Frankie: Exploring how Self-Tracking Technologies can go from Data-Centred to Human-Centred

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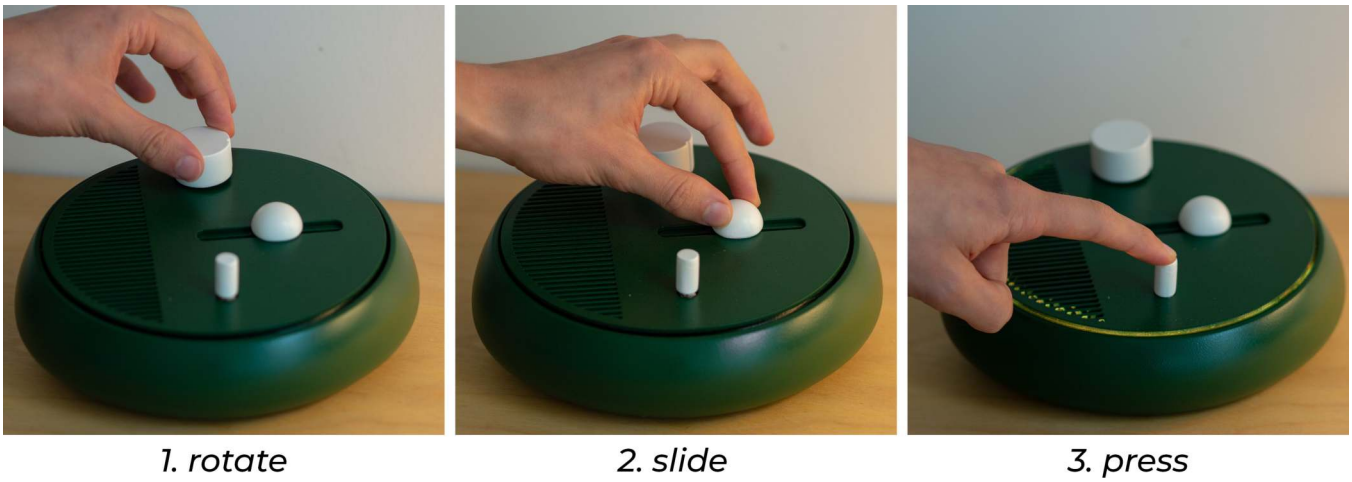

Figure 1: Frankie in use. Image 1 on the left shows the user entering the number of tasks by rotating the dial. Image 2 in the middle shows the user indicating the weight of each task, by sliding the white slider. Image 3 on the right shows the user recording a spoken reflection, by pressing the button. The LEDs provide a visual cue for the action shown in image 3.

ABSTRACT

Self-tracking technologies have long promised to enhance our well-being. However, our initial work and that of others show that most of these technologies focus on data, not the user. Based on interviews, development of mood boards, and the creation of a research product, we propose an alternative approach to self-tracking: re-humanising self-tracking technologies. Our work shows that feelings play an important role with data, that data are temporal, and associated with work and utility. We interpret four design criteria, which are applied in the creation of *Frankie*: a human-centred tracking device which records both quantitative (number of activities) and qualitative (perceived weight of the activity and spoken reflections) data to foster self-reflection. Through this design case we add to the discussion on re-imagining self-tracking technologies to go beyond data-centric artefacts.

CCS CONCEPTS

• **Human-centered computing** → **User centered design**.

KEYWORDS

Qualified Self, Self-Tracking, Self-Reflection, Humanising Self-Tracking Technologies

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1 INTRODUCTION

Self-tracking technologies (STTs) have become ubiquitous in representing a dominant form of self-knowledge through numerical models [29, 32, 33]. Everyday activities and invisible events, such as physiological data, are tracked and quantified to support the mental and physical well-being of a person. Commonly referred to as the *Quantified Self* (QS) movement [37] aimed at creating self-awareness, ultimately leading to a better life through quantification [37]. To achieve self-awareness, reflection is often considered to be an important element, as it has been shown to improve one's motivation in everyday life—when done meaningfully [12]. Design to foster reflection has been thoroughly examined in Human Computer Interaction (HCI) research within the frameworks of designing for self-tracking and can be considered as beneficial in a variety of life aspects (e.g. behaviour change, better educational outcomes, self-awareness) [3, 16]. At the same time, the dark-sides of reflections –particularly reminiscing negative memories and computational systems not capable of capturing events that are not quantifiable– have been directly linked to lack of integrating user context [1].

Despite this, most commercial STTs are developed as goal-driven systems, which do not account for the user context; creating rigid, 'one-size fits all' well-being indicators that define expectations for users, without considering what the user needs and what fits their abilities [24, 55]. This seems disadvantageous, as previous research has shown the importance of supporting open-ended and user-driven reflection in STTs (e.g. [23, 25, 53]), in contrast to altering user behaviour through extrinsic motivators such as peer pressure [11]. Current STTs can be considered 'devices' that conceal the means (backgrounding) and emphasize the ends (foregrounding), leading its user to be distracted, detached and disengaged [18, 27]. To move away from the design of devices, we need to explore the design of technology as 'artefacts' or 'things', which engage mind and body—centering our lives and connecting with the world, thus engaging and enriching our everyday life [18, 27].

To move towards this goal, the work presented here explores how we can re-imagine a well-being STT that focuses on reflection using a Research through Design (RtD) process [62]. To this aim, we conducted interviews with five people, both self-trackers and non-self-trackers, to gain an understanding of how they experience well-being, data, and STTs. These interviews highlight that personal data are more than just numbers and that feelings (should) play a role. Moreover, data are seen as requiring effort, are associated with 'work' (both regarding the input action and job-work), and can be *'belittling'*. Next to these interviews, we created mood boards to better understand how STTs are envisioned. This led to the understanding that the dominant current vision (which has been criticised in research, e.g. [20, 23, 41, 46, 58]) puts data central, not the user. Our contribution is at establishing initial design criteria of re-imagining STTs to support user autonomy. Next, we designed a tracking device called Frankie: a research product that mediates self-tracking through the use of audio modality for tracking everyday life events by applying the design criteria to account for user-context, rather than solely focusing on data creation (see Figure 1).

2 RELATED WORK

2.1 Quantified and Qualified Self

Although mood tracking and the logging of emotions has been around for some time (e.g.[25]), much of the work within STTs focuses on utility, rationality, and quantification [23, 41]. This techno-centric view has been criticised and scholars argue for an experience-centred approach (e.g. [15, 20, 23, 25, 46]) as people *"do not live as rational data scientists"* [41], nor are they 'simple machines'. Instead, they are situated and temporal beings, that co-exist with other and are always in flux [2, 23, 25, 45]. Similar complexity can be seen in the various reasons for why people use STTs [54], which range from achievement-based goals to the desire to document, reflect, and learn more about one's behaviours [46]. The latter shows that a focus on numbers, statistics, and rationality with STTs is not enough: they should be designed to embody people's felt life as well [23, 42, 46]. This sentiment is further strengthened by recent research which shows how athletes make sense of their data by relating it to their own bodily experiences—both of the (sports) activity and their body [43, 44].

With this, we see a transition from the quantified to the qualified self [56]. Examples of STTs that focus on people's felt experiences are *"MindTracker"*, a tangible modality to track one's emotions [31], *"Ambient Cycle"*, a menstrual cycle tracking device based on phenomenological theories [23], and *"Affective Loop Experiences"*, which accounted for the socio-cultural and bodily experiences of emotion processes [25]. The design of tracking beyond quantitative data shows promising results in supporting long-term user engagement, as qualitative aspects can capture the complex settings of everyday life through the embodiment of contextual factors [1]. An example of this is the design of a smart mirror that emphasises the temporality of the data on a spectrum of short and long term data representation, to support the user context and present the relevant timeline [28]. Other design considerations emphasise the need to design for learning by allowing users to express themselves freely and create a safe environment, by creating a balance between automatic logging and manually-curated memories, and personalising the data in meaningful visuals [44]. In line with these examples, our work explores how we can put the human and felt experience central in the tracking process, and how to track both qualitative and quantitative aspects of one's daily tasks.

2.2 Data, Well-Being, and Self-Reflection

Within STT-frameworks (e.g.[4, 10, 59]) self-reflection is seen as universally beneficial towards facilitating self-awareness of emotions and uncover everyday life patterns. Thus, helping people to achieve 'well-being' [19]. However, the current direction of STTs has become skewed towards creating pre-defined well-being indicators, where completing joyful and miserable activities hold the same value [55]. The notion of using data to represent well-being (e.g. happiness, fitness, and productivity) fails to address the subjectivity associated with user context, thus creating an imbalanced relation in the effort of tracking data and receiving useful feedback [12].

Designs for data tracking in STTs that are open-ended (e.g. which allow users to decide what type, amount, and modality of data) have shown to trigger reflection even during the tracking phase of

data [39]. This observation contradicts traditional STT frameworks that postulate reflection to be post-hoc to the data tracking phase. The idea of producing more data at several instances of everyday life through automatising data tracking has been criticised to be overwhelming for users—prohibiting meaningful engagement in reflection. Rather, providing timely cues –that can trigger larger memories tied to nostalgic moments or significant events– offers a potential direction for letting users be in control of their STT, through balancing automatic logging and manually curated data; as shown by the Rewind system [57]. In line with the mentioned extensions to the traditional pre-defined data tracking in everyday life to foster self-reflection, we explore the role of a dedicated device in the data tracking phase for stimulating reflection while curating the data.

3 DESIGN PROCESS

To gain an understanding of how STTs and the data they generate are experienced and envisioned, our process consisted of semi-structured interviews, mood boards, and a prototype-review. The semi-structured interviews were conducted with five participants, who had diverse backgrounds (bag maker, teacher, tech manager, advertising agent, and software developer), ages (ranged between the 27-61), and nationalities (three Dutch, one Indian and one South Korean). We deliberately selected both self-trackers (three participants) and non-self-trackers (two participants). During the interviews, participants were asked questions about their thoughts on and relation to data, data tracking, and well-being. Transcriptions from interviews were analysed using reflexive thematic analysis [5], following a inductive approach. The analysis happened in two stages: in the first stage, two researchers independently selected codes. These were then discussed to ensure that both researchers agreed on the codes and initial clusters were formed. In the second phase, clusters were finalised and named, resulting in four themes. Simultaneously, mood boards were created by the researchers to get an understanding of how STTs are envisioned [17]. The aim of the mood boards was to frame the design area, find paradoxes, and trigger new directions for further design [34].

4 FINDINGS

We first discuss the interview findings, then the mood boards. These insights are combined in design criteria. Interview quotes are accompanied with the participant number (e.g. P1).

4.1 Interviews

Participants tracked both quantitative (number of habits, heart rate, and activity data, such as step count and cycling statistics) and qualitative data (daily tasks / activities, mindfulness and journaling). In some ways, tracking this data helped participants achieve their idea of well-being, which was described as achieving self-imposed goals (P1 and P4), having *"me-time"* (P2), and being in *"balance"* with yourself and your environment (P3). Crucial to well-being was reflection (P1, P3, P4 and P5), as it allows for comparison: *"A thing for my well-being would be just saying, before I start doing, what I want to get out of it and then when I finished, compare the thing that I've made or done, to what I said in the begin"* (P1).

Besides these insights, we constructed four clusters: 1) Work, Utility, and Data; 2) Data is More Than Numbers; 3) Temporality of Data; and 4) Problematic Data.

4.1.1 Work, Utility, and Data. Both for the self-trackers (P1, P4, and P5) and non-self-trackers (P2 and P3) data were seen as being 'work'. Participants who used STTs pointed out that recording data is a burdensome process—something which has been highlighted by previous research, e.g. [9, 36]. Participants who did not use STTs, saw data as something work-related: *"For my work I gather data, a lot"* (P2) and *"For project management perspectives, business unit perspectives, yeah."* (P3).

The link to work and utility is visible in the purposes for tracking as well, which covered making sure things are not forgotten (all participants), motivation (P1 and P4), documentation (P1 and P2), control purposes –such as knowing when you are falling ill (P1)–, and to remain on top of things: *"It keeps you informed"* (P2). One purpose that falls outside the utility scope was reflection (P1, P3, P4, and P5).

4.1.2 Beyond Quantitative Data. Despite being linked to work and utility purposes, and seen as a rational activity (P3 and P5), participants indicated that data are –or should be– more than this. This can be seen in participants' critiques: *"I sincerely think it is truly overestimated value of data. [...] I mean, we have our own senses and we have our own feeling and you should have an understanding of it already."* (P3), how they tracked data beyond available technologies: *"I also supplement that with a quick qualitative description of [...] [how] the bread that has turned out"* (P1 on their bread-making journal), and their philosophy on generating data, which was considered highly personal: *"I see myself as an author of my data"* (P1). Furthermore, participants stressed the role of their (gut-)feelings, as demonstrated by P3: *"It is much more that it underpins your, the feeling you have"*. The role of feelings was also found by Sharon et al. [54]. Moreover, as mentioned by P4, it is not the data itself that is interesting: *"It is much more the initial feeling, recognising patterns, that is interesting. The data itself is just, it is just a moment in time."*

4.1.3 Temporality of Data. As the previous quote suggests, data were seen as something temporal, with temporary relevance: *"I was just a bit like sad 2 weeks ago, why would I want to be reminded of that? And vice versa, if I am feeling shit, why would I want to be reminded of what was a happy two weeks ago?"* (P4). Because of the temporary relevance, participants mentioned the importance of frequency (P1, P3, P4, and P5): *"In 10 years [...] it will be interesting, it will be far more to look at it on a macro-scale"* (P1 on their heart-rate data).

Beside being an element of data, participants harnessed temporality as a design element: *"I do post that on my [Instagram] stories. And then they disappear after 24 hours. So then people can see what's happening, but I don't want it to be logged."* (P1).

4.1.4 Problematic Data. Lastly, participants expressed various concerns and reasons for not tracking data. The first concern was the *public nature* of data, as they are not necessarily the ones doing the tracking: *"a lot of people track my data."* (P3), nor the owner: *"I am aware that if it is stored on somebody else's servers, it is not my ownership, but I still feel like as an author."* (P1). Secondly, participants

indicated that current applications can use data 'belittlingly' (P2 and P3). This was a big reason for not using STTs, as illustrated by P2 on Screen Time: *"I find that annoying. It is so, I don't know, belittling to me."* Moreover, these participants had the feeling that STTs force you to perform activities, removing spontaneity: *"It should grow organically. That's part of the fun. [...] I think it would feel like work if you have a: 'and now, now it is time for my me-time'."* (P2). Finally, participants referenced the intangibility of data and how it is often communicated through screens: *"We are looking at screens so much, I don't need to do it any longer than strictly necessary."* (P2 on why they do not use STTs).

4.2 Mood Boards

Parallel to the interviews, we created mood boards by selecting images using the terms *'quantified self technologies'*, *'smart technologies'*, *'IoT devices'*, *'smart homes'*, *'well-being technologies'*, *'quantified self'*, and *'personal informatics'* from Google Images. We further selected images from analog resources (e.g. magazines). The mood boards were created by us, as a self-exercise to create a (visual) common ground to bridge our different backgrounds (HCI, Computer Science, and Design). Mood boards are a common practise in design processes, where they are used as a abstract, sensory stimulating collection (they can be visual, haptic, or focus on other senses) of inspirational input created by the designer(s) [34]. Contrary to image boards –which depict clear, inspirational images– mood boards are meant to be abstract, to foster open-ended ideation and discussion. There is no right or wrong way of interpreting a mood board [35]. In our process, the mood boards give a glimpse of how STTs, and smart technologies and environments are currently envisioned.

Whilst looking for images online only a minority showed human beings. Instead, most images focus on technology, data generation, and data streams. At most, there is a hand, showing how the user is supposed to interact with the technology through a mobile application or images which depict a person wearing the technology (e.g. smart glasses or running with a smart watch). Although it could be argued these images show a human, it only abstractly covers the idea of a user—leaving the context and individual person out of the perspective. These aspects are rarely depicted, even though they are arguably central to personal STTs. Figure 2 on the left, under *'Mood Board 1'*, shows the mood board created using online images.

This mood board quickly began to portray a dystopian future: one where the user merely plays a side-role and the data are the protagonist. This made us wonder, are we not more than our data? How can we re-humanise the technologies of the future? Therefore, we created another mood board that captures the direction of an alternative future vision [30] using pictures and textures retrieved from analogue resources (Figure 2—right, under *'Mood Board 2'*).

4.3 Design Criteria

From the interviews we learned that current STTs can be experienced as belittling and controlling: they decide what you track and can advise when to do something (e.g. suggest going for a walk). Moreover, data were associated with work and utility purposes, even though participants indicated that qualitative and emotional aspects are important and should be included. Besides, participants described how data are often tracked and owned by others, not them—the *"authors"* of the data. This, and the feeling that data do not focus on the qualitative and emotional, can be seen in our first mood board as well.

Reflecting on the presented activities, our challenge was to design a tangible STT, which embraces user context, quantitative and qualitative data, does not demand continuous and consistent use, and which puts the user central—not the data. As reflection is both a proven element of well-being [1] and was seen as an important element by our participants, we narrowed our scope to developing an STT for open-ended reflection on daily activities. Daily activities were chosen, due to popularity amongst our participants (in terms of what kinds of things they were already tracking) and because they indicated their well-being could be improved by reflecting on such activities. To design for this experience, we used our insights and knowledge from related work to formulate the following design criteria that apply to the tracking phase in STTs:

(1) To enhance people's feeling of ownership of the data, overcome the perceived burden of current STTs being screen-based (see Section 4.1.4), and based on the lived-informatics criteria of Rooksby et al. [47], the STT has to be tangible;
(2) As data are more than numbers and highly personal, and should account for emotional and qualitative aspects of data (as reflected in the interviews as well as in literature), the STT should offer a personal experience beyond mere quantification of tracked data [23];
(3) To address the concerns that data are tracked and owned by others, the STT should leave the user in control: allowing them to decide when they want to log data and when to view it. Separating these two steps of interacting with the data, which means that logged data should not be immediately shown to the user;
(4) To further foster reflection and well-being, and limit the notion of data being utilitarian and related to work, the tracking experience should focus on user-generated data [39], and embrace spontaneity and creativity [25]. This way, we hope STTs to embrace the user's lived context and foster a deep and private relation to the user—as we tried to depict in mood board 2.

5 FRANKIE

We developed *Frankie*, an audio-based STT based on the previously formulated criteria. Audio input was chosen for a personal experience and low-effort logging of qualitative data (criterion 2). Previous research has shown that audio allows users to seamlessly capture rich data [36, 48] and engages people to be expressive and capture emotions [7]. Audio input has been extensively used in audio diaries and journaling (e.g. [14, 21, 50, 51]). Thus, we hypothesised that audio-input would allow users to record spoken reflections and feelings in-situ, whilst complying with design criteria 2 and 4.

As part of our RtD process, numerous sketches (a snippet can be seen in Figure 3) and models were created by the first two authors of this paper to come closer to realising how a tracking device can embody the findings from the interviews. Thereafter, the initial functionality of the STT was selected: 1) the device should allow users to enter spoken reflections on their activities; 2) indicate the number of daily activities; and 3) indicate the perceived 'weight' of

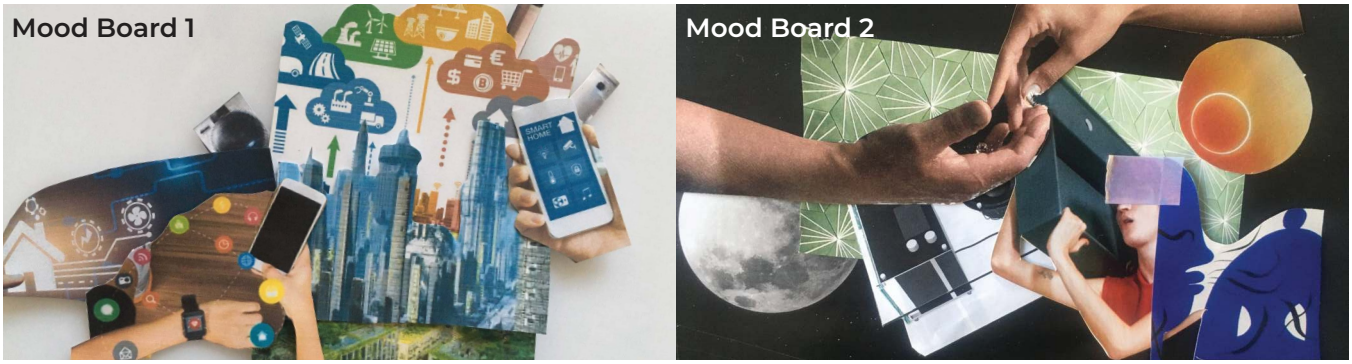

Figure 2: Two mood boards. Left: a mood board created using images found online. The composition of this mood board shows how the current vision of these technologies focuses on data and data generation. Right: the mood board created to oppose the current vision. It is purposefully abstract to trigger the feeling of re-humanising STTs and ideas [6]. This mood board was created with images from analog resources and focuses on the idea of putting the human central, softness, and a holistic interaction between human and technology.

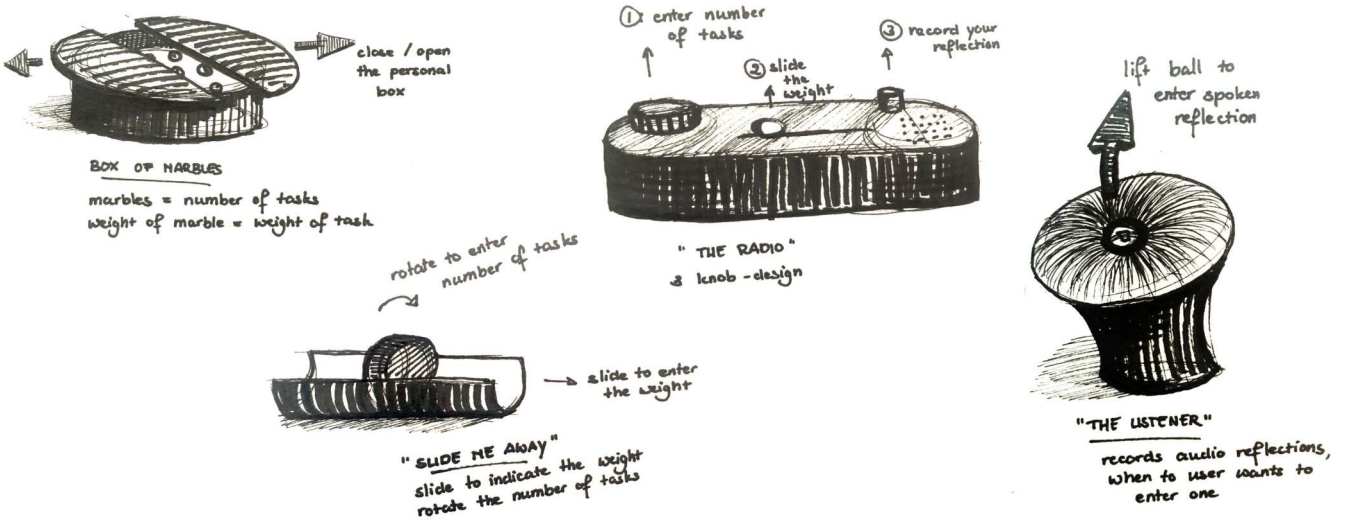

Figure 3: Overview of four concept sketches. Top left: *"Box of Marbles"*. Here users can open a circular box and store marbles inside. The marbles represent the number of tasks, and the weight of the marble the weight of the task. Bottom left: *"Slide me Away"*. User rotate the number of tasks and slide the rotational know to indicate the weight of the task. Top middle: *"The Radio"*. This idea eventually became Frankie: users can rotate the number of tasks, slide the weight of the tasks, and record spoken reflections. Bottom right: *"The Listener"*. Users can take out the cork in the centre of the design, this opens the device up to listening and recording your spoke reflection.

each activity (e.g. is it a 'heavy' task as it requires a lot of effort? Or is it an easy task and therefore 'light'?). With these functionalities, we aimed to allow the user to be able to track both quantitative (number of activities) and qualitative aspects (perceived weight and spoken reflection), and leave the user in control of the amount of detail they want to record for an activity. For example, not all activities require a spoken reflection or a perceived weight, if they are minor and easily completed. These functionalities were then used to create different iterations and designs, resulting in Frankie, as seen in Figure 1. Frankie is a research product [40] and tracking device with a total of three buttons: the top button (or dial) is attached to a rotary encoder and allows to indicate the number of activities. The middle button is attached to a motorised potentiometer (ALPS RS60N). Sliding this button to the right will have increased force-feedback, thereby increasing the weight or resistance felt. With this slider, the user indicates the perceived weight of the activity. Lastly, the bottom button is for recording. As probably not all activities require a spoken reflection, users have the option to press this when they want to leave one. By pressing the button, built-in LEDs (see Figure 1) will light up, indicating that the device is recording. Releasing this button will stop and store the recording. Since spoken reflections are considered sensitive [39], we imagine

Frankie being used in private spaces, such as one's home. The spoken reflections and quantitative data from Frankie are stored locally and not connected to any external storage units, such as cloud services. Thereby, designing for participants' concerns of who tracks and owns their data (Section 4.1.4). The supplemental materials contain a video of the interaction with Frankie.

6 DISCUSSION

One of the aims of this paper is to introduce the idea of humanising STTs. As our work discusses, current technologies centre around the creation of data, not the data creator. The current idea of data as something objective, rational, and all-knowing [24] does not suffice the vast reasons for why people track data [54] and might even 'scare' people away—coming across as 'belittling' and authoritarian [52]. Our interviews found that participants experienced inputting their data as burdensome 'work', and uncovered desires for tracking not just being about utility, but for inclusion of qualitative descriptions and taking account of feelings. Moreover, our participants saw the data as having temporary relevance (which puts into question self-tracking approaches that provide long-term tracking) and suggested using temporality as design element.

The design approach we then followed differs from standard self-tracking approaches by enabling users to focus on the meaning of the data. Instead of having to insert numbers, they can express its weight or magnitude qualitatively (turning the dial), and can comment on it verbally. This takes account, for instance, of varying fitness levels—on some days a chronically ill person might feel that walking 100 meters is an achievement, on others 10 meters might already be difficult (cf. [55]). In our approach to using tangible elements without any screen components, we were inspired by previous work [23, 38, 49], but attempted to completely avoid screens. Another key element of our approach is to separate data input completely from later interaction, which allows users to reflect on their current input, and not yet compare and assess it. This design decision emphasises the temporality of data.

We hope our work contributes to the growing body of research which broadens our understanding of STTs (e.g. [23, 39, 45]), tracking data, and well-being. In the following, we formulate directions for further research:

6.1 Limitations and Further Directions for Research

Our four preliminary design criteria for the design of a humanised STT have so far only be used for the design of Frankie. For future research we would like to further explore, refine, and add to these criteria, to set an agenda for humanising STTs. Our work is based on a small sample of people, further research is needed to validate and add to our design criteria. Moreover, at the moment it is unsure whether *Frankie* leads to self-reflection. We hope that the combination of quantitative and qualitative data can prevent Frankie from acting as an 'authority' who knows better[52], but offers space for the user to reflect how the data compares to their feelings. To test this, Frankie has to be deployed in people's personal spaces (e.g. their home) for a longer period of time, to explore whether these hypotheses hold.

Based on the design of Frankie, we see benefit in further exploring the role of audio data for self-reflection. As indicated by Mols et al. [39], audio data tends to be hidden when stored, but public when recording and experiencing it. This could possibly have a negative effect on how people use and experience data artefacts which use audio input. However, other research suggests that users are becoming increasingly accustomed to audio data [36] and that the benefits outweigh the disadvantages [8]. Therefore, we believe it fruitful to further explore audio input for reflection in STTs.

Despite spoken reflections being common in research (e.g. [50, 51]), little is known about how to represent audio data, especially qualitative audio data. Therefore, we think future research should explore how to represent audio data. For this, data physicalisation and sonification seem promising, as they seem to foster emotional connection [22, 60, 61] and enhance engagement [26]. This ties into future work which is needed to explore how to represent the data tracked with Frankie. By separating data tracking and representing/viewing, the data representation's location and medium need to be researched.

Finally, we see design possibilities for the temporal aspects of (data) tracking. As indicated by our participants, data have temporary relevance and could benefit from ephemeral qualities (see section 4.1.3). Furthermore, as indicated by Mols et al. [39] and Valk et al. [13], STTs should be designed for periods of non-use and give users the freedom to decide how they use the artefact. As such, we see possibilities in exploring these temporal aspects and whether they benefit self-reflection.

7 CONCLUSION

Our work suggests four preliminary design criteria for the design of a humanised self-tracking technology (STT) in the data tracking phase. These criteria are derived from an interview study with users and non-users of STTs, mood boards created by the researchers, and a research product called *Frankie*: a tracking device for inputting activity data based on these four criteria. The contribution of this work further adds to the discussion of humanising STTs, moving beyond quantitative data, and one-size-fits-all tracking and data representation experiences.

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