

‘Building understanding of digital vulnerability: An exploration of wearable self-tracker usage practices’

Abstract

- **Purpose:** While wearable self-trackers (WSTs) are marketed for self-care, fitness, and health improvement, emerging evidence highlights the potential for negative impacts. This paper explores the use of WSTs adopting a practice theory approach to unravel the contextual and individual factors that shape different patterns of WST usage and consumer vulnerability to harm.
- **Methodology:** A qualitative study using semi-structured interviews and visual stimuli of self-tracking data was conducted with 30 Fitbit users. Data were analysed using thematic analysis, followed by idiographic and cross-case analysis to map usage patterns and reflexivity.
- **Findings:** Three distinct WST usage patterns were identified: light, fluctuant, and intensive. The study finds that reflexivity on physical activity identity and goals plays a key role in shaping these patterns, with users' critical capacity in identity transitions emerging as a key underpinning factor in vulnerability to harm.
- **Originality:** This research focuses on the context of self-tracking and extends existing literature on digital vulnerability, defined as *a state in which people are at risk of harm due to external conditions and personal states and circumstances that significantly inhibit their agency in practices involving digital technologies*. It reveals differentiated patterns of WST use and the role of identities and identity work in shaping WST use and users' vulnerability to potential harms.
- **Practical and social implications:** To mitigate potential harms and promote healthier self-tracking practices, the study suggests the application of safe design, transparency, and accountability principles, accounting for individual goals and experience levels, and tailored guidance and educational support for users.

Keywords: Wearable Self-trackers; Digital Vulnerability; Harm; Reflexivity; Identity work; Practice Theory.

Paper type: Empirical Research Paper

Introduction

Wearable self-trackers (WSTs) are marketed as self-care tools that help users become healthier, fitter, and more active (Harrison *et al.*, 2014). They are among the most popular smart technologies globally (Statista, 2025). These devices integrate hardware, software, and advanced artificial intelligence (AI) algorithms that allow them to gather and process physical activity, sleep and other biometric data, interact with users, and generate outputs to meet their intended purposes (Finocchiaro, 2024).

Most consumer research on WSTs has concentrated on adoption and early use, aiming to enhance appeal and user satisfaction (Feng *et al.*, 2021). However, this narrow focus is increasingly questioned as evidence emerges of potential harms (Chen *et al.*, 2024) and concern grows about the power imbalances that characterise this market, linked with WST technologies and the multi-national corporations that operate the major brands (Hermann *et al.*, 2024; Kaliyamurthy and Schau, 2025). These concerns have prompted calls for research to explore the 'dark side' of self-tracking (Berry *et al.*, 2021; Feng *et al.*, 2021; Kaliyamurthy and Schau, 2025) and develop an understanding of digital vulnerability in this context (Chen *et al.*, 2024).

Contemporary conceptions of vulnerability recognise that it arises from the interplay of external and personal circumstances or states, which can be transitory or enduring (Baker *et al.*, 2005). However, literature that considers vulnerability to potential harms of self-tracking is limited and largely theoretical. The extant empirical evidence comes from research adopting individualistic perspectives, considering how WST-generated data and cues influence users' motivation, abilities and, in turn, their engagement, resulting in either positive or negative outcomes (e.g., Kerner and Goodyear, 2017). Critical scholarship provides more contextualised insight, theorising how self-tracking technologies relate to socio-cultural and political conditions, such that they exert disciplinary power by confronting users with decontextualised and authoritative content that encourages the pursuit of unrealistic appearance ideals and a normalised view of health (Berry *et al.*, 2021; Toner, 2018). This emerging literature is building an understanding of the conditions under which WST users may be vulnerable, but to adequately address ethical and policy issues, more research, drawing on alternative theoretical perspectives, is required to develop a comprehensive and differentiated view of consumer vulnerability (Wieczorek *et al.*, 2023). In this study, we apply the lens of practice theory (Shove *et al.*, 2012; Warde, 2014), which acknowledges self-tracking to be a socio-material phenomenon (Lupton and Smith, 2018).

This lens stresses the interplay between socially embedded human actions and materialistic entities, including the body, tools, and spatial arrangements (Schatzki *et al.*, 2001; Shove *et al.*, 2012; Warde, 2005). Practice theory traditionally focused on shared practices, and prior applications to self-tracking have focused on common practices within specialist self-tracking communities (Lupton, 2017). However, practice scholars increasingly recognise individuals to be carriers of shared practices, coordinating their practice performances according to their own experience and identity projects (Kelleher *et al.*, 2019; Schau *et al.*, 2009). Accordingly, we define digital vulnerability as a state in which people are at risk of harm due to external conditions and personal states and circumstances that significantly inhibit their agency in practices involving digital technologies. To explore how vulnerability to harm arises in WST usage, our study examines different performances and patterns of WST use, rather than shared practices. We focus on the WST usage practices of *ordinary* consumers with diverse social circumstances (Didžiokaitė *et al.*, 2018), rather than self-tracking communities, addressing the following research questions:

RQ1: Do WST usage practices and patterns of use differ across consumers?

RQ2: How are the circumstances of WST use linked to different usage patterns?

RQ3: Do the potential benefits and harms of WST use relate to alternative usage patterns?

The article begins by discussing WSTs and digital vulnerability, before reviewing research on the potential harms of WST use and how they come about. It introduces practice theory as a lens to examine how socio-material conditions and individual circumstances shape WST usage and vulnerability. It then describes our qualitative methodology and presents key findings. The research contributes novel findings on alternative patterns of WST usage and links with harm. It shows that, alongside broader socio-cultural conditions, physical activity identities shape reflexive engagement with WSTs. It also reveals how users' knowledge, experience, and confidence influence their ability to critically interpret device data and cues, and to mitigate harm. The article concludes with implications for technology developers, educators, and policymakers.

Wearable self-trackers and digital vulnerability

Activity self-tracking includes various approaches to gathering, recording, and evaluating personal data – on steps, sleep, biometric patterns, behaviours, etc. – as a source of insights on oneself. Self-tracking tools encompass both traditional and digital methods of measurement and recording, ranging from scales and stethoscopes to pen-and-paper

techniques and modern smart technologies. These contemporary tools integrate hardware (e.g., wearable bands), software (e.g., mobile apps), and the algorithms that govern their functionality (Sanders, 2017). With the advancement of machine learning, self-tracking technologies have increasingly deployed artificial intelligence (AI). AI systems are capable of performing reasoning-based tasks, such as selecting, classifying, and summarising large data sets, including physical activity metrics, before presenting them to users (Pantano and Scarpi, 2022). Drawing on these technologies, the WST market has developed, deploying data and algorithm-based business models. In principle, they present possibilities for improved health (Jakicic *et al.*, 2016; Stiglbauer *et al.*, 2019) by promoting more intensive (Lupton, 2014), effortful (Kristensen *et al.*, 2021), and healthy behaviours (Luyen *et al.*, 2022).

However, these models are characterised by substantial structural asymmetries, fuelling concerns about consumer vulnerability to potential harm. Power imbalances are inherent to the idea of consumer vulnerability (Hill and Sharma, 2020) and are especially pertinent in digital environments, given the potential of the technology to learn about consumers and influence their actions (Helberger *et al.*, 2022). Whereas scholars of consumer and digital vulnerability have generally focused on people's access and choices within markets (Basu *et al.*, 2023; Hill and Sharma, 2020), a prime concern with health-focused, AI-driven services is related to their power to influence users' participation in and experiences of maintaining or improving their own health (Hermann *et al.*, 2024; Kaliyamurthy and Schau, 2025), especially as users may not be aware of or think critically about these forms of influence (Kaliyamurthy and Schau, 2025). These arguments have recently been amplified by scholars warning of the harms arising from exposure to health-related social media (Powell and Pring, 2024) and AI-based psychotherapy chatbots (Tekin and Delehanty, 2025).

The combination of AI technologies deployed in WSTs and their intimate connection to the body afford them the potential to shape user reactions and actions (Kaliyamurthy and Schau, 2025). This potential is further enhanced as leading WST brands (e.g., Apple and Google) and third parties (e.g., insurance companies) devote extensive marketing resources to drive sales and customer engagement with WSTs (Paluch and Tuzovic, 2019).

In the face of these structural forces, digital vulnerability is arguably universal for WST users, but more nuanced understandings are needed to inform ethical and policy frameworks (Goanta *et al.*, 2024). Differentiated conceptions of vulnerability are often based on group-level traits (e.g., people with low levels of digital literacy), but contemporary perspectives acknowledge that contextual factors interact with individual circumstances (Commuri and

Ekici, 2008; Hill and Sharma, 2020; Marent and Henwood, 2023), highlighting the need to investigate conditions that heighten WST users' vulnerability to harm.

Understanding contextual and personal circumstances of vulnerability to harms

Harm is generally understood as a setback in well-being or welfare relative to a previous state, which includes suffering and missed opportunities for well-being benefits (Polonsky *et al.*, 2024). A growing literature considers the potential harms of WST use. To date, much of this scholarship is conceptual. These studies highlight a range of negative emotional (e.g., guilt, unhappiness), psychological (e.g., stress, anxiety), cognitive (e.g., body image dissatisfaction, negative self-evaluations), and behavioural responses (e.g., obsessive behaviours, eating disorders) associated with WSTs, as well as their detrimental effects on people's lives, social relations (e.g., isolation, hyper-individualism), and wellbeing (Berry *et al.*, 2021; Chen *et al.*, 2024; Motyl, 2020; Wieczorek *et al.*, 2023).

Recognising potential harms, scholars are turning their attention to the circumstances under which consumers are more vulnerable. The emerging research adopts diverse theories and methods to explore the interplay of external and internal factors (see review by Chen *et al.*, 2024). Much empirical research, similar to earlier studies on self-tracking benefits (see review by Feng *et al.*, 2021), adopts individualistic perspectives, applying theories such as Self-determination Theory (Deci and Ryan, 1980) and Self-efficacy Theory (Bandura, 1977) to examine how WSTs affect user motivations. Findings suggest that external control and rewards mechanisms inherent to WST technology may lead to improved activity levels, but they have mixed effects on self-efficacy (Rieder *et al.*, 2021) and reduce intrinsic motivation and enjoyment, resulting in amotivation (Etkin, 2016; Kerner and Goodyear, 2017). These studies provide valuable insights, but more contextualised perspectives are also needed. Critical scholars have been at the fore of discussions on self-tracking as a socio-cultural phenomenon, shaped by broader societal shifts that frame health and fitness as personal responsibilities and moral duties (Lupton, 2017). Drawing on critical socio-cultural theories (Berry *et al.*, 2021), feminist perspectives (Sanders, 2017), and critical health studies (Brown, 2018), this largely conceptual work argues that socio-technical environments promote a standardised, normative view of health, reinforcing ideals of physical activity, health, beauty, and self-discipline. This places pressure on individuals to self-monitor and 'correct' perceived bodily or behavioural deviations (Berry *et al.*, 2021; Toner, 2018). Concerns centre on self-

tracking's promotion of narrow, normative definitions of physical activity and reliance on reductionist metrics, which raise issues of accuracy, legitimacy, and bias (Kaliyamurthy and Schau, 2025), and the delivery of decontextualised, authoritative outputs that can drive compliance and reinforce discrimination (Bonezzi and Ostinelli, 2021).

Practice theory is another promising lens through which to gain a contextualised understanding of WST use. While researchers have applied practice theory to studies of self-tracking (Lupton and Smith, 2018; Spotswood *et al.*, 2020), the contexts of these studies have not illuminated circumstances in which harm arises. Central to the 'practice turn' (Schatzki *et al.*, 2001; Warde, 2016) is the idea that social arrangements, material environments, and everyday routines are mutually constitutive. Though there is no single unified theory (Nicolini, 2017; Warde, 2014), practice perspectives adopt a post-humanist stance, simultaneously considering the social significance of human activities (Nicolini, 2017; Schatzki *et al.*, 2001; Shove *et al.*, 2012; Warde, 2005) and the role of the materialistic entities including the body, tools, and spatial arrangements (Maller, 2015; Reckwitz, 2002; Shove *et al.*, 2012; Warde, 2014, 2016).

Traditionally, practice theory placed less emphasis on the individual (Schatzki *et al.*, 2001), but recent work stresses its potential to examine collective and contextual layers of practice (Kelleher *et al.*, 2019), thus illuminating social situations and the everyday actions and interactions of individuals (La Grouw *et al.*, 2024; Raelin, 2020; Spotswood, 2021).

Advocates of this view consider socio-cultural and material factors (Maller, 2015; Gherardi, 2025) but acknowledge that individuals coordinate their actions based on personal experience (Kelleher *et al.*, 2019) and that reflexivity shapes practice performances and outcomes (Akaka and Schau, 2019; Kristensen and Ruckenstein, 2018). This perspective provides a theoretical toolkit that enables a dynamic analysis of how practices are enacted by individuals (i.e., practices-as-performances; Shove and Pantzar, 2005), how their historical trajectories shape them (i.e., practices-as-entities; Schatzki *et al.*, 2001), and how both the histories and performances of practices contribute to their outcomes – whether positive or negative (Skålén, 2024).

A practice perspective regards self-tracking as a socio-material phenomenon (Lupton and Smith, 2018). Scholars emphasise that self-tracking is visualised, influenced, and mediated (Spotswood *et al.*, 2020; Lupton and Smith, 2018) by material tracking devices and shaped by wider discourses on physical activity, body image, and health. While sometimes treated as a single practice (Lupton, 2017), research shows that self-tracking comprises numerous interconnected practices (Spotswood *et al.*, 2020). To date, empirical applications have

focused on specialist communities such as runners (Spotswood *et al.*, 2020) and cyclists (Spotswood *et al.*, 2015) to identify shared self-tracking practices. However, self-tracking research acknowledges its reflexive (Lupton, 2014) and eudaimonic (Suh, 2018) dimensions and links with identity construction (Sharon and Zandbergen, 2016), suggesting a connection with identity work – defined as the ongoing (re)invention, development, and negotiation of personal identities in response to contextual internal and external influences (Ibarra and Petriglieri, 2010). These insights resonate with recent practice theory developments highlighting the potential for individuals to coordinate practices differently, based on their experiences and reflexivity (Bottero, 2015).

Our study draws on these recent theoretical developments to explore individuals' different performances and configurations of WST use practices (Blue *et al.*, 2016). It focuses on *ordinary* consumers, with diverse social circumstances (Didžiokaitė *et al.*, 2018). Consumer WST use occurs in domestic and other everyday settings in which socio-cultural structures interact with digital structures and technologies to shape patterns of use and differ markedly from those within communities, movements, and institutions (Didžiokaitė *et al.*, 2018). By examining individuals' WST usage in their everyday lives, we aim to build an understanding of interactions between socio-cultural and material external conditions, and between personal states and circumstances that heighten vulnerability to WST harms.

Methodology

The study adopts a post-humanist research philosophy (Bolter, 2016) to pursue a practice-centred analysis and probe humans' dynamic experiences of WST use within their social contexts. It takes a qualitative approach, based on semi-structured interviews. Visual stimuli depicting the user's self-tracking records were deployed to mitigate bias linked with recall of WST use details (Prosser and Loxley, 2008) and facilitate in-depth reflections (Orr and Phoenix, 2015). The visualisations were generated by converting users' numerical tracking data into graphs and diagrams. Interview questions prompted participants to relate their perspectives on the importance of physical activity for themselves, their families and communities, and its role in their lives. The questions also asked about their participation in sports and physical activity routines. The discussion moved on to their perspectives on self-tracking, the features of WSTs, why and how they use a WST, experiences of use, developments over time, and subsequently, their reflections on the patterns revealed in their tracking data. The study was approved by the Research Ethics Committee of the institution

where the lead author was affiliated during the research. Participants were given information on the study, including the use of tracking data during interviews, and provided their written consent to take part.

Sampling combined convenience and snowballing approaches, with participants recruited via online (i.e., Fitbit community forums) and in-person (i.e., Parkrun ambassadors) channels. Participants were all users of the Fitbit brand of WSTs. To facilitate the exploration of continued WST use, participants were required to have used the device for a minimum of six months. Thirty participants, including 9 males and 21 females aged between 20 and 72 years, took part in the study. The higher proportion of female participants reflects the gender distribution typically seen among active Fitbit users (Statista, 2025). A list of participants is shown in Web Appendix A.

The interviews were carried out via videoconferencing and were recorded and transcribed by the lead author. Participants were assigned pseudonyms, and the data were anonymised. The analysis followed a three-stage approach, including thematic analysis (TA) (stages 1 and 2) and idiographic analysis (stage 3) (Braun and Clarke, 2006; Fournier, 1998). A thematic analysis approach was taken for its ability to support inductive data analysis while remaining guided by theory. This has the benefit of preventing the analysis from digressing away from the research questions, which is a common challenge in other forms of qualitative analysis (Timonen *et al.*, 2018), and to keep a practice theory focus, which is essential for addressing the research gaps we identified (Braun and Clarke, 2022).

Stage 1 was the initial TA stage, where we started by familiarising ourselves with the verbatim data before commencing a reflexive process of open coding (Braun and Clarke, 2006). The open-coding stage produced 400+ codes, which were then grouped under 80+ axial codes. These were subsequently organised under overarching themes in stage 2 of the TA. This part of the TA cycle produced themes related to contexts, circumstances, emotions, challenges, and social norms. Example themes included ‘Life events as barriers,’ ‘Seeking change’, and ‘Feeling rewarded’. In a typical reflexive TA manner, we revisited the transcripts through a practice theory lens informed by Shove *et al.*’s (2012) three element model to identify usage practices and their underpinning factors (Braun and Clarke, 2006). Finally, stage 3 employed an idiographic analysis method – an impressionistic method of reading, coding, and comparing qualitative transcripts to identify patterns and typologies (Fournier, 1998; Raelin, 2020). This method was operationalised to examine each participant’s case independently, recursively exploring personal beliefs, histories, patterns of use, and reflexive processes in interactions with WSTs. Cross-case comparison was then

undertaken to map bundles of practices that manifested as patterns of WST use and revealed contrasting experiences. The authors worked towards the agreed coding scheme through regular meetings. All three authors have a strong grounding in the theoretical underpinnings of the study and drew on this knowledge to review and iteratively refine the coding scheme as it was developed and applied to the data. Consistent with our epistemological stances, we resolved divergences and ambiguities in coding through discussion of data, considered within the context of the participant's case (Cofie *et al.*, 2022). Exemplar coding summaries are available in the online supplementary file (Web Appendices B and C).

Findings

Stage 1 and 2 of the analysis partially addressed RQ1 and RQ2 by identifying WST usage practices and examining the contextual and personal factors shaping their performance, while stage 3 addressed the latter part of RQ1 and RQ3 by identifying patterns of use and exploring how these patterns are associated with potential benefits and harms. We present our key findings below, beginning with the WST usage practices identified. These practices were combined in ways that formed three overarching patterns of use: light, fluctuant, and intensive. We then describe each pattern in detail and examine the circumstances shaping them, highlighting their connections to participants' experiences and outcomes. Figure 1 depicts the interplay between vulnerability and practices involving digital technologies (left-hand diagram) and illustrates our findings on vulnerability to harms linked with each of the three WST usage practices (in the three diagrams on the right).

FIGURE 1 – AROUND HERE

Wearable Self-tracker Usage Practices

Eleven WST usage practices (UPs) were identified through the thematic analysis stage. Four of these UPs were described by our participants as 'basic' or 'core' aspects of WST use and were universally performed. They include getting active and tracking, seeking rewards from the device, analysing and rationalising activity records, and participating in physically active social events. Seven additional UPs reflect the intensity of participants' physical, emotional, and cognitive engagement with the device and their disengagement with it to accommodate other activities or their need to take a break. UPs are detailed in Web Appendix D.

Wearable Self-tracker Usage Patterns

While people assemble, negotiate and adapt practices in different ways, our idiographic analysis and cross-case comparison revealed that the bundling of core and additional UPs aligns with three distinct patterns that we labelled as light, fluctuant, and intensive usage patterns. Below we show how each of these usage patterns is linked to beneficial and harmful outcomes, drawing on extracts from our participants' stories, highlighting personal circumstances linked to physical activity identity that shape their use. Three vignettes, each representing a different WST usage pattern, are included in Web Appendix E to provide in-depth insights into the circumstances influencing WST use and their implications for consumers' vulnerability to potential harm.

Light usage pattern

Light usage features core self-tracking practices, and compared with other patterns, is characterised by lower engagement with the device and reduced responsiveness to its cues and notifications. The core practices combine with selective tracking, and disengaging and ignoring cues, indicating that the WST does not dictate this form of usage. Participants who exhibit this pattern tend to wear their device habitually but do not rely heavily on it to regulate their activity, comfortably resisting its influence. Stuart (33), for example, uses his Fitbit for monitoring rather than direction, noting: *'I don't live and die by [Fitbit]. If something is a bit off, I'm not too bothered.'* While they may track more intensively when preparing for personal challenges (e.g., a marathon), they consider device-set goals, summaries, and notifications to be less important. As Dennis (26) explained, *'[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 a report or something to get those steps in.'* Similarly, Aaron (20) said, *'I look at what [my Fitbit summaries are] and then [go] 'okay, I had a bit of an off week, we'll try and get it back next week', but not feel like I've got to do more next week.'*

When reflecting on their use of WSTs, participants described elements of self-identity related to physical activity, with athleticism emerging as a prominent theme among light users. These 'athletic' participants tend to be fitness-oriented and physically active, with substantial experience of being active or playing sports and high levels of confidence in their abilities and routines. In terms of WST use, they are more likely than others to have the expertise and ability to combine and contextualise data within personal (i.e., identity goals) and socio-cultural contexts of self-tracking (e.g., social norms). Some participants in this group

employed WSTs as part of an integrated tracking system that they had created, utilising multiple self-tracking tools to aid in achieving their goals. For instance, Oliver (35) explained, *'I've got the Fitbit and Strava App talking to each other. The GPS unit [on my mobile phone] records the [exercise] sessions, and then when I stop, it synchronises automatically in the background... and it all magically happens... [the different tracking tools] definitely complement each other.'* Commenting on the accuracy of tracking data, he notes that it *'depends on how you input your exercise and how the device records it,'* and that undesirable tracking data *'is not really something that particularly worries [me],'* suggesting awareness of the limitations of self-tracking technologies and an ability to contextualise the objective data.

Our participants described iterative processes of reflexivity on their WST use, which were often linked to their physical activity identities and identity work. Common forms of reflexivity associated with light usage include light-touch self-monitoring, internal benchmarking, and self-comparison, which highlight checking against personal performances, rather than device-set goals. Hazel (57) describes her use as a means to verify that she is *'still being fairly active... It's reassuring.'* For fitness-oriented individuals, such reflections help to affirm their athletic self-identity, though they do not consider themselves to be reliant on the Fitbit metrics. When there is a misalignment between their fitness routines, identity and the device's data, users sometimes increase their activity and their engagement with the device, but engagement tends to drop off once activity, identity, and the data from the WSTs are re-aligned.

This usage pattern is primarily associated with positive outcomes and participants acknowledged its benefits and implication for wellbeing, as Cassie (25) remarked, *'It's definitely motivated me [...] to go on runs'* and Aaron (20) said, *'I do enjoy looking at how many steps I've done and so... [and remembering] that I'm exercising and I'm active.'*

Fluctuant usage pattern

The fluctuant usage pattern encompasses core self-tracking practices alongside non-core ones such as social signalling and sharing, comparing steps, and striving for complete records.

This pattern is driven by device-based goals and rewards, and societal ideals of fitness.

However, it is characterised by inconsistent engagement with the device, with periods of high intensity and others of minimal engagement. Our findings show that fluctuant users prioritise physical activity data recording and are driven by it. Charlotte (26) illustrates this, stating, *'If I'm lifting weights sometimes [my WST] doesn't register [active minutes]. And so, I'll have to*

manually input what I've done... if I haven't done so, or I haven't got my watch on. I'm like, "Well, workout is pointless".'

Participants exhibiting this pattern of WST usage are typically those who have not been consistently engaged in sport or physical activity for extended periods. Rather, they have committed to being active more recently. They consider themselves to be making progress on a pathway towards a healthier lifestyle, and being 'newly fit' is an aspect of their evolving self-identity. Faith (28) explained this, saying, *'I think that Fitbit has helped me check [my physical activity] a lot more. I probably won't be walking as much [without it] because I wouldn't know how long to walk [for]... I think before I got the Fitbit, I didn't realise how long you have to walk to hit 10,000 steps. [Fitbit brings] a lot more realisation to how much exercise you need to do and I actually start[ed] meeting the targets.'*

These participants recounted growing self-assurance in incorporating physical activity into their everyday lives, with their WST usage integral to their routines. They make use of the device's key features in their daily practices, striving for complete records on their WST and seeking to hit targets. Faith shared how forgetting her Fitbit *'ruined [her] whole weekend'* as it disrupted her tracking streak. She later added, *'Today, my Fitbit is actually broken... 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?.'*

These participants reported that reflecting on their data – comparing metrics to personal benchmarks and ideals influenced by others, such as friends or fitness influencers – is a means of confirming their newly fit identities. At times when activity levels are inconsistent with desired physical activity identities, participants report spikes in WST usage and heavier reliance on device-set goals for motivation, indicating that identity work shapes patterns of usage. Barbra (45) highlights this connection, reporting that *'[Fitbit helps me know if] I've been maybe a bit more lazy than I should have been... [I] use it to motivate me a bit ... [if I] see that I'm near in steps [goal]... [usually] I'll probably try and do something to increase my steps like run up and down the stairs a few times, just to add some on.'* Misalignments between WST data and identity goals often lead to negative feelings such as discouragement, disappointment, and pressure. Whereas such feelings may discourage continued WST use, for our sample of longer-term Fitbit users, they are part of the fluctuating cycle of usage. They are not linked to serious harm, and participants largely view the device positively overall, with many attributing their fitness success to it. For instance, Betty (22) noted, *'I've recently lost quite a bit of weight... I didn't start losing weight until having had the Fitbit for a few months... It's helped me track better... I'm really proud of myself.'*

Several participants exhibiting this usage pattern also reported engaging in self-tracking practices more selectively during breaks in routine, such as holidays, despite their strong attachment to the device. For example, Faith (28) generally advocated WST use, noting that *'steps [are]... a good point to refer to... also just seeing the stars each day knowing that you hit all the targets'* but she explained that when on holiday, *'[I'm] less likely to be wearing my watch to track my physical activity... [it is] less pressure to kind of hit any kind of targets and just go about liv[ing] in some ways that are more relaxed.'* Such examples illustrate that users choose to engage less with the device at times when its metrics impose pressure that is incompatible with their circumstances. This seems to suggest that people resort to reducing engagement with the WST because they struggle to resist its influence when they rely on efforts to contextualise the device-generated data.

Intensive usage pattern

The intensive usage pattern was characterised by the highest engagement and intensity with the core WST usage practices. Ayesha's account reveals that this involves routinised checking of the device, *'[it's a habit] in the morning, [I] check my messages, and then after that I will go on the Fitbit App.'* The intensive usage pattern featured high levels of compliance with the device as people performed practices of being active and tracking, striving for full physical activity records, and seeking virtual rewards from the device. Those who demonstrated this type of use followed the default goals generated by the device, trusting its design over their own knowledge. Sarah (34) said, *'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.'* Making comparisons was another practice associated with this pattern and participants reported regularly scrutinising what others are achieving and comparing it to their own metrics. For instance, Karim (31) told us, *'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.'*

Intensive WST usage was most common amongst participants with limited experience of physical activity over their life course who were currently seeking to become fitter and more active. Given this aspiration for change, we attributed the label of 'aspirers' to the physical activity aspect of their identity. They often justify their WST usage practices on the basis that they support their desired identity transition. As they tend to lack knowledge and expertise relating to physical activity, they are more likely than other participants to respond to the

WST's cues and prompts, without question and regardless of circumstances. Ayesha (22) illustrates this uncritical response when she explains that in social settings she *'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.'*

The close monitoring of personal performance via device metrics and comparison with others' metrics is a prominent aspect of reflexivity associated with intensive use. While some participants reported positive outcomes, the majority – including those with favourable results – experienced negative impacts. These negative impacts may only be modest, as is the case with more fluctuant usage. However, potentially harmful responses – such as feelings of failure, depression, and anxiety – are more frequently associated with practices that are characteristic of intensive usage patterns, as the constant monitoring of data erodes individuals' belief in their ability to achieve a desired identity transformation. For example, Ayesha mentioned, *'I find [my WST] a bit pressurising sometimes because if you have an inactive day it will not be forgiving on the App, you will see the truth,'* and Sue (58) remarked, *'constantly not achieving that goal... I find it quite depressing. I just find it depressing to see [the number] written down.'* In a small number of cases, we found that these negative impacts escalate into intensive anxiety and exacerbate conditions such as compulsive or obsessive disorders, including eating disorders. Sarah, who recently recovered from an eating disorder, acknowledges the potential risks of WST use, stressing that she *'wouldn't recommend [WSTs] unless you're as secure in your recovery as I am.'* Yet this awareness does not appear to fully protect her from vulnerability, and she admits, *'worryingly, on reflection, I am pretty obsessed with [my Fitbit].'*

Discussion

Concern around consumer vulnerability in light of digital technologies (Dodsworth *et al.*, 2023) has centred on consumer purchase behaviours (Helberger *et al.*, 2022) and digital exclusion (Park and Humphry, 2019), with little attention devoted to the use of smart technologies that shape everyday actions. This study addresses calls for further research on digital vulnerability in the context of consumer self-tracking (Chen *et al.*, 2024). Our practice theory approach considers the socio-cultural and material conditions that shape WST usage practices (Reckwitz, 2002) and acknowledges individuals as carriers of collective practices (Shove and Pantzar, 2005), drawing upon their own experiences (Kelleher *et al.*, 2019; Schau

et al., 2009). By deploying this conception to explore WST practice performances and configurations in individuals' everyday lives (Blue *et al.*, 2016; Raelin, 2020), we address our three research questions and make several novel contributions to the understanding of vulnerability in WST use.

In keeping with critical scholarship, our research reasserts concerns that devices attached to the body, delivering continuous data, can promote a narrow, reductionist view of physical activity, exerting a universal pressure to conform to norms (Berry *et al.*, 2021; Toner, 2018). However, our findings provide a more differentiated view, identifying different usage practices and patterns – light, fluctuant, and intensive – each differently associated with potential harms. The types of harms reported are consistent with the emerging WST literature (Chen *et al.*, 2024) but differ from those experienced in other digital contexts, such as social media use (Powell and Pring, 2024) and AI psychotherapy (Tekin and Delehanty, 2025). Unlike these contexts, harms linked to WSTs stem from exposure to and interpretation of activity data, with perceptions of its accuracy and highly personalised nature shaping users' reflections on their fitness and physical activity. The intensity and prevalence of harms differ across usage patterns, ranging from mild discomfort to intensely experienced harms that have significant impacts on well-being (Polonsky *et al.*, 2024). Whereas prior studies warn that the controlling features of WSTs can lead to amotivation and device abandonment (Etkin, 2016), our findings caution that those who continue to use WSTs despite negative emotional and behavioural responses may end up on a more harmful trajectory.

In considering the interplay of circumstances that give rise to consumer vulnerability (Baker *et al.*, 2005), our research highlights the interactions between socio-cultural and technological context and individuals' physical activity identity, identity goals, and processes of reflexivity. Participants' identities – being athletic, newly fit, aspiring – are rooted in their past experiences of sport and physical activity, emphasising their commitment, knowledge, and ability to integrate physical activity into their lives, maintaining types and levels of physical activity aligned with their goals. The prominence of reflections on self-identity in this study reflects the fewer shared arrangements that guide *ordinary* users' practices in everyday settings. This contrasts with research on specialist self-tracking communities and professional settings (Luyen *et al.*, 2022; Spotswood *et al.*, 2020), where expert peers and institutions play a role in structuring practices. Aspects of identity that link to WST practices resonate with research that applies an individualistic lens to understand WST harms, which highlights how WST technologies influence or interact with users' psychological and behavioural processes, such as motives, abilities, and engagement (Chen *et al.*, 2024). However, our approach

reveals the contextualised and temporal nature of the influences at work. The multiple dimensions of self-identities, including individuals' perspectives on their past and present selves embedded within social contexts, and anticipated futures, afford a richer understanding than decontextualised, typically quantitative, measures of motives (e.g., I recognise the benefits of physical activities) and abilities (e.g., I feel able to complete physical activities that are personally challenging). Similarly, rather than simply reporting their engagement with self-tracking, our participants' accounts reveal differences in their efforts to integrate WST use and physical activity into the practice contexts of their everyday lives.

The notion of digital vulnerability also calls attention to power imbalances in the interplay of personal circumstances and aspects of the digital environment (Hill and Sharma, 2020; Helberger *et al.*, 2022). Whereas individualist perspectives tend to view WSTs as tools that people deploy to pursue their goals, the practice perspective acknowledges a more active and powerful role for non-human, material entities (Lupton, 2017). Our study shows how individuals negotiate the influence of WST technologies and differences in the authority they attribute to device outputs, revealing how their interpretations of WST data and cues are entwined with evolving physical activity identities. Light users, with established physical activity identities and prior experience in structured settings like gyms or sports clubs, suggested that they use WSTs to affirm their identity. Fluctuant users are still stabilising their identity but emphasised their growing confidence in balancing activity goals with life demands. Intensive users, in contrast, are in a more liminal, transitional phase. WSTs' algorithmic designs create and reinforce normative standards that may not suit users' day-to-day circumstances, yet intensive users perform core practices diligently. Rather than critically contextualising the device-generated data and cues, they regard them as direct indicators of their success or failure. This made the WST technologies central to their identity transformation, heightening their vulnerability to the negative emotional and psychological outcomes and to maladaptive usage practices.

This view of how harm emerges through reflexive processes linked to identity and identity goals, and feeds back into the reinforcement or adaptation of usage practices, resonates with Bottero's (2015) notion of identity work – manifested in repeated moments of reflection within highly personal practices – and Akaka and Schau's (2019) argument that identity work is integral to identity transition. The contrasts that we reveal support the idea that vulnerability arises when users lack the critical capacity to assess technologies, data, and contexts (Kaliyamurthy and Schau, 2025). This capacity is shaped by users' physical activity identities and associated knowledge, experience, and confidence. Our finding that users are

more susceptible to harm when they are pursuing transitions in their physical activity identities suggests that liminality contributes to heightened vulnerability as people engage in WSTs use. This is consistent with recent vulnerability research, which emphasises that liminality can render consumers more passive and powerless (Sudbury-Riley *et al.*, 2020; Basu *et al.*, 2023). This study highlights digital vulnerability as a particular risk for those engaging with data-driven services during such transitional phases in potentially restrictive contexts.

Conclusion

The societal trend towards self-tracking, coupled with the widespread use of WSTs, raises important questions about the effects of these devices. Our study contributes to the understanding of digital vulnerability in this context (Kaliyamurthy and Schau, 2025; Chen *et al.*, 2024) by adopting a practice theory approach (Lupton, 2018; Spotswood and Gurrieri, 2022) to build an understanding of the interplay between socio-cultural, material, and individual circumstances of use. It shows that, alongside socio-cultural conditions, self-identity is central to the reflexive processes that shape practice performances (Akaka and Schau, 2019) and patterns of WST use. It emphasises that users' physical activity identities and associated knowledge, experience and confidence are vital in enabling them to contextualise objective, authoritative WST data and mitigate potential harms. Our findings highlight the possibility of a harmful trajectory for less experienced users who continue to use WSTs despite negative emotional and behavioural responses. This suggests that the negative psychological impacts of WST use can be long-term, enduring after the device has been abandoned (Chen *et al.*, 2024; Wieczorek *et al.*, 2023), and encourages further critical reflection on the context and impacts of WST use.

This study stresses the need to protect users and uphold the public interest with implications for technology developers, marketers, and policymakers. Much of the current design, branding, and marketing of WSTs is targeted to the 'standard average consumer' (Hyde and Cartwright, 2023), yet our findings suggest that use is personal, nuanced, and diverse. As such, personalisation, applied in an ethical manner, is a crucial aspect of safe design. This could be achieved via adaptive algorithms, customisable interfaces, and ethical nudges (e.g., opt-in nudges for goal setting, customisable timing of alerts, algorithm updates that protect against maladaptive behaviours) that could take into consideration individual goals, experience levels, and usage contexts, while helping to prevent obsessive use.

Our study prompts WST brands to assume a duty of care and adhere to a more balanced practice of marketing, moving away from the dominant narrative emphasising the benefits and transformative capacity of the technology. Brands must recognise the possible harms and ensure that they promote safe design, transparency, and accountability as key principles for ethical WST technology development (Wieczorek *et al.*, 2023).

Policymakers, public health bodies, and commercial organisations that promote WST use should be sensitised to concerns that self-tracking often reinforces neoliberal ideals of personal responsibility and normative standards of health and appearance (Wieczorek *et al.*, 2023). There is a role for such authorities in encouraging users to evaluate the biases and limitations of WST technology (e.g., its ignorance of one's health conditions and personal circumstances) and to draw on their self-knowledge, including their embodied and subjective understanding of the self (Nafus and Neff, 2016). Education could also empower users to personalise the nature, frequency, and intensity of cues, and to develop reflective skills and practices that could enable them to contextualise their tracking data and avoid unintended impacts (Kumar and Suthar, 2024). This critical approach could help to avoid negative self-perceptions and emotions based only on metrics and promote greater autonomy. Support could be offered through community-based or expert-led initiatives that may also help users to develop a healthier relationship with self-tracking technologies.

While this research contributes novel insights to the understanding of vulnerability in self-tracking, it has limitations. Our focus on wearable fitness trackers emphasised usage of the device, its technologies, and data, and devoted less attention to other socio-material dimensions such as marketing strategies (e.g., insurance-linked fitness incentives) that might influence users' vulnerability. Other limitations arise from our exploratory design, interview method, and the sample size and composition. To build a more robust evidence base, future research could examine alternative self-tracking contexts and conditions of use, and employ other methods, including observational approaches. There is a need to extend the involvement of participants from diverse groups, particularly those disproportionately affected by WST biases, such as women and people from non-Western cultural backgrounds. Additionally, our findings on the risks for those prone to addictive or compulsive behaviours highlight the need for studies focused on these populations. Further work could examine conditions that amplify or mitigate harm, such as use under varying forms of normative influence or professional guidance. Finally, dominant socio-cultural narratives and WST marketing often frame health as an individual responsibility. To foster empowerment without reinforcing normative ideals, critical research is needed to explore equitable policy strategies that balance personal

responsibility with adequate social support and assistance from healthcare systems (Berry *et al.*, 2021).

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Figure 1: Digital vulnerability in contrasting patterns of WST usage (Source: Authors' own work).

