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Title	Appropriation of digital tracking tools in an online weight loss community: Individual and shared experiences
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Publication date	2021-06-28
Original Citation	Ryan, K., Linehan, C. and Dockray, S. (2021) 'Appropriation of digital tracking tools in an online weight loss community: Individual and shared experiences', DIS '21: Designing Interactive Systems Conference 2021, USA, 28 June-2 July, pp. 999-1014. doi: 10.1145/3461778.3462092
Type of publication	Conference item
Link to publisher's version	https://dis.acm.org/2021/ - 10.1145/3461778.3462092
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Download date	2026-10-30 15:00:48
Item downloaded from	https://hdl.handle.net/10468/11590



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Appropriation of Digital Tracking Tools in an Online Weight Loss Community: Individual and Shared Experiences

Appropriation of Digital Tracking tools in an online weight loss community

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ABSTRACT

Online health communities provide a space where people seek out and provide support for weight loss activities, including tracking. Our study examined the experiences of members of an online community (r/loseit on Reddit.com) who posted about using digital tracking tools for weight loss. A targeted search garnered 379 public posts, which were analyzed using Thematic Analysis. Four themes reflected members' individual and shared experiences: *Tracking as gaining insight, Tracking as a vehicle of control, Confronting challenges in sustaining tracking* and *Teaching and learning the skills of tracking*. We highlight complex socio-technical processes that members developed around tracking tools and discuss how knowledge of these appropriations can be applied to designing future user-centered tracking tools to support weight loss. We discuss how the social context of an online health community can shape both the usage of tracking tools and self-regulatory processes for health behaviour change.

CCS CONCEPTS

• **Human-centered computing** → Human computer interaction (HCI).

KEYWORDS

Personal Data/Tracking, Social Media/Online Communities, Weight loss, Qualitative Methods

ACM Reference Format:
Kathleen Ryan, Conor Linehan, and Samantha Dockray. 2021. Appropriation of Digital Tracking Tools in an Online Weight Loss Community: Individual and Shared Experiences: Appropriation of Digital Tracking tools in an online weight loss community. In *Designing Interactive Systems Conference 2021 (DIS '21), June 28–July 02, 2021, Virtual Event, USA.* ACM, New York, NY, USA, 16 pages. https://doi.org/10.1145/3461778.3462092

1 INTRODUCTION

Understanding how the design and usage of technology can support healthful behaviors is a research area of vital importance, with significant implications for population health in areas of pressing need, for example the prevalence of obesity. Obesity is a global public health issue [1] associated with numerous chronic diseases [2-4]. For many people, modest weight loss can reduce the risk of developing chronic disease [5]. As such, there have been calls for long term, scalable strategies to support those who wish to lose weight and improve their health [2]. Improving the design of digital tools to support healthy weight loss is a burgeoning area of research [5-8].

Self-tracking (henceforth referred to as 'tracking') is a process of conducting a 'status check' on one's current internal or behavioral state through recording, analyzing and reflecting to gain self-knowledge [9, 10]. The process of tracking one's diet and exercise (as key contributors to weight status), as well as weight, has been described as the cornerstone of weight loss, as it enhances the users' self-regulatory skills [8, 11-13]. Adding tracking tools to standard weight management interventions has resulted in greater weight loss than standard care alone [14], while more frequent tracking is associated with greater weight loss [8]. Tracking over the longer term enables people to continue to manage their weight [8, 11]. However, the majority of users stop using weight loss tracking tools when structured interventions cease [8, 15], so exploring the factors that influence sustained tracking is argued to be high on the HCI research agenda [16].

Technology use over the longer term evolves depending on users' changing needs. For example, the uses and roles of technologies alter, depending on where people are in their health journeys [17]. Though people have many diverse reasons for tracking [18], a negative discourse often surrounds the general use of tracking tools. Past research has highlighted that tracking tools do not consistently meet users' needs [19], has investigated why people stop tracking [20, 21], and has highlighted barriers users experience while tracking [22, 23]. Problematic use of tracking tools has also been discussed, for example in the context of enabling disordered eating [17, 24]; raising the question of whether sustained usage of tracking tools is a desirable aim at all, given the potential negative connotations of use. In the face of this, Eikey et al [17] argue against a binary view, suggesting that rather than seeing technology as either 'good' or 'bad', the focus should be on exploring how people use technology in ways that serve them.

Studying how people appropriate tools to support their personal, health-oriented goals can inform the design process and help develop more user-centered tools [25]. As such, in-depth naturalistic investigations of the experiences of people who freely choose to use



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DIS '21, June 28–July 02, 2021, Virtual Event, USA
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ACM ISBN 978-1-4503-8476-6/21/06.
https://doi.org/10.1145/3461778.3462092

tracking tools for specific health-related purposes (e.g. self-directed weight loss) should provide useful insights for the design and use of digital tracking tools [26]. Of particular interest to the HCI community is understanding how tracking tools are used in the pro-social context of online forums that promote healthy, sustainable weight loss (in contrast to the often-negative discourses around the usage of tracking tools), and how their use is shaped by interactions with other forum members. This can help us to understand the opportunities for design to support diverse user needs and create tools and services that promote - rather than hinder - health. Crucially, the processes through which these communities influence individual health behaviour change are not well understood, therefore understanding how people use tracking tools in social settings, is deserving of attention.

This study aimed to examine the experiences of members of an online community in using digital tracking tools for weight loss. Data were collected from the online weight loss community 'r/loseit,' whose aim is to support healthy and sustainable weight loss [27]. A targeted search gathered 379 public posts, which were analyzed using Thematic Analysis. These posts highlight a range of experiences specific to using tracking tools for weight loss, which clustered around four themes: 1. *Tracking as gaining insight*, 2. *Tracking as a vehicle of control*, 3. C*onfronting challenges in tracking* and 4. *Teaching and learning the skills of tracking*. These themes represent the complex socio-technical interplay between tracking tools, the user and the social context of an online weight loss community. They are discussed in relation to extant psychological theory underpinning the processes of tracking, encompassing self-regulation, self-efficacy, and personal agency. The contributions of this paper to HCI are threefold; we firstly present empirical evidence that demonstrates how weight loss tracking tools are appropriated by communities of users. Secondly, we discuss how these appropriations can inform the future designs of weight loss tracking tools, highlighting their usage as an adjunctive method for user-centered design. Finally, we highlight how both the usage of these tools and self-regulatory processes for health behaviour change can be scaffolded by online weight loss communities, adding to, and extending, the fields' understanding of how tracking tools are used in practice to support healthy weight loss.

1.1 RELATED WORK

We first discuss self-tracking as a process for health behaviour change. We then discuss the often-negative discourse surrounding users' experiences of tracking tools. Subsequently, we present a rationale for studying users' appropriations of tracking tools, scaffolded by an online weight loss community to guide future design work.

1.1.1 Theory underpinning self-tracking. Many terms are used in relation to tracking, including 'reflexive self-monitoring,' 'self-tracking,' 'quantified self,' 'life-logging', 'personal analytics' and 'personal informatics' [10]. The term 'personal informatics' dominates the HCI literature, and is underpinned by the Stage-based model of personal informatics systems [9], which proposes that people cycle through stages of preparation for tracking, data collection, integration, reflection and action. According to this model, the end goal of tracking is self-reflection and self-knowledge, which supports behavior change [9]. However, this model is founded on the premise that knowledge translates with ease into behavior change, which doesn't acknowledge the knowledge-behavior gap; i.e., that people often know what action they should take to improve their health, but for a number of reasons may not act [28].

Self-regulation theory can help explain how the knowledge derived from tracking can be channeled into sustainable health behavior change. Self-regulation comprises three steps: self-monitoring and recording (of one's own behavior, its determinants and its effects), self-evaluation (or judgement of one's behavior to a personal/external standard) and self-reinforcement (how one's thoughts/ feelings about oneself/one's performance influences behaviors) [29, 30]. While the first two steps map to the process of tracking, the third step is not accounted for in the stage-based model of personal informatics. This is of interest, as highly-developed self-regulatory skills are required to successfully change and maintain behavioral habits [31]. Self-regulatory skills are also linked to an individual's perception of their own personal agency to enact behavior change [32, 33] and their self-efficacy- their beliefs about their ability to carry out behaviors required to attain their desired outcome [29]. Further examination of users' experiences of tracking can help us understand the relationship between the knowledge (gained from tracking tools) and psychological processes of self-regulation. Moreover, exploring how social factors, e.g. meso-level aspects (like communities), influence individuals as they endeavor to enact behavior change can provide fresh insights for the design of supportive health promoting tools.

1.1.2 User Experiences of Tracking. Identifying and understanding the problems that people experience in the process of tracking is critical for designing and developing effective personal informatics [9]. A negative discourse has characterized the use of tracking tools in the research literature. Firstly, tracking tools are often reported to have a short-lived impact on behaviour. For example, one study found tracking tools to be more useful for novices in changing their behavior, and only helpful in the initial stages of weight loss for the specific purpose of identifying and learning about habitual behaviors [34-36]. Further, usability issues can taint the users' perceptions and experiences of digital tools, which can be a barrier to their ongoing usage [37]. Indeed, some users stop tracking as they find it does not fit into their lives, and is frustrating, burdensome and invasive [20]. Users suggest that the effort and attention invested in managing their weight should be focused around their diet, and not on the process of using tracking tools [38]. The high user input (e.g. number of daily entries) required for tracking can sap users' motivation to lose weight over time [36]. However, perhaps the way we are studying the phenomenon of tracking, by focusing on broad problems with the process of tracking, or concentrating on prescriptive user studies of specific tools, has prevented us from seeing the value of these tools and how they can be improved.

To improve future designs, perhaps a more bottom-up approach is warranted, exploring self-directed approaches to tracking for a specific goal. For instance, Epstein et al [39] went beyond looking at technological methods for tracking, exploring why and how women track their menstrual cycles. They drew on a range of data sources,

including reviews of menstrual tracking apps, a survey and follow-up interviews with survey respondents. This research broadened our understanding of menstrual tracking to include users' goals and motivations, guided by users themselves. Given the complexities of the weight loss process [40], investigations of peoples' experiences of using tracking tools in a self-directed way could enrich our understanding. One such approach to exploring self-directed usage of technologies is through appropriation.

1.1.3 Studying appropriation as a foundation for user-centered design. Appropriation typically describes situations where users create unforeseen uses of technologies and practices around their use, highlighting new requirements for future tools [41]. Similar to Overdijk and Diggelen [42], we consider technology appropriation to imply a broader process of social construction, where the behaviours and thoughts of the user are shaped by the use of technology, while the meaning and effects of the technology are shaped through the users' actions. Considering this conceptualization, if we examine how existing weight loss tracking tools are appropriated in the context of an online forum, we can obtain an insight into how psychological processes are impacted by technology and also the social context of their use. This process also surfaces new insights for currently unsupported, but desirable future functions. Studying appropriation has previously been proposed as an additional step in user-centered design [25]. It may help to identify specific features that are problematic for users, and it can highlight how meaning is made of tracking data "in-context," which may be very different from scientific conceptions of designers.

In the context of healthy eating, Chung et al. [43] explored how users appropriated Instagram as a social, food-based journal, to enable personal healthy food photo collections, support reflection on old posts and to find community support for healthy eating. We suggest that analyzing how communities of users appropriate existing healthcare tools can provide valuable insights for designers [25, 44, 45].

1.1.4 Online Community Forums and Weight Loss. The role of social others in health behaviour change is well established, yet the models the HCI community use to understand and design for self-tracking continue to primarily focus on the individual [43]. These models fail to adequately recognize the social influences on behavior change. For example, they do not encapsulate the interactions that occur between people in online spaces, and how these interactions may influence the experience and use of tracking tools. Much research has sought to understand users' behaviours while engaging in weight loss efforts, and using social media is a promising approach for this as it enables experiences to be represented in the commenter's own words, unimpeded by researcher interference [46].

Many studies exploring r/loseit to date have focused on the topics discussed or language used. One study examined written communication challenges in Reddit communities, including r/loseit [47]. Other studies have focused on examining associations between self-reported weight loss and the language used by posters. For example, Pappa et al [48] found that markers of social engagement within the community, e.g. high levels of online activity and the number of upvotes received per post, were associated with weight change, as was being female, BMI and specific topics of discussion. Another study examined language use in two online weight loss communities on Reddit, r/loseit and r/proED. The authors found that supportive language can reinforce norms and behaviour change, for instance, highlighting that r/loseit members discussed weight loss techniques/ strategies and celebrated weight loss achievements [49].

The studies discussed above have advanced our knowledge of the types of constructs that are discussed on online health communities and identified associations with weight loss. The potential of studying online communities to unpack the relationship between health outcomes and user experience has previously been highlighted. For example Li et al. [50], outlined the types of social and informational support prevalent within an online weight loss community, including Personal Experiences, Dieting strategies, Consumption choices, Health information and Exercise. While understanding participation in online communities has led to important insights, the appropriation and use of specific health technologies within these communities has been less of a focus within the empirical literature. One recent study has characterised patterns of engagement with MyFitnessPal in the context of three online eating disorder forums, describing how users with high levels of eating disorder symptomatology engage with, and are affected by, tracking tools [24]. Considering the social context of tracking, focusing on a weight loss community which promotes sustainable, healthy weight loss, such as r/loseit may foster new design insights.

2 STUDY DESIGN

2.1 Research Setting

Reddit is a social news website and online forum, containing a number of health-related discussion sub-forums. Its content is organized by common areas of interest called subreddits, where users may subscribe, share content and vote on submitted content [51]. In the current study we examined the subreddit 'r/loseit,' which has 1.9 million members and is described as "a place for people of all sizes to discuss healthy and sustainable methods of weight loss" [27]. Members post content to 'threads' on various topics related to obesity and weight loss, including personal experiences, recommendations and feedback about their experiences of diets or exercises [52]. Messages are asynchronous, text-based and anonymous, which may be helpful in discussing emotionally-charged or sensitive issues [53]. r/loseit members make up a supportive, prosocial community of people seeking to lose weight [49].

2.2 Data Gathering Procedure

A search strategy was developed, which used the search function in r/loseit to gather public posts relevant to tracking. Common weight loss tracking applications e.g. 'MyFitnessPal,' enable the user to log their dietary intake and exercise and receive feedback about their progress toward their weight loss goals [54]. Our search terms were: 'MFP OR myfitnesspal OR my fitness pal OR apps OR applications OR technology OR tech OR tracking'. We selected to only specifically name MyFitnessPal as a tracking tool, based on it being used in a weight loss intervention on a wider project we were working on. We also based this decision on its popularity as a weight loss tracking tool, and the wide range of functions it has in the

context of weight loss (e.g. incorporating weight, food and exercise tracking). To carry out the search, a JavaScript script was executed, which mimics a user browsing r/loseit. Posts were sorted by 'new' and processed to identify whether they matched any of the search terms. The script then sent an individual request to Reddit for each post that matched any of the search terms to collect relevant replies; only the replies relevant to the search terms were included. Posts and responses were exported to an Excel spreadsheet for coding.

2.3 Data

Initially 204 posts met the search criteria relating to r/loseit members' experiences of using tracking tools to support their weight loss. 16 posts were excluded as they were automated posts or were deemed irrelevant (e.g. used the phrase "back on track" but with no reference to tracking tools), leaving 190 original posts. 189 replies to these posts which met the search criteria were also included; replies to our 190 original posts that did not meet search criteria were excluded. This resulted in a total of 379 posts included in the final analysis. Posts typically consisted of up to one page of 12-point Cambria text, while responses were typically a paragraph of text in length. Ultimately, included posts and responses amounted to 126,544 words.

2.4 Methodology

Thematic analysis (TA) was used as an analytical approach in this study, a method for systematically identifying, organizing and obtaining insight into patterns of meaning across a data set [55]. TA was selected as it provided scope to capture a wide spectrum of experiences from community members across the r/loseit forum. We took an experiential orientation to the analysis, focusing on understanding what participants think, do and feel in relation to tracking. Our research was based on the belief that posts reflected members perspectival reality [56]. We interpreted the meaning of members' experiences by stepping back from the accounts and reflecting upon it and its broader socio-cultural meanings [57]. We expected that posts would reflect honest accounts of how members used tracking tools to support their weight loss, due to the organic nature of data collection [57], and that the resulting data would be largely prosocial in nature, based on previous research [52].

2.5 Data Analysis

Theoretical thematic analysis was chosen as the method of analysis, as we analyzed the data with a specific question in mind, that is 'what are r/loseit members' experiences of using tracking tools to support weight loss?' [58]. We followed the six phases delineated by Braun and Clarke [59] in the analysis. We started by familiarizing ourselves with the data through reading. In the next phase (initial coding), we applied a process of open coding, where we coded only the aspects of the data which we perceived to be directly related to our research question. We developed and modified the codes as we worked [58]. As Boyatzis [60] considered a "good code" (p. 1) to be one that captures the qualitative richness of the phenomenon. The first author was the primary coder, but to aid in the initial coding process, the second author coded a random sample of 13% of posts. These sets of codes were compared to check the completeness of the coding process. In phase 3, the codes were sorted into potential themes using 'Miro' virtual whiteboard software [59]. Memo-writing and discussion among authors guided the analytic process until we were satisfied with candidate themes, ensuring that each prospective theme: a) had a central organizing concept, b) was distinctive and made sense independently, but also related to the other themes, and c) related to the research question [59]. Phase 4 included reviewing the themes by examining the codes/quotes relating to each theme to check each one was coherent [58]. After reviewing the nature and structure of themes visually, we were able to define the themes and write up the analysis (Phases 5 and 6).

2.6 Ethics:

The process of analyzing Reddit posts was conducted in a manner consistent with ethical guidelines [61, 62]. Ethical approval was granted in July, 2018 from the University Ethics Board. Posts were made in a publicly accessible forum, thus were considered by us as public speech. However, to ensure compliance with site rules, written permission was obtained from r/loseit moderators to pursue the research. Quotes in this article have been altered in order to protect the anonymity of individual r/loseit members.

3 RESULTS

This study aimed to examine r/loseit members' experiences of using tracking tools for weight loss. Members' experiences were reflected in four themes: 1. *Tracking as Gaining Insight*, 2. *Tracking as a Vehicle of Control*, 3. *Confronting Challenges in Sustaining Tracking* and 4. *Teaching and Learning the skills of Tracking*. Table 1 presents an overview of the four themes, their definitions and sample quotes from r/loseit members.

3.1 Tracking as gaining insight

Tracking led to reflection and awareness in weight loss among members of this online community. Members shared a variety of different approaches to tracking to capture a range of contextual information relevant to their weight loss process.

3.1.1 Tracking as an 'informed' weight-loss approach. Gaining an insight into the (previously unknown) nature of one's behaviors was foundational to many members' personal weight loss journey. For some, the process of gaining awareness through tracking drew attention to, and slowed down, the process of eating. It instigated a process of reflection; on the food they were consuming, and to calories consumed in relation to their own bodies' daily requirements. These processes often led to members reducing their caloric intake.

> "Before, I just ate whatever was in front of me and I didn't really care, but after. . .I began to think about things I eat." (P172)

Within the r/loseit forum, tracking was positioned as an 'informed' weight loss approach. Using trackers to count calories was perceived to be a way to provide instant and objective feedback of one's current status towards their weight loss goals. This 'informed approach' was perceived by forum members to be in contrast to other commercial approaches which were thought to obscure this insight through the use of rule-based diets (e.g. when X foods is off-limits) or points systems. For example, the WeightWatchers

Table 1: Summary table depicting r/loseit members' experiences of using weight loss tracking tools

Theme	Definition of theme	Sample quotes
Tracking as gaining insight	Tracking enabled individuals to bring more awareness to their eating and led to moments of reflection in weight loss through the process of 'logging honestly'	"*Before, I just ate whatever was in front of me and I didn't really care, but after. . .I began to think about things I eat.*" (P172) *"Using My fitness pal has been instrumental in my weight loss because it lets me see what the damage is when I fail. And I found out that however much I indulge myself, it never goes beyond 500 kcals. . .I can make it up within the next few days if I try hard enough."* (P96,R5) "*I started tracking with MyFitnessPal about a month ago and I have some very high calorie days, but many more days at my target intake. As long as you log everything, you can go back and look at your high calorie days, see where those calories came from, then make a plan for tomorrow. Sometimes I need to wait a few days to autopsy my bad days. . .that's why the tracking apps are so nice. You can go look when you are ready rather than when you are stressed and know the negativity will just make things tougher."* (P203,R10)
Tracking as a vehicle of control	r/loseit members experienced tracking as a means of gaining control over their weight loss process and, by extension – over their life. They outlined the techniques they used to stay in control while tracking.	"*4 months ago I was in a terrible position, depressed and extremely anxious. It felt as if life was really not going my way at all. . . I realized something, that I need to take control of my life and get my life back...I started to focus on my calorie intake and how much I would burn during workouts. It became an obsession not only to be healthier, but to be better...I felt like I was becoming someone new, an improved version of myself."* (P185) *"I decided this time I would start slow and would add one thing more [another parameter to track] when I felt I was ready. I want to make sure this sticks, and I want to genuinely do things differently."* (P166) *"The process of trading off is getting easier, and it's more of a habit to think 'if I eat this now, it will prevent me from eating something else later. Which would I prefer?"' (P155, R5)*
Confronting challenges in sustaining tracking	Members shared experiences of struggling with using tracking tools and integrating the process of tracking into their daily lives. They also navigated negative emotions in relation to the tracking tool and questioned the accuracy of tracking tools' estimates.	*"I am lucky in that I have a free cafeteria at my work. It's great, but I really struggle with knowing the amount of calories to log. I often try and just find similar items in MFP, but. . .I don't know exact serving sizes and ingredients to know an accurate calorie count."* (P179). *"I literally do so well during the day. It's when it gets around evening time that i end up messing up. . .I overeat. . .i stop tracking my calories. It's between 7-10 pm where i get these urges and i always feel guilty later on."* (P136) "*What I don't get is how exercise comes into play. . .if I eat 1650 and burn 100 calories running, that shows up as a surplus, like I should eat another 100 calories to make up for running. . . Doesn't it defeat the purpose to eat back the 100 that I burned on purpose? I'm confused"* (P133).
Teaching and learning the skills of tracking	r/loseit members coached other members based on their experiences of using tracking tools, providing practical advice and recommending functions and features of tracking tools for weight loss that they perceived to be useful.	*"Maybe just don't try to go full-on right off the bat. Maybe just start with logging via MFP, start off just trying to stay at or just below your [total daily calorie expenditure], then aim for the 1lb a week. If you have a physical job AND a toddler, you probably get plenty of exercise to help the weight loss along for now. And don't forget there's always this forum to turn to for support."* (P93, R2). *"I'm going to do these [calculations] at [your] goal weight because you're so nearly there. . ..TDEE using Mifflin-St Jeor BMR formula = 1587 calories (Lightly Active). . .So you can't lose 1 pound a week, but you can lose 1 every 10 days or so. And a little faster because of the 2 days a week workout. You'll maintain [your weight] at 1587 calories (give or take 10% for individual differences). Well done on your success so far!"* (P142, R2). *"use a method to help minimise the impact of weight fluctuations. . .using a tool (libra [on android], happyscale [on ios], trendweight [on web]) to show you the trend will help take the focus off these ups and downs so you can see you're still headed in the right direction."* (P131, R2)

Smartpoint system ®assigns a number to each food or drink item – its point value, calculated based on calories and sugar, saturated fat and protein. Each person is allocated a daily points budget in line with their goal [63]. Although this approach sets out to simplify the weight loss process, r/loseit users' dissatisfaction with this approach suggests that having a clear insight into the calories and constituents of their diet, accessible by tracking tools was highly valued.

> "I'm thinking of switching to tracking [from Weightwatchers]. I feel like I don't have all the data. Weeks where I don't lose [weight], I'm not really sure why. And it can be hard to adapt things without all the data." (P63)

3.1.2 'Logging honestly' permits user reflection. A forum norm was that useful insight into the weight loss process was contingent on honest and accurate tracking. Across the forum, "logging honestly" represented being honest with oneself when a slip-up occurred, e.g. when people ate more than their daily calorie intake goal. While some members chose not to track the food they consumed during slip-ups, the overwhelming message from the r/loseit community was that through tracking all the food consumed during slip-ups, these typically 'off the record' moments in weight loss could be brought back into awareness and accounted for. Through tracking honestly, a slip-up could be quantified in terms of calories consumed and could be compensated for to stay on track with goals. Through tracking, slip-ups were therefore reframed by r/loseit members into a manageable hurdle to overcome:

> "Using My fitness pal has been instrumental in my weight loss because it lets me see what the damage is when I fail. And I found out that however much I indulge myself, it never goes beyond 500 kcals. . .I can make it up within the next few days if I try hard enough." (P96,R5)

Precise measurement and weighing of food was considered to be a key element of tracking honestly. Members went to great lengths to ensure they were logging their foods accurately. Weighing scales were widely used in conjunction with tracking apps, as members weighed ingredients using the scales one by one and inputted each ingredient separately to the tracking apps during meal preparation. This process was considered by the forum members to be a skill that was painstaking and time-consuming to learn but important in ensuring accurate and honest logging.

> "I weigh everything I eat on a food scale and log in the LoseIt app." (P157)

Being 'honest' in tracking was challenging, as there were times when it was charged with negative emotions, as people were not happy with what was in their log. However, members also shared the benefits of tracking honestly, e.g. an accurate account of their actions that could be reviewed at a time when they felt prepared to consider patterns on their weight loss journey, including factors which preceded the slip-up and plan how to avoid this in future.

> "I started tracking with MyFitnessPal about a month ago and I have some very high calorie days, but many more days at my target intake. As long as you log everything, you can go back and look at your high calorie days, see where those calories came from, then make a plan for tomorrow. Sometimes I need to wait a few days to autopsy my bad days. . .that's why the tracking apps are so nice. You can go look when you are ready rather than when you are stressed and know the negativity will just make things tougher." (P203,R10)

Some members seemed to particularly enjoy the minutiae of the tracking process, sharing how they used a suite of apps and wearable devices for tracking different contextual factors beyond weight that were perceived to be relevant for their own personal weight loss journey. This information was organized and collated into spreadsheets, suggesting that while some members began by tracking their weight only, this focus was soon widened as they obtained more insights about their bodies. This underlines that tracking weight can at times lead to focusing on other health-related goals, alongside weight loss:

> "I also had a Fitbit with a heartrate monitor that was giving me estimates of calories burned every day. . .I had this crazy detailed Excel sheet that had a row for each day and on each day I had: calories eaten (from My Fitness Pal, which I was using to log all my food), calories burned, steps, and my morning weight. yep I love data." (P167, R1)

3.2 Tracking as a vehicle of control

Community members experienced tracking as a means of gaining control over their weight loss process and their life. They outlined tracking techniques used to stay in control.

3.2.1 Gaining control through tracking. Many posts were declarative in nature – with members sharing their story and experiences in an empowering way for themselves and others within r/loseit. For instance, many members shared stories about how tracking was a way of gaining control over their diet, as well as their health and their lives. Many members spoke of wanting to regain control over their lives, which they perceived they had lost through becoming overweight and other events, perceived as being related to weight gain, e.g. having babies, losing a loved one, facing a change of life circumstances, or receiving negative health results from the doctor. Tracking was more than a way to quantify their progress towards their goal weight; the process made people feel better about, and more in control of their lives:

> "4 months ago I was in a terrible position, depressed and extremely anxious. It felt as if life was really not going my way at all. . . I realized something, that I need to take control of my life and get my life back...I started to focus on my calorie intake and how much I would burn during workouts. It became an obsession not only to be healthier, but to be better...I felt like I was becoming someone new, an improved version of myself." (P185)

Tracking was framed as an advanced self-care skill for many members, who shared how they felt it supported them in gaining control. Posts often involved peoples' stories of their weight loss journeys over time, sharing details of different dieting attempts

and life events, which either supported or got in the way of their weight-related goals. Screenshots of graphs from tracking tools were at times presented in posts as external evidence of self-care to illustrate these stories. Periods of tracking reflected times when they looked after their health. As such, the process of tracking was construed as a record of self-care, a way to demonstrate gaining control in their personal weight narrative:

> "I've always had some sort of log of weight/workouts/diet, at least when I was caring about myself." (P16)

Some members spoke of their attempts to use tracking tools to lose weight in a slow and controlled manner. This involved members sharing how they gave themselves ample time to devote to tracking properly, including preparing and measuring food. Members used the tools at a pace that suited them, self-managing their weight loss. As such, they were not necessarily perfectly adherent to the 'rules' of using the tracker. For example, members spoke of focusing on one aspect to track at a time, e.g. starting by tracking their food before trying to meet daily calorie goals set by the tracker or tracking exercise:

> "I decided this time I would start slow and would add one thing more when I felt I was ready. I want to make sure this sticks, and I want to genuinely do things differently." (P166)

3.2.2 Tracking techniques used to stay in control. Forum members used trackers to measure and control the number of calories consumed, balanced with calories out as a weight loss method. Across the forum, the daily calorie intake limit set by tracking apps was conceptualized as a 'calorie budget,' to which people adhered to meet their weight loss goals. Many members enjoyed the flexibility of this method in maintaining control over their diet, as they could enjoy whatever food they wanted as long as they were consistently within their daily calorie budget. Members often 'saved up' calories for special meals on a given day or week, while still adhering to their weekly calorie intake goal. There was a sense of satisfaction associated with cultivating the ability to exercise this level of control over their dietary intake.

On the other hand, some members posted that they reached a point in the early evening when they were still hungry, and their calorie budget was depleted (e.g. having eaten a calorically dense meal earlier on in the day). This subsequently became a point of learning to support users to spread out their calories over the course of the day to ensure this didn't happen again. It thus enabled a process of prioritization and decision-making, fostering, for some, a cost-benefit analysis and mindful dietary consumption:

> "The process of trading off is getting easier, and it's more of a habit to think 'if I eat this now, it will prevent me from eating something else later. Which would I prefer?"' (P155, R5)

To aid with their calorie budgeting, some members shared that they used tracking apps to log their food prior to eating (instead of after). Members spent time deciding, preparing and logging food in advance to ensure it was within their calorie-budget. Trackers were thus used as an external cognitive aid for dietary decision-making, planning and self-regulation. For example, members logged their planned meals in the morning in order to plan and ration out their daily calories:

> "I have a lot of the same struggles around losing my discipline in those social situations. What I'm trying to do now is log my day ahead of time, then if I get two drinks rather than one, I have to quickly confront the fact that it will either put me over or mean I can't have some of the food I had planned for later." (P203, R3)

Some features that highlighted process made members feel like they mastered the process of tracking. Initial weight loss following tracking led members to feel optimistic, encouraged and empowered and they shared these experiences with the online community. Members enjoyed features of tracking apps, which told them where they were on their weight loss journey, e.g. congratulatory messages on their progress. Many felt hopeful that they could reach their weight loss goals by remaining accountable to the tracker. Members shared that they viewed their trackers' data as a means of reassurance that weight loss would eventually occur if they kept going with the process of tracking:

> "The expression I like is 'rationally satisfied'. I look at my [tracking] data, look at what I'm doing, and look ahead to my next few days. If that looks right, then I'm good." (P67, R1)

Logging food became as ritualistic as eating a meal for some users and came to be seen as a lifelong process for weight management. Many logged every day even when they had attained their weight loss goals- as they viewed tracking as an essential habit to maintain control over their weight. A feature of tracking tools that supported users to establish logging as a daily habit was the 'streak' feature in the MyFitnessPal mobile application, which demonstrated the users' continuous number of days of tracking:

> "I log everything and weigh everything I consume meticulously, into MFP. I have a current 95 day login streak going that I hope to turn into 365+ someday." (P78)

In time, maintaining their streak or the habit of tracking was as much the focal point for members as was maintaining their weight loss.

3.3 Confronting challenges in sustaining tracking

Members also experienced challenges with tracking tools, struggling with the process of integrating tracking into their daily lives, experiencing negative emotions in relation to the tracking tool and questioning the accuracy of tracking tools' estimates.

3.3.1 Struggling to integrate the habit of tracking. Tracking was at times construed as a rigid habit suited to a fixed, regular routine to facilitate logging. This was seen to be at odds with daily life. The process of tracking impacted members' dietary choices, with some skipping meals, eating only one meal a day or consuming the same thing most days to make tracking easier:

> "I eat about 1200-1400 cal a day, tend to eat the same things every day." (P190)

Even those who initially enjoyed tracking, found that over time logging foods became tedious, inconvenient and boring. Logging homemade meals was a difficulty for many members who struggled with inputting these meals into their tracking apps. Some members reported becoming so fixated on the number of calories they tracked, they failed to consider their nutrition, which posed a threat to them having a healthy diet over time. Others ate mostly pre-packaged foods to know precisely the amount of calories they were consuming to track with more certainty.

Some members met with difficulties in trying to integrate the process of tracking into their everyday lives. This was particularly evident when they ate out in restaurants, as they were not in control of food preparation, and were unclear on the exact constituents of their meals. Eating out was thus seen as a barrier to tracking properly and thus a threat to their weight loss progress:

> "I am lucky in that I have a free cafeteria at my work. It's great, but I really struggle with knowing the amount of calories to log. I often try and just find similar items in MFP, but. . .I don't know exact serving sizes and ingredients to know an accurate calorie count." (P179)

Some people reported only choosing restaurants that displayed the nutritional content of meals to facilitate tracking. Others spoke of avoiding social situations which involved eating and drinking which might compromise their tracking. This highlights how tracking can influence an individual's choices about their diet and environment.

Many members also posted about restarting the process of tracking 'again' having fallen out of the habit. For some, this restarting process occurred over a number of years of losing and gaining weight. The sustained effort and challenge of weight management was marked by re-downloading tracking apps or trying new ones to support these renewed efforts:

> "I started my weightloss journey 3 years ago at 195lbs and lost 35lbs in just over three months by calorie counting and exercise. I stopped calorie counting around summer 2016 and subsequently gained 20lbs. . . It's annoying I seem to be stuck in a cycle of restricting, losing, then gaining." (P149)

3.3.2 Negative emotions associated with tracking. Many posts related to negative emotions arising from using tracking tools. For some, tracking tools were a physical manifestation of their lack of trust in their ability to make decisions about their diet:

> "I hate the feeling that I have to measure and count EVERY thing I eat or drink. The inability to trust oneself is the crappiest feeling on earth." (P1)

Members expressed fear that tracking would be too complicated and felt overwhelmed by the tasks involved in weight loss tracking. Sometimes the calorie goals set by trackers were perceived to be too restrictive, suggesting a disconnect between the ideal weight loss goal and an adequate timeframe for reasonably achieving this using tracking tools:

> "I'm trying myfitnesspal to help but I'm just so discouraged. To lose 1lb a week, it suggests a calorie goal of 1340 a day. This just seems so low to me, I'm hungry all the time. I also have trouble logging my meals. . .Is it normal to measure out or weigh all your ingredient precisely? Is this what everyone else is doing when they make a meal? It seems so time consuming. I'm afraid I won't be able to get so 'intense' about it without going overboard . . .How do you lose weight but maintain a healthy attitude towards food?" (P18)

Many posts related to food binges where members went over their calorie limits set by trackers:

> "I literally do so well during the day. It's when it gets around evening time that i end up messing up. . .I overeat. . .i stop tracking my calories. It's between 7-10 pm where i get these urges and i always feel guilty later on." (P136)

Members also reported feeling hopeless and frustrated trying to maintain good habits with tracking when the weight loss results were not occurring as they expected, or as predicted by the tracking tool:

> "It's frustrating trying so hard everyday and not making much [weight loss] progress." (P177)

This lack of achieving weight loss results - in spite of adhering to the 'rules' of tracking tools fed into demotivation for continuing to track, highlighting the link between weight loss outcomes, feedback from the tracker and sustaining motivation:

> "I'm just feeling demotivated, disappointed in myself and like, sad. . . I want to get back on the wagon and keep logging, keep gyming, and fighting. . . Im trying to get back on but even tracking food has gotten harder since then." (P21)

3.3.3 Questioning the estimates made by tracking tools. There was a perception among forum members that some weight loss tracking tools were inaccurate, in particular, estimates of calories burned from wearable fitness trackers and body fat percentages from smart body weight scales. User-entered meal calorie content in tracking apps databases were also considered to be inaccurate. The most commonly held concern related to fitness trackers, and it was widely contended that these tools overestimated 'burned calories.' This could lead a user to eating more calories than they expended in a day which could threaten their weight loss progress. At times members 'double–logged' using different tracking tools to check for such discrepancies; while others developed complex rules of thumb to account for these inaccuracies to keep their weight loss as predicted:

> "If I only count two thirds of the calories burnt it [Garmin] calculates, I lose [weight] as expected. I do this by adding one third of the calculated calories burnt as empty calories back in MFP." (P192,R1)

In general, r/loseit members wanted recognition for calories expended through exercise. However, tracking apps that automatically added calories burned through exercise to their daily calorie intake led to confusion around whether they should eat these 'extra' calories:

> "What I don't get is how exercise comes into play. . .if I eat 1650 and burn 100 calories running, that shows

> up as a surplus, like I should eat another 100 calories to make up for running. . . Doesn't it defeat the purpose to eat back the 100 that I burned on purpose? I'm confused." (P133)

Another problem occurred when members lost weight and logged their new body weight to tracking apps. Some apps did not automatically recalculate their new calorie goal, based on their 'new' body weight. This led to a mistrust in the credibility of the trackers and their ability to set appropriate calorie goals.

3.4 Teaching and learning the skills of tracking

r/loseit was where the skills of tracking could be crowdsourced. Members coached others based on their experiences of using tracking tools, providing practical advice and recommending functions and features of tracking tools for weight loss that they perceived to be excellent.

3.4.1 Seeking and providing practical advice in tracking. Many members sought practical advice in relation to their experiences of tracking. Experienced members (identifiable by their reported weight loss in their post 'signatures') assumed the role of 'tracking coaches' in providing detailed answers to a range of queries from the community. These members sometimes went as far as calculating the daily calorie requirements for the inquiring member, using and demonstrating different equations, providing links to external and internal r/loseit resources along with problem solving and practical advice for how to track:

> "Maybe just don't try to go full-on right off the bat. Maybe just start with logging via MFP, start off just trying to stay at or just below your [total daily calorie expenditure], then aim for the 1lb a week. If you have a physical job AND a toddler, you probably get plenty of exercise to help the weight loss along for now. And don't forget there's always this forum to turn to for support." (P93, R2)

For those who achieved their weight loss goals, providing support in this manner was a way to give back to the community which supported them to lose weight, and also enabled them to stay focused on sustaining their tracking habits and their weight.

Receiving feedback from trackers highlighting a 'weight plateau'- where their weight stopped dropping was a very common concern for members. They often reached out to the community and outlined their tracking habits in detail, along with their weight loss results to date to express frustration and receive feedback from the community, verifying that their tracking methods were correct:

> "Tracking has been going great. I go to [fitness] classes 4x a week, and have been at a caloric deficit every day for the past two months. However, this past week. . . I gained 3 pounds back (after losing about 15 overall since I started) ...I just don't know why I started gaining." (P43).

Often, 'tracking coaches' responded by advising the original poster to update their body weight in MyFitnessPal, as this would update their target daily calorie intake number will drop by a percentage, based on their new body weight (as was the case for them, in their own experience). In response, the original poster replied saying that having updated their bodyweight, their daily calorie goal reduced by 10% and thus they overcame an issue in tracking that was impeding their personal weight loss progress.

Other 'tracking coaches' took a more hands on approach when a community member was struggling. Some would take the original posters' statistics (height, weight, age, gender, goal weight) and calculate their 'Total Daily Energy Expenditure' (TDEE) for them, providing them with personalized advice to input into their tracker:

> "I'm going to do these [calculations] at [your] goal weight because you're so nearly there. . ..TDEE using Mifflin-St Jeor BMR formula = 1587 calories (Lightly Active). . .So you can't lose 1 pound a week, but you can lose 1 every 10 days or so. And a little faster because of the 2 days a week workout. You'll maintain [your weight] at 1587 calories (give or take 10% for individual differences). Well done on your success so far!" (P142, R2)

Other 'tracking coaches' suggested specific behavioral goals to address key issues for members, providing recommendations for tracking their calorie intake and exercise:

> "Maybe at the start try to aim for maintenance calories (your TDEE). Be 100% strict with yourself about that. Then start reducing it down 50 calories every few days until you reach the [calorie] deficit you want to be at. Then add a short 100 calorie walk every day. No need to jump into it full force." (P203, R8)

Similarly, 'tracking coaches' also shared specific advice for overcoming common tracking problems including: explaining the calorie budget approach to weight loss used in tracking tools, delineating the difference between meeting macronutrient vs. calories goals in tracking apps and providing pragmatic logging tips (e.g. not logging foods less than 5 calories):

> "For tracking homemade meals, there is a recipe feature in MyFitnessPal but I don't usually use it unless it's. . . a baked good that I'll be eating over the course of a few days. Usually, I just enter in the individual ingredients in a meal, leaving out things with <5 calories such as spices, vinegar, garlic, etc." (P18, R1)

Female community members coached other women to track their weight and their menstrual cycle side by side, to enable them to see patterns in their weight loss linked to their menstrual cycle. This insight enabled them to interpret their weight gains and losses in context, using their cycle as a way to rationalize patterns of weight fluctuation and provide reassurance:

> "I often go up 3, 5, even 7 pounds from my recent low [weight] right before my period. . .if I weren't tracking, that would be super confusing, even worrying. . . Tracking will help you be ready to see the scale climb and fall, and as a bonus, you'll be less blindsided by cravings." (P83)

In addition, 'tracking coaches' encouraged others in the community who were feeling dispirited by the challenges of the weight loss and tracking journey. They provided advice for sustaining motivation to track (e.g. increasing daily calorie intake when members were feeling demotivated) and reframed the process of tracking (e.g.

a process of 'retraining the eye' in what a serving size looks like). They also encouraged others to learn to find small wins in tracking no matter how small - in order to keep going. To this end, members shared 'non-scale victories' (tracking signs of weight loss progress other than their weight) with the r/loseit community. Indicators of progress included taking before/after pictures of themselves to visually track their progress, taking body measurements and logging them to the app, or trying on old clothes in order to assess their weight changes. Members shared these victories by uploading pictures to their trackers and to r/loseit to recognize and receive recognition for these wins within their weight loss journey.

3.4.2 Recommending functions and features of trackers. Members also shared details of aspects of tracking tools that they found particularly useful or enjoyable to help others. Weight fluctuations seen on trackers from day to day induced negative emotional reactions. To overcome this, 'tracking coaches' recommended using weight-smoothing apps which provide a trend line instead of a person's precise weight from day to day. This stopped members from getting caught up in a potential rollercoaster of emotions every time they gained and lost weight:

> "use a method to help minimise the impact of weight fluctuations. . .using a tool (libra [on android], happyscale [on ios], trendweight [on web]) to show you the trend will help take the focus off these ups and downs so you can see you're still headed in the right direction." (P131, R2)

Some members were sensitive to viewing their weight daily, finding it to be confronting or triggering. 'Tracking coaches' recommended tools such as wireless weighing scales that synced to weight tracking apps automatically, as it stopped them from getting too attached to the numbers:

> "I was gifted a WiFi enabled Fitbit scale from my dietician. . . I've learned that . . .stepping on the scale while ignoring the readout is a much less triggering/fixating way to track my weight. I've even covered it with a post it [note], but usually don't have to. . .the scale uploads within a minute to my app via WiFi, I don't have to log my weight manually, and I can focus on the trend line of my weight graph instead of how far or close my number is to last week, my goal, my highest weight, my expectations." (P83, R2)

Their ease of use and automaticity was juxtaposed with the 'manual' nature of tracking and members recommended these types of tools to others to help them in their weight loss journey.

Members also recommended their favorite tracking apps, based on their personal experience and preferences. Apps with a pleasant user interface or color scheme which were perceived as not 'judging' or negative in the feedback it provided to users:

> "Lose It is quick, simple, easy and best of all, encouraging and forgiving! :)." (P57, R7)

Other members shared their negative experiences with specific tracking apps and described apps they switched to, along with a rationale for the benefit of the wider community:

> "MFP was very slow and buggy on my phone, so after initial stumbling with logging, I switched to LoseIt [app]! I love that app! It is so quick. It remembers meals and portions and combinations. I eat ethnic foods so my initial entries were manual, it became super fast really soon. I use tablespoons/teaspoons to measure. I err on the higher side. . .to not underestimate calories. . .However my favourite part about the app is all the cheers and encouragement it gives me randomly I lose weight or exercise. It's a happy supportive app. I love the orange on my screen. :)" (P164)

4 DISCUSSION

We have examined members' experiences of weight loss tracking tools within r/loseit - an online community promoting healthy, sustainable weight loss. This analysis has first and foremost delineated the many varied experiences shared by members in using and appropriating weight loss tracking tools, centering around four themes. Our analysis has revealed complex socio-technical practices have evolved around the use of trackers, which are influenced by the social context of this online health community with its own rules, goals and norms [49, 52]. Specifically, we discuss how the social context of r/loseit shaped both the usage of tracking tools and self-regulatory processes for health behaviour change. We found that studying the appropriations of tracking tools of this online community has resulted in the documentation of rich user experiences which can augment traditional user-centered design processes, in line with previous arguments [25]. We discuss what we have learned and make suggestions based on our findings for designing technology to support health behaviour change.

4.1 Tracking and Self-regulation is scaffolded by r/loseit

Our work has shown that virtual communities can enable social and behavioral processes to become observable. Our first theme, *Tracking as gaining insight* highlights that gaining self-knowledge about their diet and exercise from tracking was a fundamental part of r/loseit members' weight loss journeys, and aligns with previous research [20, 34]. However, this self-knowledge went beyond providing insights into a person's habits and taught them about their personal weight loss process. 'Logging honestly' was a r/loseit norm, and enabled members to take ownership over, and compensate for, slip-ups in their diet through learning to track these comprehensively. This was a key lesson, as social cognitive theory dictates that successful self-regulation depends in part on the accuracy of tracking [31]. Within the forum, 'cheating' the tracker through incomplete or inaccurate logging was equated with cheating themselves, demonstrating the complex dynamic between the user and the tracking tool- with the tracker being positioned as an extension of the self. This provides an insight into how shared norms within an online community can influence individual usage of technology.

Our data suggest that a socio-technical feedback loop is at play in weight loss trackers, which influences users' behaviors. This feedback loop was influenced by the interactions with the r/loseit forum,

who provided practical techniques and emotional support to individual users who were struggling, evidenced in our theme *Teaching and Learning the skills of tracking*. Past research has warned tracking tool designers that users are not 'rational data scientists' [35]. In line with this, we have found that tracking is not a static process of simply inputting data and receiving practical information from the tool; rather it is a dynamic process where feedback from the tracking tool shapes how individuals feel about themselves and their motivation for engaging in the weight loss process. This enriches our understanding of how tracking tools support the third step of self-regulation: 'self-reinforcement' (how one thinks/feels about oneself/one's performance influences behaviors) [29, 30]. As our data demonstrate, the way feedback is interpreted by the user is influenced by their emotional and psychological state, as well as the user interface of the tool. If the user perceived the information on the tracking tool to be positive/encouraging, it supported them to feel good about themselves and reinforced continued tracking. But if users perceived feedback from the tracking tool to be negative, they felt out of control, which led to bingeing or feeling down and disheartened from putting so much effort in to the weight loss process and their weight not dropping which may lead them to stop tracking.

These emotional reactions were mediated by the r/loseit community, in that sharing their individual experiences online added another layer in between the tracker, the data it presented, and the individual. Past research in the context of fertility tracking has documented the 'emotional load' of data and its consequences, which can often be the opposite of the original intent of designers [64]. The authors found five distinct types of engagement with data: positive, burdened, obsessive, trapped, and abandoning. Each engagement was composed of an action and an emotional component that mutually influenced each other. Our findings add to this understanding, suggesting that when these emotional experiences are shared, an online community can act as a buffer between the data received from the tracker and an individual's emotional reaction to the data, which has strong implications for the design of digital tracking tools. For example, r/loseit members developed, and coached others to employ a 'workaround'- using weight-smoothing apps to see an overall trend line of their weight, rather than examining their raw weight within tracking tools to ameliorate their negative reaction to fluctuations. Learning to use this workaround scaffolded a change in how people used and responded to the data from the tracking tools, by specifying how they should reconfigure outputs in order to reduce the potential negative emotional response to seeing daily, or more granulated, data. It demonstrates how communities such as r/loseit can shape the use of technology and ameliorate negative emotions in response to the device. This dynamic between the tracking tool, the individual user, and the wider community is highly sophisticated, community-level appropriation. Designers must not only be aware of the impact of data presented by tracking tools, but must also be cognizant of how membership in online communities (either associated with specific tracking apps, or otherwise) may impact individual users and their use of these devices.

Moreover, providing "communicatively competent" [65] feedback – sensitive to how users feel in response to feedback from tracking apps could be a way forward in the design of weight loss tracking apps. One way to do this could be assessing users' moods following feedback to build an emotional understanding of the user and developing content and features that are responsive to these differences. Incorporating features that account for users' emotional health throughout the weight loss process may support sustained behaviour change and promote better holistic health for users. This is particularly important to ameliorate the potential negative effects of weight loss tracking tools. For instance, to prevent users developing maladaptive feelings or behaviors as a result of certain functionalities (e.g. fear of negative feedback when a tracker target is not met) [66] or using these tools to facilitate eating disorders [17, 24].

In addition, our work has extended our understanding of 'lived informatics' where people find meaning from information through personal tracking in everyday life [35, 67]. Rather than focusing solely on the individual's personal use of tracking tools, we extended the focus to include how social others can play a role in the process of tracking. We found users appropriated an ecosystem of tools beyond tracking tools to document, recognize and collate weight loss progress, scaffolded by other community members. For example, some female r/loseit forum members coached other women to track their menstrual cycles to identify regular patterns of weight retention and loss, which enabled broader contextual knowledge compared with focusing on weight alone. Members shared about their 'non-scale victories,' e.g. reduced body measurements or a picture of an item of clothing that was once tight and now is too large; these alternative approaches to tracking captured successes in the weight loss process beyond body weight that was shared with and recognized by the r/loseit community.

Previous work suggests that personal tracking is oriented to short-term, present or prospective goals and is aspirational or about finding out about the future [35]. Contrary to this, some members used tools beyond the capabilities of current trackers to map their historical progress- using tools (e.g. Excel spreadsheets) to track numerous weight-related variables and see the 'bigger picture' around their weight loss over time. Appropriating tracking tools and coaching others within the community, empowered others with a rationale to explain their weight fluctuations, which in turn built their self-efficacy for managing their behavior change, supporting self-regulation [33]. This demonstrates how the online community provided experience-informed education and guidance in how to adjust the tools to accommodate their emotional responses to data, and to partner weight loss trackers with other data or tools. Similar to other work, we conclude that users appreciate the ability to take ownership over their personal process of tracking [39]. Tracking tools should accommodate idiosyncratic variations in their use, e.g., enabling the tracking of meaningful personal markers, and the ability to sync with other tools like menstrual trackers. This can enable tracking of progress on a range of variables of importance to the user in their unique goals (e.g. non scale victories) to provide insight into the bigger picture of their weight loss.

4.2 Implications for personal agency

Personal agency is achieved through reflective and regulative thought, and the skills and tools that affect and support one's choice of action [68]. The theme *Tracking as a vehicle of control* demonstrates how tracking can both facilitate or reduce an individuals' control over their weight loss and their lives. For members of r/loseit,

tracking was so much more than a way to record and reflect on personal data and make sense of it [9]. Tracking at times represented an empowerment process where people took control over their lives through gaining mastery over their habits. This empowerment was consolidated through the process of sharing their experiences with the wider community and receiving social support for their efforts.

Trackers were used as an external cognition tools to support members' weight loss. For example, some members pre-logged their foods before eating, using the tracker as an external planning mechanism to ascertain how they wanted to spread out their daily calories to stick to their weight loss goals. This helped them feel more in control over the process of dieting and helped them manage hunger. Other members used trackers as an external decision-making tool, e.g. logging foods in advance to carry out a cost-benefit analysis on whether it is worth eating it in terms of their weight loss goals. Tracking also provided an external record of self-care which could be examined by users to appraise their progress. Posts reflected peoples' narratives of their weight loss journey and trackers facilitated these stories. These are akin to the 'life stories' shared by users when describing their experiences of tracking tools, spoken about in past research [35]. Previous work highlights that the process of 'becoming' or self-improvement can be afforded by tracking [10]. Indeed, we found members derived meaning from sharing their personal weight loss narratives with others. Capturing weight loss life stories in a manner similar to r/loseit could foster a sense of selfhood and personal agency in tracking.

However, despite their potential to empower users with control over their weight management behaviors, our results have also demonstrated that trackers can stifle personal agency. They can impose a rigid lifestyle onto some users, making them work to accommodate the process of tracking in their lives, rather than the tracking process fitting into the users' lives. Some members found tracking easier when they ate one meal a day, packaged foods or continuously ate the same foods in a structured daily routine. Deviations from these meant that they struggled with tracking. Supporting individuals' personal agency in their behavior change through promoting autonomy support, the enablement of ones' self-determination, personal responsibility and choice, has been emphasized as vital in providing a context that is conducive to weight loss [69, 70]. Autonomy-supportive design is crucial within personal informatics, in moving from self-tracking to self-reliance, e.g. through the provision of choice and non-controlling instructions [71]. Users need to be supported to learn how to sustain healthy behaviors to meet their weight goals, rather than adhering to the short-term 'rules' set by a tracker. In this study, the online community scaffolded this learning by acting as a sounding board, where members struggling in their tracking could seek and receive support. Indeed, some users were so fixated on their calorie intake, they failed to consider their nutritional needs, which is not ideal in supporting healthy outcomes for users. Barbarin et al. [72] highlighted that holistic health goal development, building motivation and assistance with managing stress are needed in the design of digital tools for weight reduction. One potential strategy may be to integrate virtual or remote health coaches, akin to the experienced 'tracking coaches' within our study, as an enhanced feature of tracking tools to ensure appropriate, evidence-based, person-centered support is accessible to all users in promoting behavior change [73]. Future work could explore how in-person support for tracking (e.g. via health coaches) compares to the types of online support seen in this study.

4.3 Improving the Usability, Flexibility, and Accuracy of Tracking tools to sustain motivation for weight loss

Staying motivated in tracking is one of the key factors influencing people continuing to manage their weight, with previous evidence finding that commencing a weight loss attempt is easier than sustaining one [36]. The theme *Confronting challenges in sustaining tracking* captured how some members experienced difficulties with tracking. This was due to their expectations of their weight loss progress, finding logging to have turned into a chore, or having to restart tracking again. Our findings align with previous research, which found that tracking tools can be frustrating, user-burden intensive and difficult to use [20, 36, 38]. It has also been observed that motivations and goals for tracking change, tools for tracking may change and that users lapse and restart tracking [39, 67]. In the context of food tracking, the importance of capturing individual user goals has been highlighted, given their impact on individual usage of tools [22]. Tracking tools which enable broader methods of measuring weight status may provide extra context for a user and enable changing goals over time, e.g. tracking body fat percentage, muscle gain or loss, etc. For example, someone interested in losing weight compared with someone aiming to eat healthier will use different features and have different patterns of use. Moreover, positively received tracking tools, functions and features, extolled in r/loseit may be used as models for designing other tracking tools.

Our work shows that tracking tools should strive to accommodate specific user needs as they change over time. In the *Teaching and Learning the skills of Tracking* theme, 'tracking coaches' at times took members' personal information (e.g., bodyweight, goal weight, height, etc), and performed calculations using equations to provide personalized feedback on their daily calorie intake, e.g. calculating Total Daily Energy Expenditure. This highlights how tailoring information to the individual user can support overcoming challenges in the weight loss tracking process. Past research has suggested that users may also like to adapt what items to track, select the timing/frequency of tracking, the data format of tracking and whether it can be shared with others (e.g. dieticians) [74]. As such, more tailored, customizable tracking tools are warranted, which can implement appropriate behaviour change techniques relevant to the individual, and account for the individual users' personal motivation, goals and desired pace [36, 75, 76]. Incorporating tailoring strategies may ensure that weight loss tracking tools are more personally-relevant which may lead to longer, more meaningful usage patterns [7, 77, 78]. Weight loss tracking tools should also be quick to set up and use, have attractive and intuitive user interfaces and facilitate simple logging [75, 79, 80]. Assessing users' moods following feedback could be a way to provide communicatively sensitive messaging and support users' emotional needs, which has been flagged as an important design priority for future self-tracking tools [81].

As mentioned, 'logging honestly' was a forum norm, thus for these users, accuracy was pivotal to the tracking process. One of the

most prevalent challenges experienced by members was a mistrust in the accuracy of tracking tools, e.g. physical activity trackers and to a lesser extent food tracking apps and wireless weighing scales. Where tracking tools were perceived to be inaccurate or insufficient, members 'improved' on standard weight loss apps - using other apps and tools for certain features, to provide context and see the 'bigger picture' around weight loss. People developed various elaborate rules of thumb with the community, refused to 'eat exercise calories back' and double-logged or carried out checks of distances covered to test if trackers were correct. Accuracy of devices have been highlighted as being a crucial factor in the design of tracking tools [22, 82]. For instance, the inaccuracy of food databases has been highlighted in the context of food journaling [22]. Our work demonstrates the importance of providing assurance to users of tracking tools that they are precise, accurate and have been verified. Useful design guidelines to enhance the accuracy of tracking devices have also been compiled [23].

4.4 Crowdsourcing support for tracking and community-level appropriation

Given the social context of the forum as a medium for discussing users' experiences, our findings reflected both individual and shared experiences of tracking which unfolded as some members mastered- and others struggled with- the usage of tracking tools. This suggests that the experience of learning to track can be shaped by the social context of use, including virtual community contexts. This is significant because past research has demonstrated that using tracking apps for weight loss can make people feel isolated [36]. The 'sociality of tracking' has been mentioned in previous work, which has highlighted the different ways trackers are used individually and within a social setting [35, 83].

In this study, we have identified that r/loseit provided a platform for the lived and shared experience of tracking, particularly prevalent in the theme *Teaching and learning the skills of tracking*. Our data show that practical advice and coaching for using tracking tools was crowdsourced from r/loseit. This emphasized that tracking is very much a socio-technical process in this context; a key finding was the "work" invested by community members in making these tracking tools work for other members, including performing calculations to provide concrete advice to members in tracking (e.g. setting daily calorie goals in their tracker). This adds detail to previous research which highlighted key roles of members within an online weight loss community, including roles of information-giver (e.g. on how to log exercise and calories correctly), opinion-giver and encourager [50, 84], demonstrating how these roles can overlap. The way members coached each other to use the tools, highlights gaps where tools are not useful, where there are technological or socio-technical problems and indeed, how users want to use trackers. For example, one member posted that they were overwhelmed by the process of weight loss tracking, and responders suggested simple strategies for what precisely to focus their efforts on.

Past research has emphasized the importance of social support in promoting weight loss processes, including encouragement, (e.g. provided by forum members who support others who binged or felt frustrated in their weight loss processes) [50] and providing a warm welcome to new users [52]. Online weight loss communities may fill a gap in addressing the challenge of motivation in self-directed weight loss over the longer term [85]. Previous findings found that users pursue emotional support, motivation, accountability, and advice through online health communities [86]. Across the four themes of our study, we have found evidence of each of these aspects- specifically around the usage of tracking tools. Our work demonstrates that online communities scaffold the use of digital tracking tools for health behaviour change, through supporting others to overcome barriers to their use and providing specific advice for self-regulation skills. This is something that should be given due consideration by designers of digital health tools, as this support can promote negative as well as positive health behaviors depending on the social context e.g. healthy eating forum vs pro-eating disorder forum. It also raises a broader question of whether there is a duty of care for manufacturers to be aware of such social contexts and take steps to advocate on these forums for their tools' prosocial use.

4.5 Limitations

We note some limitations with our work. Our search strategy only specifically mentioned the tracking app MyFitnessPal. This was because the study was part of a larger project which investigated a weight loss intervention that used this specific tool. As such, our search was focused on it in this current study. While it would have been preferable to include by name other tracking apps commonly used for weight loss as search terms, some of the other search terms are broader, e.g. 'tracking', hence we still managed to capture members' experiences of using other tracking tools. However, it is possible that other tracking tools were not fully represented in our study. Moreover, our study focused on r/loseit with the assumption that members would share in its overarching aim to promote healthy, sustainable weight loss. This may not have been the case, and as we did not conduct any primary research, we cannot be sure of this, which has implications for the interpretation of our findings.

5 CONCLUSION

In this study, we have examined members' experiences of weight loss tracking tools within r/loseit - an online community promoting healthy, sustainable weight loss. We have found that weight loss tracking tools can support or stifle personal agency. Our analysis has revealed that tracking plays out in a variety of complex ways in practice; in fact, whole socio-technical structures have developed around the user, the tracking tool and this online health community. These have included members developing new methods for analyzing tracked data (including 'improving' on those provided by standard weight loss apps - using other apps and tools to provide context and see the 'bigger picture' around weight loss). Our work also demonstrates the importance of designing communicatively sensitive and flexible tracking tools to accommodate users' idiosyncratic patterns, purposes and concerns of use. In the absence of this, our findings evidence that individual usage of tracking tools and self-regulation for health behaviour change can be scaffolded by meso-level factors, in this case, the prosocial online community, r/loseit. Coaching for tracking was crowdsourced on r/loseit to obtain advice in using key features and functions. The collective

wisdom of this online community shared in our findings can be channeled into the design of enhanced tracking tools for weight loss for the benefit of those who cannot - or do not want to - engage in online health communities. However, the important role of social support in enabling health behavior change efforts cannot be diminished and our work showcases how experienced users in online communities can play an important role in weight loss efforts. Those interested in designing tools for health behavior change, including weight loss, need to be aware of the complexity in how users and communities appropriate these tools, and the role online communities play in shaping their usage. Designers need to account for how the tools can impact upon the lives of users in ways that were not envisioned. Our work also has implications for design research in that the research methodologies employed in this paper may be used to complement traditional user-centered design research, e.g. alongside contextual inquiries and field studies with users.

ACKNOWLEDGMENTS

We would like to express our gratitude to the moderators of r/loseit community for enabling this research and to all the community members for sharing their experiences online. We would also like to thank Kellie Morrissey, Emma Simpson, Sarah Foley and Daniel Welsh for their support in the early stages of this study. This research was supported by the Irish Research Council and S3 Connected Health through grant number: EPSPG/2016/182. The funders played no role in the conception, design, analysis and write up of this research.

REFERENCES

[1] WHO. 2018. Obesity and Overweight factsheet from the World Health Organization Accessed online on 1 July, 2019 from: https://www.who.int/en/news-room/fact-sheets/detail/obesity-and-overweight

[2] WHO. 2000. Obesity: preventing and managing the global epidemic. Accessed online on 1 June, 2019 from: https://www.who.int/nutrition/publications/obesity/WHO_TRS_894/en/.

[3] Floriana S Luppino, Leonore M de Wit, Paul F Bouvy, Theo Stijnen, Pim Cuijpers, Brenda WJH Penninx and Frans G Zitman. 2010. Overweight, obesity, and depression: a systematic review and meta-analysis of longitudinal studies. Archives of general psychiatry, 67 (3). 220-229. 10.1001/archgenpsychiatry.2010.2

[4] Mika Kivimäki, Eeva Kuosma, Jane E. Ferrie, Ritva Luukkonen, Solja T. Nyberg, Lars Alfredsson, G. David Batty, Eric J. Brunner, Eleonor Fransson, Marcel Goldberg, Anders Knutsson, Markku Koskenvuo, Maria Nordin, Tuula Oksanen, Jaana Pentti, Reiner Rugulies, Martin J. Shipley, Archana Singh-Manoux, Andrew Steptoe, Sakari B. Suominen, Töres Theorell, Jussi Vahtera, Marianna Virtanen, Peter Westerholm, Hugo Westerlund, Marie Zins, Mark Hamer, Joshua A. Bell, Adam G. Tabak and Markus Jokela. 2017. Overweight, obesity, and risk of cardiometabolic multimorbidity: pooled analysis of individual-level data for 120 813 adults from 16 cohort studies from the USA and Europe. The Lancet Public Health, 2 (6). e277-e285. 10.1016/S2468-2667(17)30074-9

[5] Victoria L. Webb and Thomas A. Wadden. 2017. Intensive Lifestyle Intervention for Obesity: Principles, Practices, and Results. Gastroenterology, 152 (7). 1752-1764. https://doi.org/10.1053/j.gastro.2017.01.045

[6] Anna Khaylis, Themis Yiaslas, Jessica Bergstrom and Cheryl Gore-Felton. 2010. A Review of Efficacious Technology-Based Weight-Loss Interventions: Five Key Components. Telemedicine and e-Health, 16 (9). 931-938. 10.1089/tmj.2010.0065

[7] Kathleen Ryan, Samantha Dockray and Conor Linehan. 2019. A systematic review of tailored eHealth interventions for weight loss. DIGITAL HEALTH, 5. 1-23. https://doi.org/10.1177/2055207619826685

[8] Lora E. Burke, Jing Wang and Mary Ann Sevick. 2011. Self-Monitoring in Weight Loss: A Systematic Review of the Literature. Journal of the American Dietetic Association, 111 (1). 92-102. https://doi.org/10.1016/j.jada.2010.10.008

[9] Ian Li, Anind Dey and Jodi Forlizzi. 2010. A stage-based model of personal informatics systems *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ACM, Atlanta, Georgia, USA, 557-566.

[10] Deborah Lupton. 2014. Self-tracking modes: Reflexive self-monitoring and data practices. Available at SSRN. http://dx.doi.org/10.2139/ssrn.2483549

[11] Lora E. Burke, Molly B. Conroy, Susan M. Sereika, Okan U. Elci, Mindi A. Styn, Sushama D. Acharya, Mary A. Sevick, Linda J. Ewing and Karen Glanz. 2011. The effect of electronic self-monitoring on weight loss and dietary intake: a randomized behavioral weight loss trial. *Obesity (Silver Spring, Md.)*, 19 (2). 338-344. 10.1038/oby.2010.208

[12] Christopher C. Tsai, Gunny Lee, Fred Raab, Gregory J. Norman, Timothy Sohn, William G. Griswold and Kevin Patrick. 2007. Usability and Feasibility of PmEB: A Mobile Phone Application for Monitoring Real Time Caloric Balance. *Mobile Networks and Applications*, 12 (2). 173-184. 10.1007/s11036-007-0014-4

[13] Thomas A Wadden and George A Bray. 2018. *Handbook of obesity treatment*. Guilford Publications, New York.

[14] Melinda J Hutchesson, Megan E Rollo, Rebecca Krukowski, Louisa Ells, Jean Harvey, Philip J Morgan, Robin Callister, Ronald Plotnikoff and Clare E Collins. 2015. eHealth interventions for the prevention and treatment of overweight and obesity in adults: a systematic review with meta-analysis. *Obesity reviews*, 16 (5). 376-392. 10.1111/obr.12268

[15] Deborah. F. Tate, Rena. R. Wing and Richard. A. Winett. 2001. Using Internet technology to deliver a behavioral weight loss program. *Jama*, 285 (9). 1172-1177. 10.1001/jama.285.9.1172

[16] Jochen Meyer, Daniel Epstein, Parisa Eslambolchilar, Judy Kay and Lie Ming Tang. 2018. A Short Workshop on Next Steps Towards Long Term Self Tracking *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems*, ACM, Montreal QC, Canada, 1-8.

[17] Elizabeth V Eikey and Madhu C Reddy. 2017. " It's Definitely Been a Journey" A Qualitative Study on How Women with Eating Disorders Use Weight Loss Apps. in *Proceedings of the 2017 CHI conference on human factors in computing systems*, 642-654.

[18] Daniel A. Epstein. 2015. Personal informatics in everyday life Adjunct Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2015 ACM International Symposium on Wearable Computers, ACM, Osaka, Japan, 429-434.

[19] Amanda Lazar, Christian Koehler, Joshua Tanenbaum and David H. Nguyen. 2015. Why we use and abandon smart devices *Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing*, ACM, Osaka, Japan, 635-646.

[20] Daniel A. Epstein, Monica Caraway, Chuck Johnston, An Ping, James Fogarty and Sean A. Munson. 2016. Beyond Abandonment to Next Steps: Understanding and Designing for Life after Personal Informatics Tool Use. *Proceedings of the SIGCHI conference on human factors in computing systems. CHI Conference*, 2016. 1109-1113. 10.1145/2858036.2858045

[21] James Clawson, Jessica A. Pater, Andrew D. Miller, Elizabeth D. Mynatt and Lena Mamykina. 2015. No longer wearing: investigating the abandonment of personal health-tracking technologies on craigslist *Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing*, ACM, Osaka, Japan, 647-658.

[22] Felicia Cordeiro, Daniel A. Epstein, Edison Thomaz, Elizabeth Bales, Arvind K. Jagannathan, Gregory D. Abowd and James Fogarty. 2015. Barriers and Negative Nudges: Exploring Challenges in Food Journaling. *Proceedings of the SIGCHI conference on human factors in computing systems. CHI Conference*, 2015. 1159-1162. 10.1145/2702123.2702155

[23] Rayoung Yang, Eunice Shin, Mark W. Newman and Mark S. Ackerman. 2015. When fitness trackers don't 'fit': end-user difficulties in the assessment of personal tracking device accuracy *Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing*, ACM, Osaka, Japan, 623-634.

[24] Duncan McCaig, Mark T Elliott, Katarina Prnjak, Lukasz Walasek and Caroline Meyer. 2020. Engagement with MyFitnessPal in eating disorders: Qualitative insights from online forums. *International Journal of Eating Disorders*, 53 (3). 404-411.

[25] Junia Anacleto and Sidney Fels. 2013. Adoption and appropriation: A design process from HCI research at a Brazilian neurological hospital. in *IFIP Conference on Human-Computer Interaction*, Springer, 356-363. https://doi.org/10.1007/978-3-642-40480-1_22

[26] Kyrill Potapov, Victor R. Lee, Asimina Vasalou and Paul Marshall. 2019. Youth Concerns and Responses to Self-Tracking Tools and Personal Informatics Systems *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems*, ACM, Glasgow, Scotland Uk, 1-6.

[27] https://www.reddit.com/r/loseit/.

[28] Frank X Sligo and Anna M Jameson. 2000. The knowledge—behavior gap in use of health information. *Journal of the American Society for Information Science*, 51 (9). 858-869. https://doi.org/10.1002/(SICI)1097-4571(2000)51:9<858::AID-ASI80>3.0.CO;2-Q

[29] Albert Bandura. 1991. Social cognitive theory of self-regulation. *Organizational Behavior and Human Decision Processes*, 50 (2). 248-287. https://doi.org/10.1016/0749-5978(91)90022-L

[30] Frederick H Kanfer and Lisa Gaelick-Buys. 1991. Self-management methods. https://psycnet.apa.org/record/1991-97255-007

[31] Albert Bandura. 1998. Health promotion from the perspective of social cognitive theory. *Psychology and health*, 13 (4). 623-649. https://doi.org/10.1080/

08870449808407422
[32] Barry J Zimmerman. 2000. Attaining self-regulation: A social cognitive perspective. in *Handbook of self-regulation*, Elsevier, 13-39.
[33] Rajiv N Rimal. 2000. Closing the knowledge-behavior gap in health promotion: the mediating role of self-efficacy. *Health communication*, 12 (3). 219-237. https://doi.org/10.1207/S15327027HC1203_01
[34] Wei Peng, Shaheen Kanthawala, Shupei Yuan and Syed Ali Hussain. 2016. A qualitative study of user perceptions of mobile health apps. *BMC Public Health*, 16 (1). 1158. 10.1186/s12889-016-3808-0
[35] John Rooksby, Mattias Rost, Alistair Morrison and Matthew Chalmers. 2014. Personal tracking as lived informatics. in *Proceedings of the SIGCHI conference on human factors in computing systems*, ACM, 1163-1172. https://doi.org/10.1145/2556288.2557039
[36] Linda Solbrig, Ray Jones, David Kavanagh, Jon May, Tracey Parkin and Jackie Andrade. 2017. People trying to lose weight dislike calorie counting apps and want motivational support to help them achieve their goals. *Internet interventions*, 7. 23-31. 10.1016/j.invent.2016.12.003
[37] Silje Stangeland Lie, Bjørg Karlsen, Ellen Renate Oord, Marit Graue and Bjørg Oftedal. 2017. Dropout From an eHealth Intervention for Adults With Type 2 Diabetes: A Qualitative Study. *J Med Internet Res*, 19 (5). e187. 10.2196/jmir.7479
[38] m.c. schraefel, Ryen W. White, Paul André and Desney Tan. 2009. Investigating web search strategies and forum use to support diet and weight loss *CHI '09 Extended Abstracts on Human Factors in Computing Systems*, ACM, Boston, MA, USA, 3829-3834.
[39] Daniel A. Epstein, Nicole B. Lee, Jennifer H. Kang, Elena Agapie, Jessica Schroeder, Laura R. Pina, James Fogarty, Julie A. Kientz and Sean Munson. 2017. Examining Menstrual Tracking to Inform the Design of Personal Informatics Tools *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, ACM, Denver, Colorado, USA, 6876-6888.
[40] Boyd A Swinburn, Gary Sacks, Kevin D Hall, Klim McPherson, Diane T Finegood, Marjory L Moodie and Steven L Gortmaker. 2011. The global obesity pandemic: shaped by global drivers and local environments. *The Lancet*, 378 (9793). 804-814. https://doi.org/10.1016/S0140-6736(11)60813-1
[41] Alan Dix. 2007. Designing for appropriation *Proceedings of the 21st British HCI Group Annual Conference on People and Computers: HCI...but not as we know it - Volume 2*, BCS Learning & Development Ltd., University of Lancaster, United Kingdom, 27-30.
[42] Maarten Overdijk and Wouter Van Diggelen. 2006. Technology appropriation in face-to-face collaborative learning. in Innovative approaches for learning and knowledge sharing, EC-TEL 2006 Workshops Proceedings, 89-96.
[43] Chia-Fang Chung, Elena Agapie, Jessica Schroeder, Sonali Mishra, James Fogarty and Sean A Munson. 2017. When personal tracking becomes social: Examining the use of Instagram for healthy eating. in Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, 1674-1687.
[44] Janaina C Abib and Junia C Anacleto. 2015. Integrating contexts in healthcare: guidelines to help the designers at design process. in Proceedings of the 30th Annual ACM Symposium on Applied Computing, ACM, 182-184. https://doi.org/10.1145/2695664.2696018
[45] Dawood Al-Masslawi, Sidney Fels, Rodger Lea and Leanne M Currie. 2017. Nurse-centred design: homecare nursing workarounds to fit resources and treat wounds. in DS 87-3 Proceedings of the 21st International Conference on Engineering Design (ICED 17) Vol 3: Product, Services and Systems Design, Vancouver, Canada, 21-25.08. 2017, 181-190. https://www.designsociety.org/publication/39623/
[46] Hunter Gehlbach and Maureen E Brinkworth. 2011. Measure twice, cut down error: A process for enhancing the validity of survey scales. Review of General Psychology, 15 (4). 380-387.
[47] Albert Park and Mike Conway. 2018. Harnessing Reddit to understand the written-communication challenges experienced by individuals with mental health disorders: Analysis of texts from mental health communities. Journal of medical Internet research, 20 (4). e121.
[48] Gisele Lobo Pappa, Tiago Oliveira Cunha, Paulo Viana Bicalho, Antonio Ribeiro, Ana Paula Couto Silva, Wagner Meira Jr and Alline Maria Rezende Beleigoli. 2017. Factors associated with weight change in online weight management communities: a case study in the LoseIt Reddit community. Journal of medical Internet research, 19 (1). e17.
[49] Stevie Chancellor, Andrea Hu and Munmun De Choudhury. 2018. Norms Matter: Contrasting Social Support Around Behavior Change in Online Weight Loss Communities Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems, ACM, Montreal QC, Canada, 1-14.
[50] Victor Li, David W McDonald, Elizabeth V Eikey, Jessica Sweeney, Janessa Escajeda, Guarav Dubey, Kaitlin Riley, Erika S Poole and Eric B Hekler. 2014. Losing it online: characterizing participation in an online weight loss community. in Proceedings of the 18th International Conference on Supporting Group Work, 35-45.
[51] Itamar Shatz. 2017. Fast, Free, and Targeted:Reddit as a Source for Recruiting Participants Online. Social Science Computer Review, 35 (4). 537-549. 10.1177/0894439316650163
[52] Tiago Cunha, Ingmar Weber and Gisele Pappa. 2017. A Warm Welcome Matters!: The Link Between Social Feedback and Weight Loss in /r/loseit Proceedings of the 26th International Conference on World Wide Web Companion, International World Wide Web Conferences Steering Committee, Perth, Australia, 1063-1072.
[53] Neil S Coulson. 2005. Receiving social support online: an analysis of a computer-mediated support group for individuals living with irritable bowel syndrome. Cyberpsychol Behav, 8 (6). 580-584. 10.1089/cpb.2005.8.580
[54] Daniel Evans. 2017. MyFitnessPal. British Journal of Sports Medicine, 51 (14). 1101. 10.1136/bjsports-2015-095538
[55] Virginia Braun, Victoria Clarke, Nikki Hayfield and Gareth Terry. 2018. Thematic analysis. in Handbook of research methods in health social sciences, Springer Berlin, Germany, 1-18.
[56] Carla Willig and Wendy Stainton Rogers. 2017. The SAGE handbook of qualitative research in psychology. Sage Publications Ltd., London.
[57] Carla Willig. 2013. Introducing qualitative research in psychology. McGraw-hill education, United Kingdom.
[58] Moira Maguire and Brid Delahunt. 2017. Doing a thematic analysis: A practical, step-by-step guide for learning and teaching scholars. AISHE-J: The All Ireland Journal of Teaching and Learning in Higher Education, 9 (3). https://ojs.aishe.org/aishe/index.php/aishe-j/article/view/335
[59] Virginia Braun and Victoria Clarke. 2006. Using thematic analysis in psychology. Qualitative research in psychology, 3 (2). 77-101. https://www.tandfonline.com/doi/abs/10.1191/1478088706qp063oa
[60] Richard E Boyatzis. 1998. Transforming qualitative information: Thematic analysis and code development. Sage Publications, Inc, California, USA.
[61] Psychological Society of Ireland PSI. 2010. Code of Professional Ethics of the PSI. Dublin, Ireland.
[62] BPS. 2017. Ethics Guidelines for Internet-mediated Research., British Psychological Society: Leicester. Accessed online on 4 February, 2018 from: www.bps.org.uk/publications/policy-and-guidelines/research-guidelines-policy-documents/researchguidelines-poli.
[63] https://www.weightwatchers.com/uk/smartpoints.
[64] Mayara Costa Figueiredo, Clara Caldeira, Elizabeth Victoria Eikey, Melissa Mazmanian and Yunan Chen. 2018. Engaging with health data: The interplay between self-tracking activities and emotions in fertility struggles. Proceedings of the ACM on Human-Computer Interaction, 2 (CSCW). 1-20.
[65] Gary L Kreps. 2014. Achieving the promise of digital health information systems. Journal of public health research, 3 (3). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4274501/
[66] M. Honary, B. T. Bell, S. Clinch, S. E. Wild and R. McNaney. 2019. Understanding the Role of Healthy Eating and Fitness Mobile Apps in the Formation of Maladaptive Eating and Exercise Behaviors in Young People. JMIR Mhealth Uhealth, 7 (6). e14239. 10.2196/14239
[67] Daniel A. Epstein, An Ping, James Fogarty and Sean A. Munson. 2015. A lived informatics model of personal informatics. in Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing, ACM, 731-742. https://dl.acm.org/doi/10.1145/2750858.2804250
[68] Albert Bandura. 1989. Human agency in social cognitive theory. Am Psychol, 44 (9). 1175-1184. 10.1037/0003-066x.44.9.1175
[69] Theodore A Powers, Richard Koestner and Amy A Gorin. 2008. Autonomy support from family and friends and weight loss in college women. Families, Systems, & Health, 26 (4). 404. 10.1037/1091-7527.26.4.404
[70] Amy A. Gorin, Theodore A. Powers, Richard Koestner, Rena R. Wing and Hollie A. Raynor. 2014. Autonomy support, self-regulation, and weight loss. Health psychology : official journal of the Division of Health Psychology, American Psychological Association, 33 (4). 332-339. 10.1037/a0032586
[71] Rafael A. Calvo, Dorian Peters, Daniel Johnson and Yvonne Rogers. 2014. Autonomy in technology design CHI '14 Extended Abstracts on Human Factors in Computing Systems, ACM, Toronto, Ontario, Canada, 37-40.
[72] Andrea M Barbarin, Laura R Saslow, Mark S Ackerman and Tiffany C Veinot. 2018. Toward health information technology that supports overweight/obese women in addressing emotion-and stress-related eating. in Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems, 1-14. https://doi.org/10.1145/3173574.3173895
[73] Ruth Q. Wolever, Leigh Ann Simmons, Gary A. Sforzo, Diana Dill, Miranda Kaye, Elizabeth M. Bechard, Mary Elaine Southard, Mary Kennedy, Justine Vosloo and Nancy Yang. 2013. A Systematic Review of the Literature on Health and Wellness Coaching: Defining a Key Behavioral intervention in Healthcare. Global advances in health and medicine, 2 (4). 38-57. 10.7453/gahmj.2013.042
[74] Yuhan Luo, Peiyi Liu and Eun Kyoung Choe. 2019. Co-Designing Food Trackers with Dietitians: Identifying Design Opportunities for Food Tracker Customization Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems, Association for Computing Machinery, Glasgow, Scotland Uk, Paper 592.
[75] Jason Tang, Charles Abraham, Elena Stamp and Colin Greaves. 2015. How can weight-loss app designers' best engage and support users? A qualitative investigation. British journal of health psychology, 20 (1). 151-171. 10.1111/bjhp.12114
[76] Kathleen Ryan, Lisa Ellen Murphy, Conor Linehan and Samantha Dockray. 2020. Theory in practice: identifying theory-based techniques in health coaches'

tailored feedback during a weight loss intervention. Psychol Health. 1-23. 10.1080/08870446.2020.1748629

[77] Nancy Grant Harrington and Seth M Noar. 2012. Reporting standards for studies of tailored interventions. Health Education Research, 27 (2). 331-342. 10.1093/her/cyr108

[78] Seth M Noar, Nancy Grant Harrington, Stephanie K Van Stee and Rosalie Shemanski Aldrich. 2011. Tailored health communication to change lifestyle behaviors. American Journal of Lifestyle Medicine, 5 (2). 112-122. https://doi.org/10.1177/1559827610387255

[79] Steven S. Coughlin, Mary Whitehead, Joyce Q. Sheats, Jeff Mastromonico, Dale Hardy and Selina A. Smith. 2015. Smartphone Applications for Promoting Healthy Diet and Nutrition: A Literature Review. Jacobs journal of food and nutrition, 2 (3). 021-021. https://pubmed.ncbi.nlm.nih.gov/26819969/

[80] Caroline Glagola Dunn, Gabrielle M. Turner-McGrievy, Sara Wilcox and Brent Hutto. 2019. Dietary Self-Monitoring Through Calorie Tracking but Not Through a Digital Photography App Is Associated with Significant Weight Loss: The 2SMART Pilot Study—A 6-Month Randomized Trial. Journal of the Academy of Nutrition and Dietetics. https://doi.org/10.1016/j.jand.2019.03.013

[81] Amid Ayobi, Tobias Sonne, Paul Marshall and Anna L. Cox. 2018. Flexible and Mindful Self-Tracking: Design Implications from Paper Bullet Journals. in Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems, Association for Computing Machinery, Paper 28.

[82] Lena Mamykina, Elizabeth D. Mynatt and David R. Kaufman. 2006. Investigating health management practices of individuals with diabetes Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, ACM, Montréal, Québec, Canada, 927-936.

[83] Julie Maitland, Scott Sherwood, Louise Barkhuus, Ian Anderson, Malcolm Hall, Barry Brown, Matthew Chalmers and Henk Muller. 2006. Increasing the awareness of daily activity levels with pervasive computing. in 2006 Pervasive Health Conference and Workshops, IEEE, 1-9. 10.1109/PCTHEALTH.2006.361667

[84] Diane Maloney-Krichmar and Jenny Preece. 2005. A multilevel analysis of sociability, usability, and community dynamics in an online health community. ACM Transactions on Computer-Human Interaction (TOCHI), 12 (2). 201-232.

[85] Kevin O. Hwang, Allison J. Ottenbacher, Angela P. Green, M. Roseann Cannon-Diehl, Oneka Richardson, Elmer V. Bernstam and Eric J. Thomas. 2010. Social support in an Internet weight loss community. International journal of medical informatics, 79 (1). 5-13. 10.1016/j.ijmedinf.2009.10.003

[86] Mark W. Newman, Debra Lauterbach, Sean A. Munson, Paul Resnick and Margaret E. Morris. 2011. It's not that i don't have problems, i'm just not putting them on facebook: challenges and opportunities in using online social networks for health Proceedings of the ACM 2011 conference on Computer supported cooperative work, Association for Computing Machinery, Hangzhou, China, 341–350.