	- Understanding of others' interests and physical activity preferences - Certain level of closeness with the people they talk about their activity with (friends, family, etc).
Emotional and cognitive procedures	- Feeling proud - Sense of belonging to a community. - Sense of relatability to other.
Device agency	Low
Device centrality	Peripheral

4.8.3 S3: Comparing steps

This is a practice of comparing one's steps with that of others, sometimes while also competing with them. Before delineating this practice, it is imperative to highlight that while competing and comparing sometimes took place together, there is a distinctive difference between the two. While competing entails a form of an explicit, mutual challenge, comparing does not necessarily include a challenge. In this practice I define comparing as the act of evaluating own metrics in relation to that of others, with or without formal competition. For instance, JMG and his wife, often compare but are uninterested in competing with one another.

JMG (male, 35): 'I[my wife and I] we both have a personality [that] if we were to be having a casual conversation about it, we definitely get into [a] competition… we'll look at it and see who's already had the most, we'd go out of our way to see like, 'Oh, this week, I'm gonna get more than you'.'

Interestingly, it has been noticed that this practice is commonly performed with family, friends, and acquaintances only. As such, comparing with strangers was often deemed irrelevant by the participants. MEQ sheds light on this in how he approaches Fitbit challenges in the quote below.

MEQ (male, 31): I'm quite [a] competitive person so when we do the weekly challenge with other Fitbit friends then I motivate myself to do more. [If] I have a competition happening, then I am definitely checking Fitbit more often. I need to make sure I stay within the top three… However, people I [haven't] even met in person… my friends who got Fitbit… sometimes they invite me to their [friend] groups. Everyone has a different story. Everyone has a different background, everything, different capabilities [so] I don't compete with [their friends], I wouldn't, no. They're their friends. So, I'm just there.'

Overall, similar to the previously discussed social practice, this is a low device-agency practice, and the tracker plays a variable role in the practice performance procedure depending on the medium (i.e. via Fitbit or not). Table 28 explains the components of this practice.

Table 28: S3 underpinning factors

S3: Comparing steps	
Tools and material objects	- Owning a WST - Access to a social community of like-minded individuals
Knowledge and skills	- Understanding of others' interests and physical activity levels - Good understanding of own physical activity levels and abilities
Emotional and cognitive procedures	- Cognitive engagement with the metric being tracked - Competitive mindset - Sense of achievement
Device agency	Low
Device centrality	Variable

4.8.4 S4: Social signalling

WST developers market their devices as essential tools for 'fit' and 'healthy' lifestyles. While some researchers accept that tracking provides some benefits, such as allowing a form of autonomy over health and physical activity (i.e., Owens & Cribb, 2017), the argument that just by wearing a device one could become 'fit' and 'healthy' is still highly debatable.

However, some of my research participants reported that they wear the device all the time, believing that they get their motivation from it, and consequently it helps them become more active. An example of that can be found in RA's account below:

RA (female, 26): 'When I'm wearing it, I think I'm a lot more motivated. So, I'm more likely to go to the gym and more likely to go for a walk just to try and get my steps up. Just to try and yeah, register it.'

While the majority of the participants admitted that they do use Fitbit to become more active, they also stressed the fact that they want to be perceived as an 'active' person with a seemingly superior societal status. Below are some examples from the interviews with CG (female, 29) and CL (female,29), respectively.

CG: I'm trying to wear the device more because my goal is to be more active… I [also] just kept a Fitbit on. That kind of give a little cultural thing that you know, people who are like fitness people, they know, and they give you a nod. [laughs].'

CL: 'everyone around me can see that I'm working on becoming a better me because I wear a Fitbit all the time… it's also a bit of virtue signalling I guess [laughs]. Like 'look at me, a Fitbit! [shows on camera], 'I'm one of these people', 'I might look really lazy but I'm not' [laughs].'

Some users start wearing the device regularly to signal a positive identity for themselves, hoping that by being a devout user of WST they are becoming a 'better' member of society. The practice essentially revolves around the device, which gives it high centrality. However, the device only has moderate agency here as the practice performers often allowed other factors, such as the socio-cultural beliefs, to have a certain level of agency over them (i.e., push them to wear the device for longer). The components of the practice are listed below (Table 29).

Table 29: S4 underpinning factors

S4: Social Signalling	
Tools and material objects	- Owning a WST - Access to a social community of likeminded individuals
Knowledge and skills	- Comfortable wearing the device 24/7 - Awareness of the socio-cultural symbolism of the device - plan to track all daily activity without missing any - aspiring for a more positive social status
Emotional and cognitive procedures	- Desire to be perceived as an active or 'fit' individual - Derive motivation from wearing the device
Device agency	Moderate
Device centrality	Central

4.9 Cognitive Practices

This dimensional category includes two practices, characterised by high levels of cognitive engagement extending beyond performers physically active hours to include their daily life as a whole (e.g., thinking about how to compensate for the missed hours later). While some bodily actions were observed, the main cognitive practice procedures include frequently *thinking* about the device during the day, *imagining* better ways to integrate it into their pre-existing activities and *discovering* better ways to tailor tracking to their personal needs and aspirations. This is not to say that cognitive practices do not involve physical performances, they do, however the physical performances were often shaped by the thoughts, perceptions, and previous experiences of the WST user. The in-depth interviews revealed that *tracking* in cognitive practices is a shallow observable performance, which is underpinned by deeper elements such as self-knowledge, previous experiences with tracking, history of mental illness, amongst others.

4.9.1 C1: Selective Tracking

Contrary to the Physical Activity practices P1 and P2, some users adopted a more cautious approach to tracking to protect themselves from the potential obsessive, or damaging behaviours that could result from self-tracking (e.g., Etkin, 2016; McCallum, 2019). The majority of performers of this practice had a history of mental health conditions such as anxiety and eating disorders (ED). From the beginning of the interview with RND, she kept on stressing that her self-tracking pattern is unique, cautious, and somehow utilitarian as she had a history of a severe eating disorder.

RND (female, 34): 'I remember having long conversations before I got one with my partner, my friends and family being like "I want a Fitbit and I don't think it's because I've got disordered thoughts, but I just need to sound them out [as] I don't trust myself." And, we had an agreement that like… if it did

trigger anything, I would get rid of it immediately.'. Although she declared that she recovered from her ED, she still believed that self-trackers could exacerbate some mental health disorders admitting that she 'wouldn't recommend it unless you're as secure in your recovery as I am.'

Selecting the device was not an arbitrary matter either, RND deliberately chose a Fitbit device as she perceived it to be less serious than more specialised sport-watches i.e., Garmin.

RND: 'it was actually the why I chose a Fitbit rather than like a Garmin because Fitbit aren't that reliable, I think. [Laughs]'… I don't track calories or anything like that, I'd delete that off the app… it's just at automatic… I guess I'm not that bothered. I think [manual exercise tracking] would feel too monitoring-y for me, and I think I've got to be careful with that'.

Being selective is perceived as a being authoritative and expressing *agency*, RND and CG express this in the quotes below:

RND: 'I do joke about this a little bit with my partner because, you know, he says, it's like, most people need trackers and encouragement to move, but he's like, you need trackers and encouragement to not move.'

CG (female, 29): 'I don't want to have too much monitoring over my lifestyle. And if I, say ate more today than yesterday, I don't want to [be] feeling guilty. Because I enjoyed what I ate today. So don't want the machine to then start, like judging me in a way'… I won't wear it at night time because I don't want to start obsessing that can check your sleep cycle content, how much your REM sleep, whatever. I don't want to know. I can't do anything about that.'

It is evident here that the agency in this practice is exercised by the human, while the centrality of the WST is somehow intermediate. In other words, the device is needed for certain parts of the practice i.e., tracking steps, but not for others where selectiveness is actively exerted through dis-engagement with the device, and potential anxieties around the negative impact of 'over tracking'. Table 30 below delineated the components of C1.

Table 30: C1 underpinning factors

C1: Selective Tracking	
Tools and material objects	- Owning and using a WST
Knowledge and skills	- Deciding which activities are worth tracking and which are not. - Good self-knowledge and understanding of own mental health and general needs - Understanding of Fitbit technology
Emotional and cognitive procedures	- High self-awareness - mental dis-engagement with tracking when reaching a critical point and feel a need to slow down. - Feeling empowered or in control.
Device agency	low
Device centrality	Intermediate

4.9.2 C2: Ignoring reminders

This is a dissociative cognitive practice which involves a high level of emotional and mental engagement, yet fewer physical actions. For example, choosing not to perform the activity when reminded by the WST (e.g., walk for 250 steps or drink a glass of water) due to factors related to the physical environment (Cohn, 2014; Spotswood et al., 2019), or social pressures, as JB and SG explain.

JB (female, 28):' I try to hit the 250 every hour but a lot of the times I don't because I have meetings.'

SG (male, 26):' if I get a notification and I'm busy at work, I'm not going to leave a meeting or stop writing report or something to get those steps in… if I'm not too busy, if I get [the reminder to move] notification, I might try and just get a few more steps in.'

However, for others it is less of a choice as the nature of their lifestyle does not permit much physical activity. For LM, working from home blurred the lines between work and personal life, she often struggles to move as often as she sets her reminders to.

LM (female, 49): [since started working from home] It's hard. It is hard [to stay active]. When you're working in the office, not many people would think, 'Oh, I need to go back to the office because I haven't done that', you wouldn't usually do that. Whereas when you're at home, you're like, 'Oh, I just do that later on tonight.'

She explained: 'I do have the reminders to move, but whilst I'm sat working it will beep to tell me to move, but I don't move because I'm in the middle of working. So, it kind of is a psychological

reminder that I need to move and then you feel guilty that you've not moved but you can't always move because you're doing something else.'

It can hence be inferred from the quotes above that the practice is largely about cognitive engagement. Despite limited amount of bodily movement involved, the users often think about the reminders far after they receive them, feeling guilty, planning their next physical activity, or mentally justifying the decision to themselves. This practice foregrounds the agency of the human (or user) who sometimes chooses to ignore the cues of the device. C2 affords an intermediate level of device centrality for the device is key to initiate the practice yet not necessarily part of the whole process. Listed below are the details of C2 (table 31).

Table 31: C2 underpinning factors

C2: Ignoring reminders	
Tools and material objects	- Wearable tracking device - Physical barrier to performing the task
Knowledge and skills	- Wearing the device during reminders hours. - Turn notifications on. - Being technologically able to set/disable reminders on the app. - Sense of agency.
Emotional and cognitive procedures	- Feeling guilty. - Other negative emotions I.e., disappointment - Think about a justification while ignoring the reminder.
Device agency	low
Device centrality	Intermediate

4.10 Emotional Practices

Virtual reward seeking is the only predominantly emotional practice identified in this research. The emotional dimension was high despite the observable part perhaps looking very similar to the act of target-chasing (common amongst self-trackers). The main distinguishing point here is being motivated by external, virtual rewards rather than meeting targets. This category (or practice) is underpinned by emotions, both positive and negative. For example, failure to obtain the virtual badges triggered negative emotions for some participants such as disappointment and shame.

4.10.1 E1: Seeking virtual rewards

This practice is where physical activity is performed for the purpose of obtaining virtual tokens of achievement by the device (or associated app) and is strongly driven by emotions and rewards.

Fitbit is designed to reward its users with ‘stars’ for every day the steps-goal is met, awarding them achievement badges for walking certain number of miles, or, if in a competition, offering potential to be ‘leader’ of a virtual competition. Hence, E1 practice performers actively sought a form of these virtual rewards. Both JB and NW talked about the role of ‘stars’ in their usage experience.

NW (female, 59): ‘I do quite like to get a row of stars though I virtually never achieve it…I just look at the pictures. I like pictures, not words. So, I just look at when I've got stars or not’.

JB (female, 29): ‘also just seeing the stars each day knowing that you like hit all the targets. So, for example, last week, I wanted to hit a target 11 k [steps] every day, and I forgot my Fitbit on the Friday. So I couldn't hit my target. I think that ruined my whole weekend because that is my target. So sat here Saturday and Sunday, and go 'oh it won't be a streak anyway'. So like [I pay attention to] little things like that’.

From JB’s quote, it is clear the emotional engagement with this practice can have both positive and negative effects on the performer. In fact, some performers’ perceived inability to obtain the virtual reward can stop them being active at all.

JB: ‘Today, my Fitbit is actually broken. So, they're sending me a replacement, but I haven't gone for a walk this morning. Because there's nothing that's going to track it. I won't even be on the leadership board so [what is the point]’.

It is therefore suggested that the device has got high agency in the context of this practice despite the variable level of centrality. This is because the WST is attached to the body to be able to collect the activity data and grant rewards, yet the importance of these rewards and the frequency of checking the App varied across the sample. The breakdown of this practice to its underpinning factors is shown in table 32 below.

Table 32: E1 Underpinning factors

E1: Seeking virtual rewards	
Tools and material objects	- Wearable tracking device
Knowledge and skills	- Interest in gaming and seeking digital tokens of reward - Ability to access the App and find the virtual reward
Emotional and cognitive procedures	- Feeling rewarded. - Enjoyment/disappointment - Sense of achievement - Feeling superior
Device agency	High
Device centrality	Variable

4.11 DEVICE AGENCY AND CENTRALITY SUMMARY

This chapter presented eighteen novel WST usage practices and discussed the device agency and centrality of each providing empirical examples from the collected data. Put simply, device agency is viewed as its influence and authority over the actions of the human, while device centrality is how integral the device is for the human to perform a certain practice. As such they can be empirically observed in opposite directions.

To summarise, the device agency was highest among the tracking practices (T#) which naturally allow the device more space for influence, and lowest among the cognitive practices (C#) which mainly reflect the cognition and authority of the human.

Device agency was also low in social practices (S#) which could be attributed to the collective nature of these practices which entails the involvement of additional external entities in the practice (e.g., friends, family members etc). These entities usually exerted their agency in the system or at least took precedent over listening to and/or thinking about the device. Device agency varied for physical activity practices (P#) as it largely depended on the dynamics of the practice such as where, how and why, it took place. The single emotional practice E1 involved a high degree of device agency as it depended on the WST rewards and feedback loops.

As for the device centrality, albeit is important, device centrality is largely a functional feature as such it varied across the UPs based on the requirements of the observable performances i.e., is the device essential for performing the UP. Device centrality was high (central and intermediate) for the vast majority of the UPs with a notable exception of social practices which again can be justified by the nature of the activity which has an element of leisure and collectiveness. Table 33 below summarises the device agency and centrality of all eighteen UPs for better visualisation.

Table 33: Summary of practices' agency and centrality levels

Device Agency ⇨ Device Centrality ⇩	**High**	**Moderate**	**Low**
Central	P2, T1, T3, T7	P1, T5, T6, S4	T8
Intermediate			T2, T4, C1, C2
Peripheral			P3, S2
Variable	E1		S1, S3

4.12 CHAPTER CONCLUSION

In this chapter I identified and discussed eighteen Usage Practices of wearable self-trackers, which were grouped under five distinct categories based on their dominating dimension. This discussion, and

categorisation, facilitate our understanding of how users interact with their WSTs and improves our knowledge of the role of the body (physical), mind (cognitive and social), and external agents (the device) have on how people use their WST devices. Each practice is explained, according to the proposed theoretical framework, in terms of the observable procedure as well as the underpinning factors: tools and material objects, knowledge and skills, emotional and cognitive procedure. In addition to that, the concepts of device agency and centrality are integrated into the analysis to improves our understanding of the interaction between device and man. Overall, this chapter is positioned as a descriptive foundation for the next findings chapter where UPs are contextualised, and then discussed in further depth.

CHAPTER 5: THE PATTERNS OF WST USE AND USERS' CHARACTERISTICS

5.1 INTRODUCTION TO THE CHAPTER

The previous chapter delineated the Usage Practices (UPs) the research analysis revealed. In this chapter, I discuss and contextualise the patterns of WST use found across this research sample of participants. As explained in the methodology chapter (see 3.10 Analysis), at the later stages of the thematic analysis different themes of use started to emerge. Those themes suggested variable ways of interacting with the device in terms of the level of *intensity*, role of the device, and the personal characteristics of those who engage in it. The purpose of this chapter is to distinguish between the different types of usage patterns found to be associated with prolonged WST use. The findings presented in both chapter 4 and 5 will then be discussed in the final chapter to follow.

5.2 GENERAL PATTERNS OF WEARABLE SELF-TRACKERS USE

Generally, two distinct types of usage patterns were identified: performance and intensity patterns, both of which will be defined next.

5.2.1 Performance patterns

A performance pattern refers to when a practice is performed in the same way across participants. For instance, this research data found eight core practices (detailed in 5.3) which were performed similarly across all participants. For example, P1: Getting the steps in, is practiced by all participants, regardless of their different goals, demographics, or sense of self.

5.2.2 Intensity patterns

Intensity patterns refer to a user's perception of time and effort invested in the performance of a practice (Luyen et al., 2021), as well as their responsiveness and reflexivity upon the cues of the device during the performance. Here, *effort* is viewed as a multidimensional construct that involves cognitive, emotional, and physical activities (Luyen et al., 2021; Sweeney et al., 2015). During the analysis stage, a user's performance of a UP was coded along with the intensity at which the user performed the practice. More intense patterns represent frequent micro-interactions with the device (or other agents), and more responsiveness to cues and deliberation on actions when performing the practice. While less intense patterns refer to more passive performances where less time and effort is invested in the practice, and the user is unlikely to respond or react to the cues of the device. This type of coding allowed for deeper exploration of WST use and enabled three clusters to emerge. Each of the three clusters represents some participants' usage pattern of shared intensity.

To sum up, consistent with the practice clustering approach seen in Schau, Muniz and Arnold (2009) and Luyen and colleagues (2021), three clusters of WST practices were inferred from this research. While the analysis showed similarity in terms of core practices, i.e., pointing towards a single, shared *performance pattern,* the intensity in which these core practices were performed and the additional UPs users often integrated into their usage pattern, revealed three distinct groups of users. These groups also share important characteristics and perceptions of themselves.

5.3 PERFORMANCE PATTERN: CORE PRACTICES OF SUSTAINED WSTS USE

C*ore practices* were performed by the majority of participants, regardless of their demographics, physical activity levels and behavioural characteristics, thus, pointing towards one performance pattern. The practices encompassed in this pattern were usually basic, essential, or functional for the use of WSTs and their performance did not involve a high degree of reflexivity or deliberation. For participants, these core practices represent a basic level of use that they associate with being a user of this technology. For example:

HD, a 20-year-old university student and regular gym-goer explains how he settled on his 'basic' self-tracking routine: 'I[at the beginning] I kind of felt like I had to use everything. So like, track how much water I drank, see how much I ate, see how many steps I've done. So, I kind of used it all and try to learn everything about it. But as time went on, it was like, 'I forgotten to do [all of this] yesterday, you know, [forgot to] track everything from yesterday. So it was just like, right, 'I'll see how many steps I've done because that's, I felt like that was the main part of it. [so now] I look at steps. I look at active minutes and I look at how many calories I've burned.'

He adds explaining his attachment to his WST: 'one, it was [a] present [so] I should be wearing it all the time, two, I do enjoy looking at how many steps I've done and so on some days. And now that I'm exercising and I'm more active, it's, you know, I need to use it more. So, that's another reason for why I use it more often.'

The majority (i.e., seven) of the eight core practices identified in this research are tracking and/or tracker related practices where the performance of the observable part of the practice is strongly dependant on the wearable self-tracking device. In fact, six out of the eight core practices have an element of monitoring steps or other popular parameters (e.g., active minutes) and as such are high device-centrality practices (Table 34). Similarly, all but the social practice (i.e., S1) of the core practices list were moderate to high device- agency practices where the tracking device is able to motivate, influence and/or (re)shape the performance of these practices.

The table below (Table 34) shows a summary of the eight core practices of sustained use, including the device agency, device centrality, and functions of the device that are essential for their performance.

Hereby, it is to be noted that 'variable' centrality in the last two practices is related to the mode of performance of these practices (online and/or offline) which affect the degree of importance of the device (i.e., centrality) in the performance of the practice (see 4.4 Device Centrality for further details).

Table 34: Core practices of sustained WST use

Core practice	Device Centrality	Device Agency	WST function related to the practice
P1- Getting the steps in	Central (high)	Moderate	Steps
T1- Full recording	Central (high)	High	Steps, active minutes, distance taken, floors climbed, exercise sessions recorded
T3- Tracking steps as proxy	Central (high)	High	Steps
T5- Monitoring Physical activity Weekly	Central (high)	Moderate	Steps, active hours per day, active days per week, active minutes, sleep
T6- Personalising goals	Central (high)	Moderate	Steps, active hours per day, active days per week, active minutes, distance taken
T7- Tracki**ng** sleep	Central (high)	High	Sleep tracking
S1- Organising and participating in physically active social events	Variable	Low	Fitbit community/ App, steps
E1- Seeking virtual rewards	Variable	High	Fitbit App, steps, distance taken

5.4 INTENSITY PATTERNS

At a certain stage of the data analysis (i.e., first cycle of impressionist reading following the formation of themes, or practices) patterns of use started to emerge. Those patterns corresponded with the intensity of user engagement with WSTs during prolonged usage experiences. They were characterised under themes that corresponded to the *intensity* level associated with them in terms of both: time and effort invested in the use, and the responsiveness and reflexivity upon the cues of the device. Following a lengthy and iterative investigation, three distinct patterns of use were identified, namely: high intensity, low intensity, and fluctuant intensity usage patterns. Each of these encompassed a bundle of connected UPs that users performed together to (re)enact a certain *usage intensity pattern*. The analysis of the data was highly iterative, during a later cycle of the thematic

analysis, themes related to self-view, self-perception, and identity of the performers of each pattern emerged. This indicated a potential link between usage patterns and users' sense of (role-)identity. To investigate this, an idiosyncratic analysis was undertaken (as detailed in 3.10.3). This iterative analysis process resulted in the finding that each usage pattern was distinct to a group of people who shared a similar view of self-identity in relation to fitness and exercise.

The three patterns and their characterising features are discussed below to provide a more in-depth understanding of how UPs are manifested as patterns in the context of actual, prolonged use. As per the conventions of idiosyncratic approaches (Fournier, 1998), after the description of each usage pattern, a *case* is taken for each group to demonstrate how those who performed a certain pattern articulated, and explained their perceived and/or desired identities during the interview in the participants' own words, and how that was conceptualised. A full list of the codes that corresponded to the conceptualisation of each identity group can be found in appendix 4.

5.4.1 Bundle 1: High intensity usage pattern

This usage pattern is characterised by its high intensity or users' high level of depth of cognitive, emotional, and physical activities. Nine practices were performed as part of this practice, the majority of which were high (5/9) or moderate (3/9) device- agency practices. Generally, this pattern of use constituted of tracking (T#) and physical activity (P#) practices and was found to be driven (and often elicited) by the device. All nine practices were normally performed at high intensity except in periods of lifestyle disruptions (e.g., lockdown restrictions on exercise time, or having a new baby).

Perhaps one of the most notable characteristics of this pattern is the high influence of the wearable device itself (and associated App) on the user. Users who engaged in this pattern of use allowed the device to lead their daily practices as well as longer-term goals. They reported trusting the device and having faith in its design and ability to help them achieve their goals.

YAP is a 31-year-old, female, who until recently led a sedentary and 'less active' lifestyle. She recently started a journey to become more active with the help of a friend who is coaching her to run for fitness. YAP talked about her trust and fondness of Fitbit saying: 'I bought the most basic Fitbit, and I was happy with it. It was like a very basic band, but then I lost it. So, I had to buy another Fitbit because I noticed that it motivated me to walk more, to be more active.'

She then proceeded to talk about keeping her goals: 'I use the goals that they bring you [by] default, because I don't have like the knowledge to say like, [for example] 'No, okay, I need more sleep or less sleep'… and yeah, I think [they are] achievable'.

Those who engaged in this pattern of use usually alluded that the device is more informed, and in a way qualified to tell them what to do. But despite being driven by the device, the performers of this high intensity pattern often preferred to keep their progress and achievements to themselves, and although some of them enjoyed being active with others they usually preferred to not talk about their own metrics socially.

As a high intensity pattern, those who engaged in it often interacted with the device (and App) personalising goals, seeking virtual 'badges' and 'stars', and closely chasing numerical targets. However, the downside of this was when they reportedly disengaged if they failed to obtain targets of virtual rewards repeatedly. This sometimes went so far as to disengage with physical activity and exercise all together due to feeling of helplessness and disappointment often triggered by the WST's display screens. Several of the users who intensely engaged in self-tracking via wearables also declared experiencing negative feelings such as feeling' bad', 'pressurised', or 'discouraged' by the device (see examples in AN's account below).

A list of the practices encompassed under this pattern, along with their level of device-agency and centrality can be found below. As mentioned above, the bundle of practices in this pattern are largely dependent on the device where the device occupies a central role that enable it to exercise moderate-high level of agency.

Table 35: Practices of the High Intensity Usage Pattern

Pattern Practices	Type	Device agency	Device centrality
P2: Chasing in-device target	Present in 2 bundles	High	Central
P1: Getting the steps in	Core	Moderate	Central
T1: Full recording	Core	High	Central
T7: Tracking sleep	Core	High	Central
T3: Tracking steps as proxy	Core	High	Central
T5: Monitoring physical activity weekly	Core	Moderate	Central
T6: Personalising goals	Core	Moderate	Central
S1: Organising and participating in physically active social events	Core	Low	Variable

E1: Seeking virtual reward	Core	High	Variable

From the table above, it can be noticed that all but one (i.e., P2: Chasing in-device targets) of the practices observed in this high intensity usage pattern are 'core' practices. As for S1, social practices are an important category of UPs, which were generally found to be performed differently[25] according to users' confidence. For this group of performers, they typically avoided 'organising' the social events and were often mere participants following the instructions of others. As such, the agency here is predominately exerted by other human entities rather than the device, albeit still external.

A notable finding here is that the device had higher agency in this usage pattern. High intensity users often followed the device without a question arguing that 'it knows better'. Also, with regards to the users who engaged in this pattern, it is important to mention that as I started to connect these patterns to potential personal characteristics, the idiosyncratic analysis revealed that this high intensity usage pattern was predominantly performed by a group of people who were in a journey to negotiate, change or reobtain their fitness identity. This group was entitled 'The Aspirers' which will be discuss next supported by quotes from this research interviews.

5.4.1.1 The Aspirers

The aim of this section is to report the findings relating to the fitness identities[26], in this instance, the Aspirers' fitness identity. This role-identity emerged and named after inferences from the data suggested that the majority of the high intensity usage pattern of wearables were aspiring for better, fitter, more disciplined selves. Put concisely, the Aspirers is a group of users who are using the device in pursuit of fitter bodies, increased physical activity, and more positive fitness-identity. The majority of this group had little experience with exercise and physical activity which meant that they were learning about the device and their own physical ability through self-tracking. This group of users were more attached to the device, following in-device goals consistently, and feeling a sense of disappointment when failing to meet those goals. In other words, those who were identified as Aspirers allowed the device to exert higher level of agency in the performance. AN is a typical case of that, she is a 22-year-old masters student of Indian heritage. Growing up, exercise and fitness were never a priority in her surroundings, and she always struggled with her weight (current BMI 27.5-

[25] S1, S2, S4 had slightly different observable performance in each bundle yet they shared the same underpinning factors.

[26] The analysis of Fitness-identity included constructs such as: self-defining personal, social and cultural concepts (e.g. being a teacher or being a footballer etc); importance of physical activity (i.e., throughout childhood, early adulthood, before tracking, after adopting WST, and most recently); and users self-view in the context of wearing self-trackers (e.g. I feel confident, I know better, Fitbit knows best etc) (Fournier, 1998; Ruvio & Belk, 2012).

overweight) due to inactivity and living with polycystic ovarian syndrome (PCOS). In the following quote she explains how she came about to using Fitbit and grew attached to her device since.

AN:'[so] my boyfriend gifted [my Fitbit] to me. Because, I was like, always complaining about like, 'Oh, I really want to be more active', Like, I don't really know how to measure these things. He was like, 'oh, I'll get you a Fitbit for your birthday'. So, he got me the Fitbit, but I didn't actually start using it properly because like, it was a pretty intense time. Like I was like, at my final year of my undergrad… then when January came about like this year, that was when like, I've kept it on like, I haven't taken it off *at all*.'

AN mentioned that she gets 'upset' because of her Fitbit, when asked to elaborate she said: 'I don't know, like when [Fitbit] is setting the bar too high and then like getting really upset when like, you can't fulfil it.'

When asked to describe a typical day of WST use since adopting Fitbit, she said:

AN: [First thing] in the morning like kind of check my messages and then after that I will go on the Fitbit App… I just keep [my Fitbit] on whether I'm active or not just to, like, encourage myself to be more active.'

This again alludes at high levels of emotional engagement and device agency through its ability to influence her mood and influence future decisions.

She then adds talking about her use of Fitbit: [it] is a bit weird, going out for [a] walk without the Fitbit... like trying to go out and like exercise, you want to, like, have it on the App or else it just kind of feels a bit pointless.' A quote which again confirms her high attachment and emotional engagement with the device.

In the same vein, she added: 'It ends up being a bit annoying, I think, to other people. Because like, I'm just like, 'oh, like, I'm gonna actually walk home, I have like, 500 steps to go to hit 10 K', like, I will just end up bringing it up and like, doing like, really annoying, compulsive things sometimes where I'm like, 'Oh, no, no, no, I don't want to sit down, you can sit down, I'm just gonna, like walk around while we talk. So, I can hit my step goal'.

From the quotes above, AN's high intensity pattern of use is evident. In addition to tracking her non-exercise physical activity religiously and being cognitively engaged with the device all the time, she also utilises Fitbit to measure her exercise quality through the numbers displayed on her wrist. As such allowing the numbers to effect, and perhaps change, her feelings and perceptions e.g., feeling

energised after a workout but not hit a Fitbit goal would undermine her achievement and lower her satisfaction levels.

AN: ‘[in the gym] I will like look at it to look at things like how high my heart rate went up like during my workout, so I know what to like work on like how many minutes I was in the cardio zone for... um and then I look for how many calories burnt during a workout because I like to average like 200 to 250 calories in like a 30 minute workout’

This high intensity user group usually also used WST in non-fitness related situation, in a manner similar to lifelogging (see 1.1. Research Background), in AN’s case, she used it to ‘stay safe’ in parties. Quote: ’you can always monitor like [pauses] like different things at a party… [to] know like how much alcohol you're [drinking] or like anything else that you might be consuming. I think it's always safer to keep your Fitbit on [to] remind you to like maybe be safe, drink more water, like things like that. Because like you can see how hight your heart rate is going and like, you know [think to yourself] you should probably like slow down a bit or something.’

Being highly susceptible to the cues and feedback loops generated by their devices, it was common for the Aspirers to feel ‘down’ or that they have ‘failed’ if they do not achieve their targets. Normally, when the user’s activity is low, lower numbers of various metrics would be obviously visible on the device/app, the aim of which is to create awareness and perhaps a form of motivation. Yet in reality, many less-active users (i.e., Aspirers) found that depressing and/or ‘pressurising’ instead.

AN: ‘find it a bit like pressurising sometimes because if you have an inactive day, like it will not be forgiving on the App like you will see the truth…find it a bit like pressurising sometimes because if you have an inactive day, like it will not be forgiving on the App like you will see the truth… it'll keep messaging, like, sending you these alerts, like, 'Oh, you've been pretty inactive' and I'm just like, 'Okay, fine. Thank you so much.’

To conclude, this group often allowed the device to direct them and dictate their physical activity and had a general lower sense of agency. They often aspired to become fitter, more active and/or healthier but generally found it difficult to stay consistent. Seeing the low or ‘bad’ numbers on display by their WST display screens made them feel pressured and disappointed despite these features being originally implemented to motivate behaviours by creating awareness (see 3.5 Fitbit).

5.4.2 Bundle 2: Low intensity usage pattern

This usage pattern characterises by its low intensity or users’ low level of depth of cognitive, emotional, and physical activities. Sixteen practices were performed in this pattern which included

five exclusive ones. This pattern was found to be mostly done to either check, or benchmark activity against current and/or previous personal performances which entailed high levels of confidence and experience on the part of the user. The low intensity of performance was predominant, however, and users who engaged in these practices had periods of tracking relatively more intensely to ensure they are doing 'well still' i.e., Episodic Tracking.

On the whole, this usage pattern involved the performance of the 16 practices interchangeably and at various points in time. A summary of the practices that are part of the low intensity pattern is listed in the table below (Table 36).

Table 36: Practices of the Low Intensity Usage Pattern

Practices	type	Device agency	Device centrality
P3: Taking rest	Present in 2 bundles	Low	Peripheral
S3: Comparing steps	Present in 2 bundles	Low	Variable
C2: Ignoring reminders	Present in 2 bundles	Low	Intermediate
P1: Getting the steps in	Core	Moderate	Central
T1: Full recording	Core	High	Central
T3: Tracking steps as proxy	Core	High	Central
T5: Monitoring Physical activity Weekly	Core	Moderate	Central
T6: Personalising goals	Core	Moderate	Central
T7: Tracking sleep	Core	High	Central
S1: Organising and participating in physically active social events	Core	Low	Variable
E1: Seeking virtual reward	Core	High	Variable
T2: Create a multi-device tracking system	Exclusive	Low	Intermediate
T4: Episodic Tracking	Exclusive	Low	Intermediate
T8: Innovative wearing	Exclusive	Low	Central
C1: Selective tracking	Exclusive	Low	Intermediate
S2: Sharing activity facts	Exclusive	Low	Peripheral

As it can be seen from the table, the eight core practice were also performed in this bundle however, a noticeable difference here was that the overall impact of the device (i.e., device agency) on the majority of performers of this pattern was much lower than the previous usage pattern e.g., more sporadic, less impactful or considered less often. As SG (male, 26) puts it: '[Fitbit notifications are] a gentle reminder. You know, if I get a notification and I'm busy at work, I'm not going to leave a meeting or stop writing report or something to get those steps in, but it is a gentle reminder.'

The five exclusive practices however were all characterised by being selective, dissociative, or tailored by the human to match their needs and/or desires which suggests more agentic performers. It is worth mentioning however that despite the episodic and selective tracking practices, users who engaged in this 'low intensity' pattern had the most complete activity data. This could be explained by the fact that they wore the device habitually regardless of their engagement with it, and as explained, WST are designed to collect and record activity as long as it is attached to the body.

Finally, I found that common characteristics of those who utilised WSTs according to this pattern included being Fitness-oriented, confident users who interact with their WST in a personalised way to best serve their goals and aspirations. This suggests deep understanding of their bodies and activity levels, and hence, high level of personal agency all of which enables them to create customised tracking systems that they design to out-perform the generic Fitbit tracking abilities.

5.4.2.1 The Fitness-oriented

The aim of this section is to report the findings relating to the fitness identities, in this instance, the Fitness-oriented fitness identity. This role-identity emerged from the idiosyncratic analysis and is conceptualised as those who are routinely and/or inherently active and are physically fit. The Fitness-oriented user identity was found to be linked to the low intensity usage pattern of wearables explained above and the majority of those used the device as a tool to 'benchmark' or 'check' on their activity levels. For this purpose, I present an example case of PSA a 33-year-old post-doctoral researcher who played football since childhood at a semi-professional level. Similar to the majority of this group members, he is highly active whether that is through cycling, sports or hiking. In the past two years PSA has become increasingly busy with work and has been contemplating tracking his activity. He has recently (6 months at the time of the interview) been gifted a Fitbit by his life partner after she noticed his interest in the device and hesitation to pay for one. In his own words, PSA said: 'I'd wanted to get one [a Fitbit] for a while. And I've been thinking on and off for maybe a couple of years or so about getting one on. So yeah, to get one finally it was great.'

He then quickly adds about the type of Fitbit he had wanted: 'I'd have wanted something that had more, you know, more functionality not that I necessarily use all the functionality on the Fitbit, but just so if I wanted to use it, you know [it's there].'

When asked about his general physical activity, PSA said:

PSA: '[I] played football for years. But I'm not part of any football club at the minute… I typically cycle to and from work, sometimes run back from work. So that's something that I've regularly done, other than the last year or so when I was commuting from Loughborough to Birmingham. I did my PhD in Nottingham [I was commuting from] Loughborough to Nottingham, either side of the train, cycling every day'.

He continues to talk about his usage of the device:

PSA: 'I mean, with me I don't know, I've always had a fairly low heart rate. Um like in the 40s, and I've always pretended that's because I'm extremely fit and a super athlete. And so probably just use that functionality [heart rate monitoring] to make me feel better about my now less active, miserable lifestyle [laughs]…I quite like knowing what [my numbers] are and I can check them, and you know, check if I'm doing particularly terribly at anything… I don't live and die by [Fitbit]. If something is a bit off, I'm not too bothered'.

From the quotes above, it is evident that PSA prioritise physical activity and perceives himself as a physically fit individual, yet he is not consistent with tracking. He goes on to explain why his records he shared before the interview incorporated several gaps: 'I think like I said, sometimes it dies. I let it die, and maybe don't charge it for a couple of days or something. And I'd say I probably do the same [amount of activity] regardless.'

The quote above illustrate that PSA uses the device mainly out of interest, and to help him live up to his own predetermined standards of 'good' levels of activity which helps him maintain his 'athlete', Fitness-oriented identity. The following quotes from the interview are included to support this idea:

PSA: 'I *prefer* to use [Fitbit], I'd say… I certainly think having it on is better because if I look at it and something, you know, if I look at my steps or active minutes or something, [and it] is particularly low. [if] I'm not doing well at something… then I'd actively try and improve that… on the other side of things, like once I do something well, and I'm happy with it, you know, I know from experience over the years, you know, I'll very often drop off and then it'll [be] like a cyclical thing, you know where, I've reached my goal, and now I'm satisfied, and then it'll drop off'

He adds: 'I think having it on maybe helps in terms of the, maybe the longer-term complacency… [but generally I] just wear it and keep doing good things.'

As can be inferred from the quotes above, commonly this group of users were more agentic and as such allowed little agency for the device. Additionally, those who belonged to this group of users have high self-awareness as they recognise their goals and needs and are usually confident about how to achieve them. Hence it was noticed that within this group of users, goals and plans are set by the users themselves who may occasionally respond to the devices' cues just for guidance. To conclude, the Fitness-oriented use the device to facilitate maintaining their preferrable physical activity levels and sense of fitness-identity rather than to change or improve it.

5.4.3 Bundle 3: The fluctuant intensity usage pattern

This usage pattern falls in between the high and low intensity patterns and characterises by its users' fluctuating levels of depth of cognitive, emotional, and physical activities via recursive cycles of reflection and deliberation. This pattern included a bundle of practices close to the one seen in the low intensity pattern yet distinctively different. The main difference between this pattern and that seen amongst the Fitness-oriented participants is the more cautious approach to tracking this pattern performers displayed. Those who displayed a fluctuant usage intensity pattern often reported being new to fitness, have struggled with their weight or body image before, and/or lack self-confidence when it comes to their fitness-identity. Those people were more likely to respond to the device than the Fitness-oriented, and they appear to allow the device more agency, while also having more episodes of close monitoring of their statistics in a manner that resembled that see in the high intensity pattern. Put concisely, users who engaged in this bundle of UPs fluctuated between having episodes of high agency and confident in their fitness-identities, and others of being completely dictated by the device. The latter were often triggered by either being 'called upon' (Warde, 2016) by the device either when seeing that have not been reaching their goals or that their physical activity is dropping, or when motivated to challenge themselves to a higher level of activity to confirm to themselves and/or others their newly acquired fitness-identity.

As can be seen in the table below, this bundle encompassed thirteen usage practices three of which were in common with the Fitness oriented, namely P3: Taking rest, C2: Ignoring the tracker's reminders, and S3: comparing steps, and one, S4: social signalling was special to this group only. The performance of S4 here is imperative as it captures the essence of what is especially important to this group who often reported starting their tracking journey to reach socially desirable 'fit' bodies, and fitness-identities. This is unsurprisingly reflected here through social signalling their new, more favourable identities through wearing and showcasing the device.

Table 37: Practices of the fluctuant Intensity Usage Pattern

Practices	type	Device agency	Device centrality
S4: Social Signalling	Exclusive	Moderate	Central
P3: Taking rest	In common with bundle 2	Low	Peripheral
S3: Comparing steps	In common with bundle 2	Low	Variable
C2: Ignoring reminders	In common with bundle 2	Low	Intermediate
P1: Getting the steps in	Core	Moderate	Central
T1: Full recording	Core	High	Central
P2: Chasing in-device target	In common with bundle 1	High	Central
T3: Tracking steps as proxy	Core	High	Central
T5: Monitoring physical activity weekly	Core	Moderate	Central
T6: Personalising goals	Core	Moderate	Central
T7: Tracking sleep	Core	High	Central
S1: Organising and participating in physically active social events	Core	Low	Variable
E1: Seeking virtual reward	Core	High	Variable

While UPs of benchmarking, social signalling and seeking external reward were some of the most common practices performed by this group, they also were able to disengage from tracking especially when removed from their day-to-day routines. This sometimes was justified by their tracking experience and knowing that they now have constructed these desirable identities, they do not need to rely on the constant reinforcement. Almost as they are giving themselves the permission to trial dissociative practices (on a much less intense level) commonly seen among the Fitness-oriented group.

As mentioned above, the Newly Fit performed the practices they have in common with the Fitness-oriented at different intensities. As such, when they were taking rest, if the device is still attached to their body, they might still be more cognitively engaged than they want. Therefore, they often removed the device completely when taking time off tracking. This justifies the less complete physical activity records received from this group.

Generally, the device played a central role in this performance of this bundle of practices. Below, this will be substantiated with evidence from a Newly Fit participant's case.

5.4.3.1 The Newly Fit

The aim of this section is to report the findings relating to the Newly Fit fitness-identity group and how this related to Bundle 3 above. This type of fitness-identity was found to be linked to fluctuant intensity usage pattern explained above. The Newly Fit is the final fitness-identity group identified in this research and it refers to those who have recently achieved a 'fitter', more positive identity. Those who fell under this group expressed close attachment to their devices, yet they were more agentic in their language and actions than the Aspirers. From the analysis it has become clear that the majority of this group were at a stage of beginning to feel more confident in their new fitness-identities and less pressured by the device. However, as they have typically only recently achieved their fitness goal(s), they still closely monitored their physical activity at a much more detailed level than the confident Fitness-oriented group, probably -sometimes subconsciously- fearing to revert back into bad habits. KM, a 22-year-old student is taken as an example of the Newly Fit. KM explained that she historically struggled with her weight, but now she describes herself as both 'active' and *'on a health kick'*. KM has been tracking her activity for 2 years at the time of the interview.

When asked how she would describe her physical activity, she said, KM: 'oh gosh, umm I'd say I am active.'

She added: '[Before lockdown] I was going to the gym every day, sometimes twice a day to do classes and so. I do spinning. I did BodyPump classes and then sometimes I just go to the gym. I was in a bit of a health kick'.

Following that, KM was asked to talk about her lifestyle, and social life before she got on a 'health-kick'. She explained: '[laughs] [all] Go[ing] out probably. Well, before I was a master student, I'd go out like a few times a week, but as a master student, probably just once a week, go to Ocean [a nightclub], or like some bars in town and just [drink]... and then we'd eat a few, we'd get a few takeaways, but not loads, just because we were on a *bit* [emphasises the word] of a health kick.'

She then proceeded to explain, KM: 'I've recently lost quite a bit of weight as well, lost about a stone… I didn't start losing weight until having had the Fitbit for a few months…it's helped me like track [my bodyweight] a bit better.'

She continued to talk about her recent achievement with pride, saying: 'before [losing the weight] running was a bit painful for me, like, hurt my knee and everything. But now I'm really proud of myself. I ran 12 kilometres without stopping so was quite a good achievement'.

However, KM was still self-conscious in busy environments (i.e., the gym) saying: 'when I go swimming, I like to go with my sister. I don't [go] if my sister wasn't here, I don't think I would go to this- go swimming- by myself. I feel a bit uncomfortable'.

When she was asked about the reason she does not like to go alone, she answered: 'self-consciousness. I think it's mainly because I would be worried about seeing someone I know!'

As discussed under bundle 3, many participants who fell under this group of users expressed a close attachment to their WST. As the interview with KM went on it became clear that KM is now strongly attached to her device to an almost obsessive extent where she tries to avoid moving at all when the device is being charged. KM: '[my Fitbit] is always on. I take it off to charge it then I put it straight back on... I wear it every day. Yeah, I wouldn't take it off. Definitely have it [on]. It's like, ingrained in my mind that I have to hit 10,000 steps a day'.

She adds, KM: '[when the device is charging] I make sure I'm sat down. So [laughs] I get really frustrated if I, like forget, I've taken it off and I just walk somewhere, even if it's only a couple of steps. I'm like ' Ah need to put it back on'.

From the analysis of this group's accounts, it was also inferred that despite them being often highly active, unlike the inherently Fitness-oriented, they usually aimed towards default in-device targets believing, perhaps misleadingly, that these are socially and scientifically acceptable benchmarks. In other words, the device-agency appears more influential amongst this group.
KM: 'I think I left all [my targets] the same. I've got the eight hours. 250 steps, 10,000 steps'. When asked why she kept her steps target to 10,000, she answered: 'I don't know. 10 is a nice round number [laughs]… just I find it like rewarding to see hitting the 10,000 steps like that, I just, that's my motivation, really, like just hitting the targets [my Fitbit] sets'.

KM also later said: 'I have the feature that tells you to walk every hour [on]? so you have to get 250 steps every hour. So when if I haven't done it, it will vibrate and then I'll make a conscious effort to get up and do a few steps even if it's literally just the 250 steps that I have to do.

In summary, this group of users usually have just achieved more desirable and fit fitness identities, and hence were still closely attached to the device, ensuring it is attached to their bodies and following its cues all the time.

However, at the same time, they are beginning to feel more confident in their newly acquired identities and starting to exercise some agency over the device as well, for example, KM changing the way it looked to suit her personal aesthetics: 'I've got this gold strap on it now, so it just looks less

ugly… When I had the black strap on it. I did take it off but now I've got this I just leave it on… [showing the watch to the camera] it doesn't really look like a Fitbit. It looks like a normal watch.'

5.5 SUMMARY OF THE INTENSITY PATTERNS

These findings regarding the patterns of WST use indicate that the intensity usage pattern, and the device agency in the encompassed practices are inherently linked. As such, the device is highest in influence in the high intensity pattern which could be due to the user's attachment and dedication to tracking manifested through the enactment of this bundle. And the device agency is lowest in the low intensity pattern where the majority of those who engaged in it were agentic, confident and fitness oriented. This device agency and ability to influence behaviours fluctuated in bundle 3 where those who engaged in exercised low intensity usage patterns at times but were cautious in their approach. They explained their apprehension by their fear of reverting back to less desirable habits as they were mostly new to fitness and self-tracking.

Taken together, the three bundles found in this research signify three distinct types of long-term usage behaviours. This is the first study to find different patterns of WST use and a connection between the user's overall observable usage patterns, device agency and sense of fitness-identity (see Appendix 5 for an overview of Participants' Fitness-identities). The implication of these findings will be discussed in detail in the next chapter.

Below, I present a tabulated summary of three usage patterns (High, low, and fluctuant intensity). It can be seen that eight of the eighteen usage practices found in this study were performed universally across the sample which are presented here as the *core practices*. While the core practices were clearly linked to sustained use by the majority of the study participants, when they discussed their usage patterns, they explained slight differences in the frequency and/or extent these practices were performed. To give an example, while the majority of participants engaged in T5: Monitoring physical activity weekly, the more Fitness-oriented participants only did this via reading the 'weekly progress report' Fitbit sent straight into their inbox, while other individuals who are more intensely engaged with their WSTs examined their records in much more depth on the companion App e.g., analysing the inconsistencies, and justifying to themselves not hitting certain goals. Another noticeable variation was in performing E1: Seeking virtual rewards, where the Newly Fit participants generally sought more virtual rewards, more frequently than any other group e.g., seeking daily 'stars', striving to be on the 'leaders board' in their virtual Fitbit challenges amongst others.

In terms of bundle-specific practices, those were mainly observed within the low-intensity usage pattern in which users exerted high agency and interacted only lightly and episodically with their devices. Social signalling was the only UP specific to the fluctuant intensity bundle users which also happens to be one of the most popular practices within this group. This is possibly connected to this group being easily affected and influenced by external entities such as their society (and its norms).

Table 38: Patterns Summary

Titles		High intensity (Aspirers)	Low intensity (Fitness-oriented)	Fluctuant intensity (Newly Fit)
Core practices (universal)	1.	P1: Getting the steps in	P1: Getting the steps in	P1: Getting the steps in
	2.	T1: Full recording	T1: Full recording	T1: Full recording
	3.	T3: Tracking steps as proxy	T3: Tracking steps as proxy	T3: Tracking steps as proxy
	4.	T5: Monitoring Physical activity Weekly	T5: Monitoring Physical activity Weekly	T5: Monitoring Physical activity Weekly
	5.	T6: Personalising goals	T6: Personalising goals	T6: Personalising goals
	6.	T7: Tracking sleep	T7: Tracking sleep	T7: Tracking sleep
	7.	S1: Organising and participating in physically active social events	S1: Organising and participating in physically active social events	S1: Organising and participating in physically active social events
	8.	E1: Seeking virtual reward	E1: Seeking virtual reward	E1: Seeking virtual reward
UPs specific to 1 bundle	9.		T2: Create a multi-device 'tracking system'	
	10.		T4: Episodic Tracking	
	11.		S2: Sharing activity facts	
	12.		C1: Selective tracking	
	13.			S4: Social Signalling
UPs seen in 2 bundles	14.		T8: Innovative wearing	T8: Innovative wearing
	15.		P3: Taking Rest	P3: Taking Rest
	16.		S3: Comparing steps	S3: Comparing steps
	17.		C2: Ignoring the tracker's reminders	C2: Ignoring the tracker's reminders

	18.	P2: Chasing in-device target		P2: Chasing in-device target

Table legend

- Practices of the high intensity usage pattern
- Practices of the low intensity usage pattern
- Practices of the fluctuant intensity usage pattern
- Parallel practice not performed within this bundle

5.6 CONCLUSION

This chapter examines the dynamics of the enactment of UPs in relation to the different types of users that participated in this study. On the whole, I identified two general types of usage patterns (i.e., performance and intensity patterns). This chapter discusses the performance pattern and the universally performed practices that fell under it (i.e., core practices), which were linked to the users' prolonged use of WSTs regardless of their interpersonal differences, as well as the three bundles of UPs performed under each intensity patterns. This chapter then proceeds to explain how UPs are combined in different ways by specific user groups to construct each of the intensity usage patterns, namely: high, low, and fluctuant. It further distinguishes between these patterns not only according to the level of effort and time users invest in their WSTs usage experience (i.e., intensity), but also in terms of the interpersonal differences (i.e., fitness-identity) that were found to be an important factor that influences the selection, engagement with, and (re)enactment of UPs.

To summarise, the high intensity usage group were the most attached to the device as they utilised it as a tool to change, or (re)obtain their fitness-identity. This group, termed The Aspirers, often struggled with their weight, and/or body image, and usually struggled to reach the recommended levels of physical activity. Interestingly, a link was discovered between intensity patterns and the overall device agency (across the practices performed with the pattern). The device agency was especially high in this group as those people reported often being made to feel 'down' or 'disappointed' by the device and were easily influenced by it.

On the contrary, the low intensity usage pattern characterised by light and/or infrequent contact with the device. Those who engaged in this pattern of use were Fitness-oriented, confident, and often athletic. As such they reported utilising the device to 'check' and benchmark against their own previous or desired levels of physical activity. This pattern was found to be the lowest in terms of

device-agency as this was a highly agentic group of users who did not *need* guidance or change. The Fitness-oriented participants only used their WSTs as monitoring tools (usually episodically) to keep an eye on their own self-determined goals and hence were the only group of users who performed 5 exclusive practices deemed necessary for their usage experience e.g., creating a multi-device tracking system.

Finally, the third bundle of practices was characterised by a fluctuating level of intensity, and consequently device-agency. This pattern was usually seen amongst those who were Newly Fit and/or have just recently achieved a more desirable fitness-identity. While this group engaged in some low device-agency practices (e.g., C2 ignoring reminders) they predominantly followed the instructions and cues generated by the device especially at times when they notice their physical activity dropping or are perpetually not meeting their numerical goals.

On the whole, these patterns involved a cognitive interplay between the human and the device-agency which was usually swayed by the users' sense of current and/or desired fitness-identity.

CHAPTER 6: DISCUSSION AND CONCLUSIONS

6.1 INTRODUCTION

This final chapter of the thesis starts by presenting an overall summary of the aims of this thesis followed by the theoretical, and practical, implications of the findings, respectively. The chapter concludes with a reflection on the research design and its limitations, along with recommendations for future research.

6.2 THESIS AIMS SUMMARY

This thesis aim is twofold a) understand the practices associated with the prolonged use of wearable self-trackers (WST) and reveal the role of wearables (and associated technology) in this context, and b) uncover the similarities and/or differences in the way users utilise their WST.
As such, the following specific research questions were formulated:

1) What are the practices associated with the prolonged use of wearable self-tracking technologies?
2) What factors influence how the use practices take place?
3) What role do wearable self-tracking devices play in the interaction?
4) Are there any patterns linked to the performance of these practices? If so, how can they be differentiated?

To recapitulate, the findings of this thesis uncovered eighteen usage practices (UPs) associated with the prolonged use of WSTs while revealing an agentic capacity of the device itself (i.e., device agency) as well as a functional role (i.e., device centrality). For a better understanding of the themes of usage practices they were grouped under five dimensions based on their dominant characteristics (i.e., physical activity, tracking, social, cognitive, and emotional). In a true inductive fashion, the thematic analysis indicated the potential presence of three distinct usage patterns. After an iterative analysis process, three *usage intensity* patterns were found, those finding also showed contrasting fitness-identities across the groups. Namely: high, low, and fluctuant intensity usage patterns corresponded, respectively, with Aspirer, Fitness Oriented and Newly Fit fitness-identities.

6.3 DISCUSSION AND THEORETICAL CONTRIBUTIONS

6.3.1 Understanding the prolonged use of WST

This thesis contributes to the literature by applying a post-humanist approach to the study of smart wearable technology. The ontological stance of this study views reality as 'monist' where the real cannot be fully understood without considering the human and the non-human together (Braidotti, 2006). Epistemologically, I argue that reality is subjective, contextual, and experiential (Fox & Alldred, 2017). As such, I approach the context of this thesis with an emphasis on practices as a unit of study considering all the various forces that take place together to shape practices as observed. This approach uncovers the agentic capabilities of WST in (re)shaping practices (e.g., for the Aspirers) and triggering reflection and deliberation (e.g., for the Newly Fit) (see 5.4.1, and 5.4.3, respectively). It further introduces new theoretical insights into the study of prolonged WST use that could inform the design of future studies in the wider area of self-tracking and the use of commercial smart technologies. The post-humanist approach offers an alternative lens that enables researchers to view such phenomenon in an encompassing way where the agency of the device, the human and other actors in the system are considered. As can be inferred from the findings, post-humanism does not simply deemphasise the human, instead it introduces a post-supremacy, post-exclusivity view, allowing for a more comprehensive, contextual and experiential view of the use of smart, agentic technology.

This research is the first to emphasise the role and agency of WST devices and posit that these devices possess an influential capacity capable of pushing, altering or eliciting cognitive, emotional and/or physical reactions from the human (RQ3). Recognising the agency of WST is an important advancement that could have a host of positive practical implications (see 6.4 below). It also, however, raises questions on whether these tools could have a negative influence on the safety and the wellbeing of the user which some participants alluded to in this research (e.g., obsessive behaviours, eating disorders etc). Especially given that the findings of this study suggest that those more prone to WST influence are also the ones most in need for a behaviour change and/or further guidance with regards to their health and fitness (i.e., the Aspirers group who often struggled with their weight, health, and physical activity- see 5.4.1).

Finally, the alignment of the post-humanist approach with practice theory (which often considers tools and material objects as key components of practices (Shove et al., 2012; Spurling et al., 2013; Nicolini, 2017)) posits an opportunity for marketing and social science researchers to apply and advance on practice theory models in various, underexplored, digitally mediated contexts.

6.3.2 Practice theory

As discussed in chapter 2 (2.7 practice theory), practice theory is a theoretical orientation focused on practices as a unit of analysis while putting the emphasis on the performance of the practice as well as all the various factors that influence said performance (Shove & Pantzar, 2005; Warde et al., 2017). As explained, practice theory does not deemphasise the human, instead it provides the theoretical tools to consider the role of the human and the non-human equally in constructing and shaping practices (Nicolini, 2017; Shove & Pantzar, 2005; Warde, 2014).

I build on the practice theory iceberg model first proposed by Spurling et al. in 2013 which is a visual variation of Shove and Pantzar's practice theory framework (Shove & Pantzar, 2005; Spurling et al., 2013) (see 2.7.2 Practice theory model in this thesis). In this thesis, I advance on the 'iceberg' model to provide an extended theoretical model which can better inform our understanding of digitally mediated practices, such as in the context of this thesis, the usage of wearable devices. The specific theoretical implications concluded from the findings of this research are discussed below.

Put concisely, this thesis theoretically contributes to the multi-disciplinary literature on the use of wearables for fitness self-tracking by utilising practice theory, which allows a more encompassing consideration of the various entities and elements that underpin use. Similarly, the study contributes to the conceptual body of literature on practice theory by emphasising the role of the device in (re)shaping practices and triggering deliberation. This research uncovers three distinct patterns of use and is the first to consider (current and desired) role-identities as an underpinning factor to engagement patterns. Finally, unlike most research in this area, this study was designed to explore actual usage experiences that extend beyond the initial novelty period and hence is the first to outline a set of core practices associated with the prolonged use of WSTs (see 2.6 The Gap). All the above contributions conclude that contrary to the common human-centric orientation in the literature which assumes that all users are cognitively driven (e.g., TAM in Jarrahi et al., 2018; Kim & Shin, 2015), WSTs use varies depending on a host of factors related to the user (e.g., role-identity), the device (e.g., notifications and feedback loops) and the context (e.g., social norms and physical environment) in which self-tracking is taking place (RQ2). As such this part of the study addresses the theoretical gap created by the widespread use of Technology acceptance models (TAM) and the general focus on the human.

6.3.2.1 Advancing the device agency construct

This research shows that WST use can be linked to eighteen Usage Practices, of which eight were core practices performed by all participants (RQ1). Stemming from these findings, and the central role of the device not only philosophically (post-humanist approach) but also practically in the

(re)emergence, performance, and repetition of UPs, I advance on the Spurling and colleagues' work by introducing the concepts of *device agency* and *device centrality* to the iceberg model (Spurling et al., 2013). The incorporation of these concepts represents an alternative, more encompassing way of understanding behaviours through considering the recursive, bidirectional interaction between 'device' and 'man' (Fox, 2016). The new model proposes that observable behaviours (e.g., how often the user check their companion app) influence and are influenced by the device. As such, the device-agency could go so far as to dictate how (and if) a practice is performed, which can determine the degree of centrality of the WST in that same practice. In short, I found a cyclical, iterative process between the degree of device-agency, the observable way in which practices are performed, and the centrality[27] of the device in the performance. For example, P2 Chasing in-device targets, is a high device-agency practice where the performance is driven by the device, it is hence a high device-centrality practice as it requires the wearable device to be present, active, and attached to the body throughout the entirety of the target chasing practice.

Countless conceptualisations have been proposed for *Agency* across various disciplines and schools of thought (Emirbayer & Mische, 1998; Rossiter, 2007) and, whilst this thesis does not claim a universal conceptualisation of the term, nor a comprehensive understanding, it does identify a *quality of agency* associated to WSTs and emphasises its role in triggering deliberation in the self-tracking process. Reflexivity and deliberation are concepts that are very sparsely explored within practice theory (Warde, 2016; Appendix 6). Similarly, in marketing, Akaka and Schau (2019) point at a potential reflexive process that impact the fate of practices of value creation in consumption journeys (i.e., leading to immersion, innovation and/or dissolution of practices). Thompson and colleagues on the other hand explored the reflexivity on social identities in divorced women and their post-divorce consumption practices to accomplish their 'reactive identity goals' (Thompson et al., 2018). Yet, apart from those studies, the idea of reflexivity (specifically on identity roles/goals) through practices remains surprisingly unexplored. Warde (2016) was the first (and only) scholar to conceptually address the matter (in the context of the practice of eating) from an explicit practice theory angle suggesting that moments of reflection and deliberation in practices' performance happen "when impediments arise in the orchestration of performances" (Warde, 2016). Warde gives examples of those impediments such as when an element of the practice 'goes wrong', the circumstances of performing the practice change or disappear, or when a change is 'called upon'. Along the same lines, the findings

[27] Device centrality is the importance of the device in the orchestration of the performance, and it could be viewed as a *result* of the device-agency (see 4.4 for further details).

of this thesis suggest that the device is able to 'call upon' deliberation through its design and ability to generate automated cues, and feedback loops.

The role of things in the formation of practices is a subject that has been investigated in different disciplines e.g. Geography (Barratt, 2011, 2012), Social Marketing (Spotswood et al., 2019) and Sociology (Maller, 2015; Warde, 2016), yet the theoretical novelty of this thesis is the concept of device-agency, as such proposing that non-human entities having such powerful capabilities that enable it to influence not only how practices are (re)enacted and (re)formed, but also when and if they are performed at all. While wearables are a good example of this process, I argue that this theoretical model could be applied to understand smart technology mediated practices in general which are becoming more prevalent in our day-to-day life (e.g., smart home technologies, self-driven vehicles etc).

Again, this is not to say that the human agency is negligible in the presence of the device, but to emphasise a dynamic interplay between the agency of the human and the non-human that influence how, if and when practices take place. For instance, users who perform usage practices such as Episodic Tracking and Create a multi-device 'tracking system' manifest more agency over their WST use experience, while those who Chase in-device targets usually reported allowing the device to lead their behaviour. Finally, these inter-personal variabilities in responding to device-agency led to further empirical (i.e., the identification of usage patterns) and theoretical (i.e., the impact of role-identity) discoveries which will be discussed later in this chapter.

6.3.2.2 New insights on role-identity in practice theory

On the whole, the findings of this research highlight three different *usage intensity patterns* each of which was found to be performed by a certain *type* of users according to fitness- identities[28]. Here I suggest that users' sense of identity (perceived and/or desired) underpins UPs and influences how, if, and when they are performed.

In other words, the findings posit that the fitness-identity influences the type of practices of WST users they engage in, how and when they choose to perform them, and how much agency they allow the device in such performances. This is a novel finding which merits a further extension to the iceberg model (Spurling et al., 2013) to integrate *role-identity* into the iceberg model. But first, I will elaborate on the conceptualisation of fitness-identity and identity negotiation (through deliberation) as crucial

[28] Role-identity specific concept of the self in reference to fitness (Belk, 1988; Giddens, 1991; Warde, 1994)

constructs of this thesis. Later, I discuss my advancement on the Iceberg model and its application in and beyond the context of this research.

6.3.3 Fitness-identities

Identity is a construct of the self which encompasses our personal conceptualisation of "who and what we are" (Schouten, 1991). The term identity is widely used in various disciplines, yet there is considerable variability in the way it is conceptualised (Stryker & Burke, 2000). In marketing, particularly in consumer research, identity is a frequently explored concept (for examples see: Schouten, 1991; Shankar et al., 2009; Thompson et al., 2018; Akaka & Schau, 2019) potentially due to the long-standing belief that consumption is an expression of identity and a medium through which identities are confirmed, negotiated, rejected and invented (Banister & Hogg, 2004; Bauman, 2001; Maguire, 2008a; Schouten, 1991; Thompson et al., 2018). Until the early 1990s, identities were viewed as static sets of beliefs, behaviours and conceptions such as one's age, gender, religion and the culture in which they were born (Bauman, 2001; Giddens, 1991; Maguire, 2008a). This approach implied that when people are faced by challenges, changes and/or choices they are expected to react in ways that would bring the narrative (back) in line with their socially pre-determined self-identity (Giddens, 1991). An alternative view concurrently emerged in the area of consumer psychology where identities were conceptualised as dynamic cognitive constructs that are defined and negotiated *recursively* through actions, achievements, aspirations and/or possessions (Markus & Nurius, 1986; Schouten, 1991; Shankar et al., 2009; Thompson et al., 2018). This view implies that identities are constantly evolving through acts of consumption (defined as interactions with products and service providers) (Ibarra & Petriglieri, 2010; Markus & Nurius, 1986; Shankar et al., 2009; Warde, 2005).

In this thesis, I follow the latter conceptualisation of identity as it posits that people are empowered to explore, define and reinvent who they are (Ibarra & Petriglieri, 2010; Shankar et al., 2009). It also suggests that people may construct several *role-identities* for themselves relating to various aspects of their lives which may or may not be in complete harmony (Ibarra & Petriglieri, 2010). Role-identities (used interchangeably with sub-identities in the literature) are defined by context-specific messages that people transmit via engagement in practices, collecting objects, and possessing goods (Akaka & Schau, 2019; Belk, 1988; Giddens, 1991; Warde, 1994). This study revealed three patterns of engagement with WSTs across the sample of participants (RQ4), but perhaps the most notable finding here is identifying that each pattern is performed by a group of people with shared fitness role-identities (simply referred to here as *fitness-identity)*. This finding suggests that unlike the common assumption in the sociological WST literature (e.g., the work of Deborah Lupton- see (Lupton, 2016a) for an example), the use of these devices is not identical for all users, but in fact is recursively architectured by the user to best serve their fitness-identity goals.

6.3.3.1 Identity negotiation

This research takes a dynamic view on identity where *current* fitness-identities are constantly (re)invented, developed, and *negotiated* based on various internal and external factors e.g., moving cities, getting married or wanting to lose weight. This process of *identity negotiation* can be both circumstantial and/or deliberate, the latter is more commonly known as 'identity work'. The mere term *identity work* implies formality, suggesting a systematic process with a clear end in mind (Ibarra & Petriglieri, 2010). From the findings of this thesis, I further infer that the nature and design of wearable self-tracking devices allow them to play an active role in initiating and feeding back in the identity negotiation processes.

In this study, three identity negotiation patterns were observed each of which was specific to a certain fitness-identity group. The first resembles an act of checking and confirming existing, long-established positive fitness-identities (common in the *Fitness-oriented* group), the second is in the form of establishing and solidifying newly achieved, positive fitness-identities (common in the *Newly Fit* group), and the last is a form of *identity work* done to create and/or communicate possible, attainable, fitness-identities (common in the *Aspirers* group).
In other words, users' fitness-identities underpinned the intensity of engagement in usage practices and the overall pattern of use. To give an example, when users current fitness-identities are less favourable, the device is used more intensely as a mean of co-constructing a more favourable fitness-identity that is believed to be within reach (Belk, 2016; Markus & Nurius, 1986).

6.3.4 The extended smart technology practice theory model

The prime focus of practice theory is the dynamics and components of practices. Despite the proliferation of technology, practice theory is lagging in exploring the role and impact of (smart) technology on how practices are (re)shaped, and (re)enacted. To contribute in this regard, this thesis takes a post-humanist, practice theory approach to capture a comprehensive view of the usage practices of WST considering the several elements underpinning their observable performances regardless if these are related to the human (users) or the non-human (the WST device).

From the findings of this research, it can be inferred that the observable practices users perform when interacting with the device are influenced by the agentic capabilities of the smart device and are recursively negotiated against users' current or desired fitness-identities. These findings concur with previous research by Akaka and Schau (2019) which suggests that considerations of potential identity (mis)alignment with practices may determine the future of those practice and whether they are (re)created, (re)shaped or dissolved over time (Akaka & Schau, 2019). I differentiate my work from such studies by considering the role of the non-human in the process of reflexive identity negotiation,

and subsequently the (re)formation, and performance of practices, which makes the proposed theoretical model the first to facilitate the exploration of agency powers beyond the human in such performances. This extended Spurling model also advances on Akaka and Schau (2019) by explaining the identity negotiation (and work) that take place during the performance of long-term, recursive practices rather than at one-off, or inconsistent consumption touchpoints. For example, during each performance of Episodic Tracking, the user is reflecting on whether their numbers (mis)align with their fitness-identity and if there is a point of 'conflict' (which calls upon change). If so, they would incrementally adjust the way they perform the practice (e.g., more intense episodes of tracking) until satisfied.

The diagram below shows the Extended Smart Technology Practice Theory Model for exploring smart technology mediated practices. This model suggests that what we observe of smart-tech use practices, is underpinned by the device agency, which in turn determines the functional importance of the device for the performance of the practice (i.e., device centrality). The model further posits an interplay between the underpinning elements related to the human (knowledge and skills, and cognitive and emotional processes), and the tool and material objects related to the practice. As such, it suggests that the practices as entities are equally influenced by the human and the nonhuman (flat, monist ontology), and knowledge about these practices is only possible through considering the two together.

I argue that this model presents a more comprehensive theorisation of smart-tech mediated phenomena which are becoming increasingly prevalent in the world. It is proposed that the model facilitates a better understanding of the uptake, and performance, of practices associated with conventionally human-centric, manual processes that are being supplemented with smart-tech e.g., artificial intelligence assisted driving.

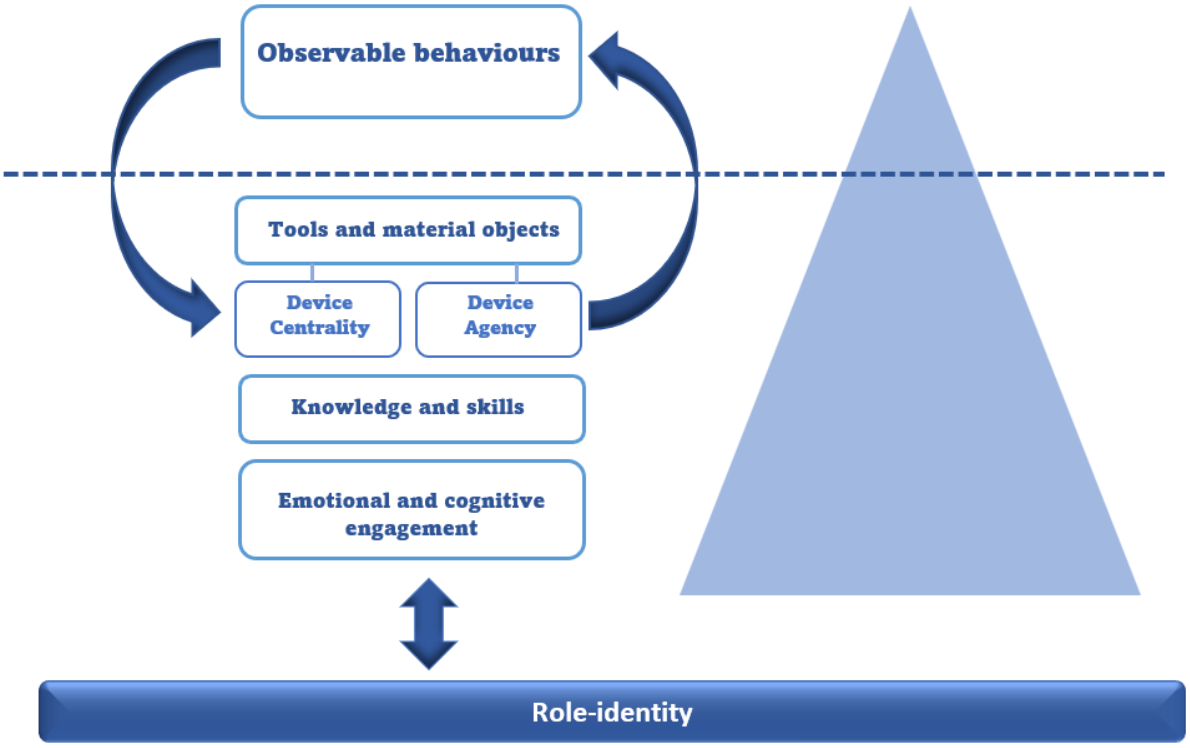

Figure 16: The Extended Smart Technology Practice Theory Model (extended from: Spurling et al., 2013)

6.4 PRACTICAL IMPLICATIONS

In addition to the theoretical contributions to the WSTs and practice theory literature, this thesis provides several practical implications that are relevant to not only designers and developers of WSTs but also to health and wellbeing authorities tasked with tackling lifestyle disease (e.g., obesity). This thesis presents a better understanding of self-tracking using wearable technology and is the first to uncover eight core practices related to the sustained, long-term use of WSTs. It also offers a more comprehensive understanding of the various patterns of engagement in UPs and the connection of thereof with users' fitness-identity while highlighting the commonalities and differences across these patterns.

All of this could inform future work of marketing researchers and allow developers, marketers, and public health professionals to better tailor their approaches to capitalise on the opportunities sustained self-tracking presents for corporations (monetary benefits), as well as personal and societal health.

6.4.1 Managing practices

Before discussing the specific practical implications of this thesis, it is worth highlighting the empirical benefits of the practice theory approach. Practice theory is a method theory which offers conceptual and methodological tool which allows the focus on activities, processes and performances (Nicolini, 2017; Warde, 2005). Hence its adoption here has the benefits of understanding the *origins* of behaviours by considering the cognitive and emotional processes that underpin them, as well as the practicalities of their emergence through considering the tools, material arrangements and skills necessary for the performance.

This granular view of practices as a unit of analysis offers benefits for researchers, WSTs developers and health professionals alike by explaining the architecture of practices. In turn, this approach makes practices clearer, and hence, designable and manageable which posits a unique practical opportunity.

6.4.2 Optimising wearables design for sustained use

Research to date focuses on what motivates users to adopt wearables and start participating in self-tracking (Chuah et al., 2016; Dehghani & Kim, 2019; Jarrahi et al., 2018; Shin, Jarrahi, et al., 2019). Less attention has been given to exploring the sustained long-term use of WSTs and the fundamental characteristics of the practices of use. Wearables developers position such devices as personal care solution that can motivate users to be healthier and more physically active[13] (Harrison et al, 2014), however evidence show that this hinges on WST sustained use (Stiglbauer

et al., 2019). In addition to the lack of reliable scientific evidence on WST health benefits, researchers report high rates of disengagement, and abandonment (Attig & Franke, 2020; Chuah, 2019; Stiglbauer et al., 2019). Hence, this thesis aimed to explore the activities and practices of actual long-term users aiming to understanding how they consistently utilise their WSTs over time, and whether there are any factors that influence these.

The adoption of a practice theory approach is particularly useful in bridging the gap between theory and practice and can greatly enhance the practical value and impact of academic research findings (Warde et al., 2017). A practical view of the findings on this research could help in optimising the design of wearables to foster better and more sustained usage patterns. This could be achieved by utilising the device-agency through its features (e.g., notifications, feedback loops etc) to facilitate the performance of the core practices (i.e., those that are universally performed across the research sample). This in turn could encourage sustained use making the health benefits of sustained physical activity more attainable for WSTs users.

To give an example, as the majority of the core practices were linked to routine and/or complete tracking, this device could be designed to bring the user more awareness of their average activity level (i.e., steps) and suggest a tailored, ambitious, yet achievable target. Enjoyability is an element that has been repeatedly linked to more effective-self-tracking (Etkin, 2016; Luyen et al., 2021), similarly the findings of this thesis revealed that many users enjoy their tracking less when the targets seem (or are) unattainable. Hence the proposed approach has the benefit of making practices achievable, and subsequently, more enjoyable, which should increase the chance of sustained performance of practices.

Viewing self-tracking from a practice-theory angle creates a more detailed understanding of what underpins the observable performances of practices. Hence, I argue that optimising the design could be beneficial for behaviour change interventions. This could be through targeting the practice's roots (i.e., underpinning elements), instead of the usual approach of targeting attitudes (hypotheticals) and behaviours (shallow observables) (Cohn, 2014; Maller, 2015). For example, reminding the user (Underpinning element: knowledge) that daily activities add up to weekly activity, creating weekly 'stars' system (underpinning factor: emotional engagement), as well as creating a *weekly* steps monitoring icon on the main dashboard (Underpinning factor: tools) could encourage the performance of T5: Monitoring physical activity weekly.

6.4.3 Tailoring the usage experience to foster better engagement

Wearables are marketed as personalisable devices, yet the findings of this study suggest that the majority of users leave their WST on their default settings, which they believe are 'good' or socially acceptable targets. This is especially prevalent amongst those who are new to fitness (see 5.4.2.1 The Aspirers). The same group which could arguably be most in need for wearables' promised benefits. However, the issue here is that the device 'content' (e.g., steps averages, suggested active hours goals etc) are all influenced by the information it gathers which is rarely a complete and accurate reflection of one's activity for it depends on several factors such as wearing the device all the time, and the device being active and effectively reporting (Feehan et al., 2018; Harrison et al., 2014). This raises questions on the reliability and effectiveness of automated WST goals and their impact on users' physical and psychological wellbeing.

Aiming for unattainable or unrealistic targets has been reported to demotivate users and potentially lead to the abandonment of the device and related 'healthy' behaviours e.g., walking (Attig & Franke, 2019, 2020). I found that prolonged users of WSTs who are generally physically active or effectively aspiring to be, tailor the device goals, reminders, and experience to their own aims/needs (see 5.4.1.1 and 5.4.3.1, the Fitness Oriented and the Newly Fit, respectively). In other words, these users selectively engage in tracking only the parameters that are relevant to their goals, and often tailored the default numbers to make their in-device goals more achievable (or challenging), depending on their aim at the time. Some more experienced/athletic users went further and created a multi-device tracking system to tailor their self-tracking efforts to their personal needs (i.e., T2: Create a multi-device 'tracking system').

Hence attention to practices should not be limited to the universal core practices of use, instead, there is an opportunity for developers, designers, and those responsible of public health to utilise mass personalisation[29] to tailor the usage experience (including cues, goals, feedback loops etc) to the user group utilising fitness-identities. Practically, this could be done by personalising the registration process to Fitbit and App installation via including questions related to users' sense of identity inspired by the coding of this research analysis. Example questions could be, why have you decided to use Fitbit? Have you used any other WSTs before? What type of sports or physical activity do you perform, and how often per week? amongst others. An automated (algorithm-based) analysis of the answers can be integrated to the set-up of the device that then tailors the usage experience to push the performance of practices known to be performed effectively by

[29] Defined as an algorithmic process that utilises big data to generate predictions unique to individuals (Kotras, 2020; Tiihonen & Felfernig, 2017)

users of a particular fitness-identity. While this approach conceptually aligns with the essence of behaviour change and maintenance literature which focus on individuals, it differs in the way it operationalises the knowledge inferred from this research in practice (i.e., device-agency and the influence of role-identity on use). Of course, this approach must be considered with caution taking into account potential risk of algorithm-based personalisation such as not considering environmental and other hurdles that may impede or stop the performance. Informing the user that the algorithm is tailored to their 'data-profiles' (see 2.5.3 WST impact on the user) and allowing two-way feedback loops (device-user, and user-device) are good ways to mitigate such problems. This approach could offer adaptability, and subsequently better adherence, through mass personalisation which could be pivotal for the success of future, WST-based, behaviour change initiatives.

6.5 LIMITATIONS

While this research offers novel insights into the use of WSTs it has a number of limitations which are important to highlight. Being aware of these limitations may help future researchers better design their studies to provide deeper and/or new insights into the growing phenomenon of WST use. First, as explained in the introduction section, prolonged use is argued to be essential for reaping the promised health benefits of WSTs. While in this thesis the main focus is to understand the underexplored phenomenon of prolonged WSTs use, aiming to infer knowledge that may help mitigate unsustainable usage patterns, or early abandonment. The scope and limited timeframe of this study meant that the investigation of whether the prolonged usage patterns found were associated with, or facilitated better patterns of physical activity, or whether the users noticed any health benefits since started using WSTs was not possible. Further, as explained in the methodology chapter, the connection between fitness-identity and the three patterns of use was an emergent construct. Had this been known before the design of this study, it could have been explored in further depth in the interviews.

Methodologically, due to the restrictions on social contact at the time of collecting the data, it was difficult to reach and recruit suitable respondents that are more demographically, behaviourally and socio-culturally diverse (see 3.4.1 Impact of the pandemic on research design). It was particularly hard to reach less technology savvy users, and those who are less engaged with social media and Fitbit forums. Arguably, these same groups might be more prone to disengage and/or abandon the device and related 'healthy' behaviours all together.

Further, while online interviews were successful in this instance, in-person interviews would have been beneficial in gaining further insights through body language and habitual actions e.g., glancing over the wrist when a notification comes in. Hence, in-person interviews could have informed this research further providing richer insights into mindless, habitual behaviours and practices.

6.6 FUTURE RESEARCH

6.6.1 Prolonged use and users' physical and mental wellbeing

My interest in long-term use stems from the speculations in the literature about a potential connection between health and physical activity benefits and prolonged use of wearables which in turn is based on evidence from healthcare research. This evidence suggests that incremental change in behaviour that is maintained over time is more effective in realising the benefits than short-term radical behaviour change approaches (Kwasnicka et al., 2016).

This thesis is the first to explore the prolonged use of wearables and to consider the role of the device in the usage process yet does not tackle the question of whether the prolonged use could be associated with realising the WST promised health benefits, or whether these vary across the types of users this research identifies (i.e., Aspires, Fitness Oriented, Newly Fit). Future studies could build on the knowledge inferred from this study to explore these questions.

Further, the literature review conducted for this study reveals a potential impact of WST use on the mental health of users. While this falls outside the scope of the current study, my research participants often alluded at a potential harmful impact of WST on their mental health saying things like they feel 'pressurised' or that it triggers 'eating disorder symptoms' for them. I would recommend for future researchers to advance on the findings of this thesis with regard to the varied levels of device agency that users allow WST to investigate the potential impact on users' physical as well as mental wellbeing.

6.6.2 Active interviews

Practice theory is a pragmatic theoretical orientation that aims to study and decipher social phenomena (Nicolini, 2017). At its core, practice theory is a way of understanding the world we inhibit as a constellation of practices, tools, entities, and performances. As such, it approaches the world with an alternative approach that avoids post-hoc rationalisations and interpretations. Instead, the practice theoretical orientation is a pragmatically descriptive way of understanding social phenomena as they emerge considering all forces and factors involved in the performance (Nicolini, 2017; Spurling et al., 2013). Stemming from this, I argue that future work should focus on observing wearable self-tracking use as they happen to uncover mundane, habitual practices that were perhaps missed due to the

design of this research. One way I propose is active interviews e.g. walking interviews (Evans & Jones, 2011), or running interviews (Esmonde, 2020) where the researcher enters the natural environment where practices take place allowing for more comprehensive observation of WSTs usage practices.

6.6.3 Applying practice theory to the use of other smart devices

This thesis proposes an extended practice theory model specific to understanding smart technology mediated practices. This model incorporates the agentic capabilities (device-agency) of the device, its functional importance (device-centrality) and the users' sense of role-identity into the elements that underpin and shape how practices take place. The model was effective in the context of this thesis in offering deep insights into the use of wearables and showing novel patterns of WST use. Hereby, I suggest that another useful application of this model could be to study the use and engagement with other smart-tech devices which could also possess as element of device-agency such as smart-home devices, insurance (self-)tracking devices, or self-driven vehicles, to name a few.

The theoretical benefit of this approach is to a better understand the device-agency in the human-nonhuman interactions in our highly digitised world. This could have empirical implications on creating digital devices that are more tailored and user-centric which can facilitate their integration into our daily life. To conclude, I argue that better adoption and more sustained use can be fostered through the integrating of new digital technologies into existing practices instead of attempting to change these practices to accommodate for their use (i.e., the mainstream behaviour change approach).

6.6.4 Further exploring the concept of fitness-identity

The findings of this research suggest a connection between the UPs users perform when interacting with the device and their cognitive perceptions of current and/or possible fitness-identities (or role-identities, more broadly). While previous research by Akaka and Schau (2019) has addressed the link between identity and (brand) community practices, the study fell short in conceptualising *identity* and was hence ambiguous in that sense. Apart from a few isolated studies, the role of identity reflection in shaping behaviours and performances remains generally underexplored in marketing, and even less so in the broader practice theory domain.

Fitness identities are becoming increasingly important in relation to health, fitness as well as consumption practices. The concept of role-identity (e.g., exercise identity) has been addressed in marketing and other disciplines (e.g., sports science), often suggesting that individuals' identities "give meaning and value" to their behaviours (Akaka & Schau, 2019; Anderson & Cychosz, 1994; Thompson et al., 2018). The most relevant example to the context of this research can be found in sports science. Sport scientists argue that role-identities motivate or underpin behaviours that are relevant to them,

and this has been used since as the basis of the popular Exerciser Identity Scale (EIS) (Anderson et al., 2001; Anderson & Cychosz, 1994; Strachan et al., 2009). Briefly, the EIS is a measurement scale that was developed based on a survey inspired by the findings of prior research on the relationship between role-identity and (future) behaviours (Anderson & Cychosz, 1994). The 9 -item measurement instrument ranks individuals as *'exercisers'* on a scale of 1-5 (Anderson & Cychosz, 1994). Similar to the findings of this thesis, the EIS suggests that role-identities underpin, and drive behaviours and activities to achieve/maintain or avoid (future) identities.

While the three fitness-identities identified in this thesis serve as initial evidence on the potential role of identity in (re)shaping and initiating usage patterns, future researchers could build on these findings in multiple ways. First, by scaling and broadening the scope of their studies to seek thorough classification of fitness identities beyond the three identified in this research. Second, they could apply the concept of 'identity scaling'[30] for the general population hence expanding beyond the field of sports and athletic performance. The finding of this thesis, and potentially, future exploratory studies on the link between role-identity and WST use, could also assist in creating a more informative 'Identity Scale' where numerical scoring is replaced by qualitatively conceptualised role-identities related to fitness (fitness-identities). All these suggestions could form the basis for a more comprehensive profiling tool that could inform the design of WST-based health interventions, and the next generation of WSTs, making them more tailored and personalised which can potentially drive better use and behavioural adherence (Tiihonen & Felfernig, 2017).

[30] Creating a scale to rating people's role identity in terms of fitness affinity and/or experience from 1-5 (Anderson et al., 2001)

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APPENDICES

8.1 APPENDIX 1: THE CONSENT FORM

University of Nottingham
UK | CHINA | MALAYSIA

Nottingham University Business School
Participant Consent Form

Name of Study: Exploring the Impact of Interacting with Wearable Fitness-trackers on Physical Activity

Name of Researcher(s): Sahar Bakr, Professor Sally Hibbert, Professor Heidi Winklhofer.

Name of Participant:

By signing this form, I confirm that (please initial the appropriate boxes):	**Initials**
I have read and understood the Participant Information Sheet, or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	
Taking part in this study involves an interview the participant that will be recorded using video and/or voice recording. The recorded interview will be transcribed as text and analysed using digital softwares.	
Personal information collected about me that can identify me, such as my name or where I live and my wearable tracking-device data will not be shared beyond the study team.	
My words can be quoted in publications, reports, web pages and other research outputs.	
I give permission for the de-identified (anonymised) data that I provide to be used for future research and learning.	
I consent to the use of my fitness-tracker activity data during the interview, and in publications and research output.	

I agree to take part in the study

	Name	**Signature**	**Date**
Researcher:	Sahar Bakr		
Participant:			

2 copies: 1 for the participant, 1 for the project file

8.2 APPENDIX 2: FEATURES CHECKLIST

Number	Functionality	Use
1	Premium user	YES / NO
2	Step-count goal accomplishment	YES / NO
3	Caloric burn goal	YES / NO
4	Monitor heart rate	YES / NO
5	Exercise goal setting (active days per week)	YES / NO
6	Exercise goal setting (active minutes per day)	YES / NO
7	Reminders to move	YES / NO
8	Active hours goal setting	YES / NO
9	Distance taken per day	YES / NO
10	Flights of stairs/floors climbed	YES / NO
11	Track exercise sessions (i.e., weightlifting, yoga, indoor cycling… etc.)	YES / NO
12	Auto-recognition of exercise (i.e., swimming, cycling, walks… etc.)	YES / NO
13	Trail tracking (For running, walking or hiking)	YES / NO
14	Sleep tracking	YES / NO
15	Nutrition tracking	YES / NO
16	Hydration tracking	YES / NO
17	Women's health (i.e., menstrual cycle tracking)	YES / NO
18	Participate in community forums	YES / NO
19	Member of specialised groups (i.e., cycling, yoga, activity-at-work …etc.)	YES / NO
20	Challenge setting (alone)	YES / NO
21	Challenge setting (with others)	YES / NO
22	Monitor performance across weeks/months	YES / NO
23	Read educational articles and blog posts by the provider (i.e., Fitbit)	YES / NO
24	Consider advice and recommendations made by the device (i.e., to amend your exercise goal to meet the national recommendation)	YES / NO

8.3 APPENDIX 3: THE FULL INTERVIEW GUIDE

	Interview Guide Questions	Rationale	Relevant Research Question (RQ)
Lifestyle			
1	**Could you please confirm your name? And would you mind telling me your age and occupation?**	Background. For sample socio-demographic analysis. To document the diversity of the sample.	**General (G)**
2	**Could you please describe your lifestyle? Is physical activity important for you?** (Probe: what do you enjoy doing; who do you live with; any children; do you have any illnesses, conditions that affect your lifestyle; what are your hobbies; do you have any friends you share your hobbies with; what types of facilities for physical activity are available to you)	General context to gain insight into the overall lifestyle of the interviewee and possibly, adjust the following questions accordingly. This question helps us establish the meaning of physical exercise to participants, the role of physical activity/sports for them personally and in their community whilst also allow us to explore any significant constrains to physical activity their lifestyles might impose on them	G
3	**You said you work/study X, can you describe a typical workday of yours?** (Probe: what do your mornings look like, how do you travel to/from your destinations, do you sit at a desk most of the day, what do you do in the evenings)	Link to 'activity at work', 'active travel', 'exercise' practices. how/if the device has an operational or emotional impact on the user's daily lifestyle practices. The impact of context and lifestyle on practices (Burke et al., 2009; Cockerham, 2005)	G, RQ1, RQ2
4	**How do you travel to work?** (Probe: drive, cycle, walk, public transport) **Has that changed since you started using your fitness tracker?**	Further insight on the participant's lifestyle and fitness-orientation (Cockerham, 2005) Information about the impact of the device on the participants' physical activity, and perhaps also about the change that happened. Also, insight into other factors that impact on physical activity	G, RQ2, RQ3

	(Probe: walking more, started cycling, does the weather impact your choice of mean of travel)	practices (i.e. skills such as ability to cycle, availability of safe pavements) (Schau et al., 2009; Spotswood et al., 2019; Woermann & Rokka, 2015) explore the temporality of practices (Woermann & Rokka, 2015)	
5	**How do you typically spend your weekends?** **Do your activity levels differ between workdays and weekends?** (Probe: any specific hobbies you practice, are you active or chill; if mentioned specific sport or hobby earlier in the interview, follow up on that)	The impact of social structure, context and lifestyle on practices of interacting with the device, and on physical activity (Burke et al., 2009; Cockerham, 2005) . Information about skills, rules and know-how of specific performances (i.e. sports such as football) and how that might impact the enactment of practices (Schau et al., 2009; Woermann & Rokka, 2015)	RQ2
6	**How is your social life like?** (Probe: Do you socialise?, do you spend any time with friends?) **If yes; could you tell me more about what you do together?** (probe: spend time together after work, go to a pub/restaurant together, go to the gym together, do activities together such as hiking, cycling, paintball…etc) **If no; how do you spend your free time?** (probe: watching TV, reading, going out alone or with family)	This question helps us establish the meaning of physical exercise to participants and in their community. Identify some of the activities the interviewee does on his/her free time.	G, RQ2
7	**What do you do when you're taking time off (i.e., holidays, Christmas break… etc)** (Probe: do you just chill, take it easy or do you go on active/adventure kind of holidays?; do you spend your time with family or friends, or do you like to take time off for yourself)	General lifestyle. Attachment to the device (Shin, Feng, et al., 2019).	RQ1, RQ3

8	**Do you exercise or participate in sports?** If yes, **what type of exercise do you participate in?** (Probe: do you go to the gym, run, swim, part of a sports team) If no, **what activities do you use your Fitbit to track and why?**	Uncovering types of practices and whether they are tracked or not. Explore what goals do users set for themselves (if any) and what they do to achieve them (Chuah, 2019; Nelson et al., 2016; Shin, Jarrahi, et al., 2019)	RQ1, RQ2, RQ4

Use:

9	**Was your fitness-tracker a present or did you buy it yourself?** **Follow up question:** Why did you buy it? OR Have you expressed interest in fitness-trackers before? **Did you start wearing your Fitbit immediately after you got it? If not immediately, why?**	Explore the propositions in the literature (mainly through the application of TAM) that suggests a connection between the purpose of adoption and the probability of continuous use (i.e. Crawford, Lingel and Karppi, 2015; Lunney, Cunningham and Eastin, 2016; Shin *et al.*, 2019)	**G**
10	**Why did you start using the Fitbit?** (probe: curiosity, to be more active; medical reason, family history of chronic disease)	Adoption intention (Choi and Kim, 2016; Zhang *et al.*, 2017). Meanings and purposes (Schau et al., 2009; Shove & Pantzar, 2005; Spurling et al., 2013).	RQ3
11	**Do you enjoy using your Fitbit?** (Probe: would you say you have fun tracking your activity) If yes, **why do you find it enjoyable?** If no, **has it always been not enjoyable for you? Please elaborate.** (Probe: do you use it exclusively for the health benefits, is it more like a "chore", do you use it because someone else (i.e. family member or a friend) uses it)	Hedonic motivation for continuous use (Choi & Kim, 2016; Kim et al., 2013; Matt et al., 2019) Lack of enjoyment and "work-like" use may be linked to the abandonment of newly adopted healthy behaviours (Etkin, 2016)	RQ1, RQ2, RQ3, RQ4
12	**Do you wear your device regularly?**	Attachment to the device.	G, RQ3, RQ4

	(follow-up question: how many days a week)	Dedication and motivation (Shin, Feng, et al., 2019) Agency (Crawford et al., 2015; Fotopoulou & O'Riordan, 2017) Practice of wearing the device as part of daily routines.	
13	**Do you sometimes forget to wear your device?** If yes, **tell me what do you do When this happens?** (Probe: do you just go normally about your day, do you do anything about it, does it matter to you, do you manually log in your activity i.e. long walk, gym session etc) If no, **what makes you so consistent in wearing your device?** (probe: does it motivate you, friends are competing with you, do you participate in online challenges, habit)	The impact of use on physical activity (Owens & Cribb, 2017; Stiglbauer et al., 2019) Device inducing motivation to practice healthier behaviours (Jarrahi et al., 2018; Shin, Feng, et al., 2019). New "healthy" practices integration into users' lifestyle (i.e. habit formation) (Nascimento et al., 2018).	RQ1, RQ3, RQ4
14	**Can you describe to me how you use your Fitbit on a typical day?** (Probe: track steps, reminder to move, log activity information)	Interaction with the device. Uncover some of the main practices of interaction with the device and tracking physical activities. The role of different features of the activity tracker in encouraging continuous use (Canhoto & Arp, 2017; Dehghani & Kim, 2019; Jarrahi et al., 2018; Owens & Cribb, 2017)	RQ1, RQ4
15	**On the Functionality checklist, you ticked x, y, z …etc.** (Lyons et al., 2014; Piwek et al., 2016) **Why do you use these functions?** **(follow-up questions:** why do you use x/y/z function?; do you compare performance (in x/y/z) across weeks/months?; **have you always used the same functions**	The interaction with the device. The impact of specific features on use continuity and users' physical activity (Canhoto & Arp, 2017; Hardey, 2019; Matt et al., 2019; Nelson et al., 2016). Explore the features most popular amongst the fitness-trackers' community.	RQ1, RQ2

	since adoption of the device?; how do you use this specific function?- *probe: input data, record before you start an activity…etc-* ; **are you interested in trying a function but don't know how?)**	Explore the temporality of the practices associated with the use of wearables (Woermann and Rokka, 2015) Emotional engagement with the device and some of its features (Schau, Muñiz and Arnould, 2009) The impact of skills and knowhow on the performance of "healthier" behaviours (Schau et al., 2009; Woermann & Rokka, 2015)	
16	**Did you ever customise the device default goals to match your own?** (Probe: the device suggests 10000 steps per day, 7 days of exercise per week, 8 active hours per day and so on. have you changed these?) If yes**, why?** If no, **how do you asses your activity level?**	The role of the device in helping people become more active and consistent in their healthy habits through goal-setting (Chuah, 2019; Owens & Cribb, 2017; Shin, Jarrahi, et al., 2019)	RQ1, RQ3, RQ4
17	**How often do you check the device's companion App?** **What for?** (Probe: look at stats, check caloric burn associated with specific activity, participate in community forums, input data manually) **Do you think that has changed from when you first started using your tracker and now?**	Emotional engagement with the device (Schau et al., 2009). Explore the features that are most important to users. Dedication and motivation (Shin, Feng, et al., 2019) Explore the temporality of the practices associated with the use of wearables (Woermann & Rokka, 2015) Users' recursive reflexivity (Akaka & Schau, 2019)	RQ1, RQ2, RQ3, RQ4
18	**Have you noticed any changes in your overall fitness/physique since you started wearing your activity tracker?** If yes, **do you think your Fitbit played a role in that? How?** If no, **why do you continue to use the device then?** (Probe: do you feel better, has your appearance improved, have your mental health improved, is it	Emotional engagement with the practices (Schau et al., 2009) Device role in motivating users to be more active (Attig and Franke, 2019) Habit formation (Nascimento, Oliveira and Tam, 2018) Elements that influence usage continuity (Akaka & Schau, 2019) Reflexivity (Akaka & Schau, 2019)	RQ3, RQ4

	other people's or encouragement)		
19	**Have you learnt any interesting or concerning facts about your health/ physical activity since you started tracking?** (Probe: have you visited a doctor or got professional advice due to readings recorded on your device, have you realised that your health is actually better than you thought it is, have you learnt that you can be more active that you currently are)	Actions based on devices' readings. Understanding whether the interaction with the wearable device changes based on the readings. The utilitarian use of wearables (Canhoto & Arp, 2017)	RQ2, RQ4
20	**Do you notice any difference regarding your physical activity on days where you're wearing the tracker vs. on days where you're not?** **Can you elaborate on why is that?** (Probe: is there a difference at all, do you walk more, do you go out of your way to hit your goals, do you ever get bored of tracking, any specific feature that motivates you, do device positive feedback and reward badges matter to you)	The impact of wearables on physical activity (Stiglbauer et al., 2019). Device motivation to be more active (Attig & Franke, 2019). Habit formation (Nascimento et al., 2018). Relapse into old habits after the initial 'honeymoon' period of use (Attig & Franke, 2019; Shin, Feng, et al., 2019; Stiglbauer et al., 2019)	RQ3
21	**Do you know others who use fitness trackers?** If yes, **do you compare your activity statistics with others (i.e. steps taken over the weekend, how intense was your run last week)?** (why/ why not) (Probe: are you competitive, is it just small talk, do you like to share your achievements with others you care about- for example friends, partner, family; do you go on walks/runs	Factors that impact the usage experience The influence of socio-cultural rules and structure on practices and their continuity (Burke et al., 2009) The role of self-efficacy and agency on the enactment and continuity of tracking and interaction practices (Cockerham, 2005; Maller, 2015; Veenstra & Burnett, 2014) The influence of social shared meanings and rules on practices (Spurling et al., 2013)	RQ1, RQ2, RQ4

	together; do you challenge each other on the App;) If not, **do you share your results with non-users?** (why/why not) (Probe: small talk, conversation starter, sharing something you are proud of)	The role of the process of recursive reflexivity (Akaka & Schau, 2019) Fitness trackers as lifestyle symbol (Choi & Kim, 2016; Chuah et al., 2016)	
22	**Have you ever considered switching brands or upgrading to the next Fitbit model? Explain why please.** (Probe: any features that you are interested in that your device don't offer?; better design, aesthetics, better provider)	Device features importance for continuous use (Canhoto & Arp, 2017) reliability and usability of the device correlation to continuous use (Matt et al., 2019; Nascimento et al., 2018) Fitness trackers as lifestyle/fashion symbol (Choi & Kim, 2016; Chuah et al., 2016)	RQ2, RQ3
23	**You have been using the tracker for [specify months or years]. In your opinion what made you stick to wearing your tracker until now?**	This question addresses emotional engagement with the device, meaning and objectives, and potentially participants' recursive reflexivity on their identity and goals within the world and how the use of a fitness-tracker is influencing these (Akaka & Schau, 2019; Schau et al., 2009; Warde, 2016) This should also allow the researcher to compare between practices as performances (the observable part of a practice) and practices as entities (the underlying elements of a practice that cannot be simply observed) (Spurling et al., 2013)	RQ2, RQ4
24	**In your opinion, are there any features in the device that can be improved to help more people continue to use their Fitbits?** **Finally, if I asked you to give a general piece of advice to**	Device-related factors that influence use continuity (Canhoto & Arp, 2017) Insights into the most important aspects and practices of using the device. The downfalls of using wearables and the barriers to long-term use	G, RQ2, RQ4

	someone who is considering buying a Fitbit, what would it be? (Probe: warnings, tips, features that you like, activities they should try)	(Casselman et al., 2017; Hargreaves, 2011; Piwek et al., 2016) Individual and/or social meaning behind some practices (Hardey, 2019; Spurling et al., 2013).	

8.4 APPENDIX 4: CROSS-PERSON IDIOSYNCRATIC ANALYSIS CODES

Identity group	Most important Identity-related codes (generated during the Idiosyncratic analysis)
The Aspirers	1. Adopted to become less sedentary 2. Aiming for in-device goals 3. Associate wearing Fitbit with being fit and healthy 4. Attached to the device 5. Being active with family members 6. Convenience is the main determinant for daily physical activity 7. Device agency 8. Exercise is pointless if not tracked 9. Externally motivated 10. Feel bad (or gross) when activity is plummeting 11. Feel guilty when not hitting targets 12. Finds sports pressurising 13. Fitbit makes you feel guilty 14. Frustrated when forgetting to wear the device 15. Grew up in a family where physical activity was not that important 16. Inactive since lockdown 17. Initial novelty use 18. Interesting to see activity records 19. Justify 'bad' records 20. Manually track exercise sessions 21. Participate in exercise competitions 22. Push myself when activity is being tracked 23. Records are evidence or proof that I've been active 24. Sedentary behaviour 25. Seeking virtual rewards 26. Too many notifications are annoying 27. Track for motivation 28. Trust Fitbit 29. Usually start exercising then drop off after a while 30. Walk where I can for physical activity
The Newly Fit	1. Active commuter 2. Aiming for in-device targets

	3. Always try to be active 4. Attachment 5. Conscious effort to be more active 6. Enjoy being active 7. Enjoy tracking 8. Fitbit makes me do more 9. Frustration for forgetting to wear the device 10. Frustration when activity is not reflected in steps 11. Gets moving when Fitbit notifications come through 12. Gym goer 13. I try to always hit my goal 14. I was heavier 15. Lack of genuine internal motivation 16. Learning through tracking 17. Manually add in unrecorded data 18. More engaged with the device when pushing myself 19. New to fitness 20. On a health kick 21. Quantifying my physical activity helped improve it 22. Seeking validation from the device 23. Seeking virtual rewards 24. Tracking brings awareness 25. Want to log every step onto the records 26. Weight-loss is/was an essential aim
The Fitness-oriented	1. Active commuter 2. Active upbringing 3. Benchmarking via tracking 4. Check weekly Fitbit emails 5. Confident 6. Episodic tracking 7. Exercise is a routine 8. Fitness-oriented 9. Go on active holidays 10. Good tech knowledge 11. Human agency 12. Increased physical activity is correlation not causation 13. Internal motivation 14. Physical activity is important in my family 15. Plays sports 16. Prioritise physical activity 17. Proud of oneself 18. Quantifying is interesting

	19. Same level of physical activity in lockdown even if through different activities 20. Solo offline challenges 21. Tracking brings awareness 22. Tracking may change my daily decisions to the better 23. Tracking out of curiosity 24. Underestimate her/his daily activity 25. Utilise multiple tracking tools and techniques 26. Weekends are for rest

8.5 APPENDIX 5: PARTICIPANTS' FITNESS-IDENTITIES

Name	Fitness-identity
FO	Aspirers
YAP	Aspirers
MEQ	Aspirers
AN	Aspirers
JNM	Aspirers
OSC	Aspirers
SG	Fitness-oriented
NVV	Fitness-oriented
GK	Fitness-oriented
VS	Fitness-oriented
CJ	Fitness-oriented
GC	Fitness-oriented
MK	Fitness-oriented
LA	Fitness-oriented
RND	Fitness-oriented
JMG	Fitness-oriented
MA	Fitness-oriented
PSA	Fitness-oriented
AH	Fitness-oriented
CL	Newly Fit
JB	Newly Fit
LM	Newly Fit
KM	Newly Fit
CG	Newly Fit
CB	Newly Fit
RA	Newly Fit
SH	Newly Fit
HD	Newly Fit
NW	Newly Fit
GS	Newly Fit

8.6 APPENDIX 6: GLOSSARY OF TERMS

Word / Abbreviation	Definition
Physical activity	Any form of bodily movement that is performed in order to increase the body energy expenditure (Caspersen et al., 1985).
Agency	The quality and capacity of an entity (human or non-human) to sense the surrounding environment, gather and process data (or information), and produce an outcome that could affect the order of the surrounding world (Hoffman & Novak, 2018; Sillar, 2009; Rossiter, 2007).
Device-agency	Quality of power, and capacity of a wearable self-trackers to collect, process and feedback personal data to influence the user's practices (Hoffman & Novak, 2018; Sillar, 2009; Rossiter, 2007).
Degree of agency (high, moderate, and low)	The extent of the authority of the (agentic) device (Schweitzer et al., 2019)
Authority	Power to affect which usually is hierarchical
Device- Centrality	The degree of functional importance of the tracking device and related technology for the *enactment* of the practice as described.
Reflection	Careful and close thought and re-examination of past actions, decisions, and data to reach meaningful conclusions that could inform future decisions and/or behaviours[31]
Reflexivity	A reflection on the self within the world and the alignment of thereof with one's goals and aspirations. Reflexivity could present itself in various forms such as existential, critical, reactive to name a few (Akaka & Schau, 2019; Thompson et al., 2018)
Deliberation	The process of planning and reasoning normally triggered by certain 'meanings', and proceeding high-involvement and/or personal future decisions and/or actions which is usually based on current knowledge (Cohn, 2014; Warde, 2005, 2014)
Meanings (in the practice theory model used)	A subjective cognitive or emotional understanding(s) underpinning decisions and/or actions.
Track (verb)	Manually and/or automatically set the wearable device to record a certain activity over time
Record (verb)	Manually and/or automatically set the wearable device to record a certain activity (one off)
Monitor (verb)	Keep watch on certain parameters whether that is on the wearable device, the companion app or both.
Biometrics	An encompassing term of all the types of data recorded by WSTs. In this thesis, used to refer to one day or a general account.
Records (noun)	Accumulation of the user's biometrics over a longer period of time (usually longer than one month)
Patterns	The manner by which users engage with a certain practice
Fitness-identity	Self-concept in relation to fitness
WST	Wearable self-trackers
TAM	Technology acceptance model
AM	Active minutes

[31] Linguistic definition drawing on academic and common use of the word (main source: Cambridge Dictionary).