Seeking connectivity to everyday health and wellness experiences: Specificities and consequences of connective gaps in self-tracking data

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Abstract

Objective: Self-tracking technologies have created high hopes, even hype, for aiding people to govern their own health risks and promote optimal wellness. High expectations do not, however, necessarily materialize due to connective gaps between personal experiences and self-tracking data. This study examines situations when self-trackers face difficulties in engaging with, and reflecting on, their data with the aim of identifying the specificities and consequences of such connective gaps in self-tracking contexts.

Methods: The study is based on empirical analyses of interviews of inexperienced, experienced and extreme self-trackers (in total 27), who participated in a pilot study aiming at promoting health and wellness.

Results: The study shows that people using self-tracking devices actively search for constant connectivity to their everyday experiences and particularly health and wellness through personal data but often become disappointed. The results suggest that in connective gaps the personal data remains invisible or inaccurate, generating feelings of confusion and doubt in the users of the self-tracking devices. These are alarming symptoms that may lead to indifference when disconnectivity becomes solidified and data ends up becoming dead, providing nothing useful for the users of self-tracking technologies.

Conclusions: High expectations which are put on wearables to advance health and wellness may remain unmaterialised due to connective gaps. This is problematic if individuals are increasingly expected to be active in personal data collection and interpretation regarding their own health and wellness.

Keywords

Connectivity, connective gaps, hype and hope, health and wellness promotion, pilot study, self-tracking

Introduction

Personal data is regarded as an important learning and motivational resource that is considered to assist self-reflection, thereby advancing attempts, for instance, to make life-style changes. In recent years we have seen a growing interest in the use of self-tracking devices as tools for collecting and reflecting on personal data. Various self-tracking technologies and services, including related smartphone applications, have created high expectations, even hype, regarding the possibilities of using these technologies to produce personal data to monitor, document and analyse various aspects of daily life affecting health and wellness. People are even encouraged to actively collect their personal data because they are considered to be the ‘best (yet often ‘untapped’) resource for information about themselves in general, and their own
states of health and illness in particular’ (p.132). High expectations set on the increasing collection and applicability of personal data have materialised, for instance, in emerging approaches in healthcare settings such as P4 medicine that aims to shift the emphasis from treatment to prevention of illnesses through stressing the role of data as predictive, preventive, personalised and participatory. The expectations set on such novel types of medicine highlight the importance of people’s own activities in achieving and promoting their optimal health and wellness, and it is here that the self-tracking tools are promoted as useful devices.

There is, however, a danger that we overestimate the potential of new technologies or the willingness of consumers to integrate novel appliances into their daily lives. High expectations set on personal data produced by self-tracking technologies do not necessarily materialise. Even though people use self-tracking devices for different purposes, they mainly seek and long for personal data that is first and foremost lively, meaning that data can be reflected on and somehow become meaningful in their daily lives. One of the key prerequisites for the development of lively data is people’s connectivity to their everyday experiences through their own data. This means that to be able to engage with and reflect on data, people first need to be able to gain connectivity to their everyday experiences through data when self-tracking devices and applications act as mediating technologies.

The concept of connectivity first originated as a description of technical connections referring to relationships between electronic devices, but increasingly, the concept has shifted from technical domains to social interactions. Kolb has defined connectivity as ‘mechanisms, processes, systems and relationships’ that act as linkages between individuals and collectives facilitating ‘material, informational and/or social change’ (p.128). Recent research has moved away from focusing solely on human actions to studying the entanglements of both social and material agencies, and examines how technologies as tools of connection function in social spheres and even in the production of our identities. When considering modern communication technologies, connectivity has been found to be their defining feature. In the case of self-tracking devices, connectivity can be considered the key underlying infrastructure that underpins datafication, that is, the conversion of human action into quantified data (see Mayer-Schönberger and Cukier and Van Dijck). The connectivity provided by modern communication technologies is not, however, necessarily constant as suggested but, instead, there may exist ‘connective gaps’ when the connection is for some reason not available. In the context of self-tracking, this means that the qualitative aspects of life do not, for some reason, fully transform into quantitative data. Instead, there are gaps in the data streams. Careful examination of connective gaps can increase our knowledge on the difficulties in the production of lively data in self-tracking contexts in general and the materialization of people’s expectations of their data in particular. This can also lead to a better understanding of why some measurement practices become rooted in our daily lifestyle, or what eventually forces them into extinction.

This study examines the specificities and consequences of connective gaps between people and their personal data in the context of self-tracking. These are situations when self-trackers face difficulties in engaging with and reflecting on their data. The study is based on an empirical analysis of 27 interviews of experienced, inexperienced and extreme self-trackers, who participated in a pilot study aiming at promoting health and wellness. Self-tracking devices are assumed to play an important role in attempts to promote health and wellness and have therefore been closely integrated in pilot initiatives that try to make people carry out lifestyle changes. In this study, the focus is on analysing the ways in which the volunteering participants in the studied health and wellness pilot initiative confront their self-tracking data collected by the Withings Activité Pop activity wristwatch and visualised by the connected smartphone application. The results suggest that in connective gaps the personal data remains invisible or inaccurate to the users of the self-tracking devices. The empirical material shows that those in the study using self-tracking devices actively search for constant connectivity to their everyday experiences through data, but the data repeatedly fails them. From the users’ perspective, the data appears so incomplete that it only generates feelings of confusion and doubt. These are the alarming symptoms of a process that leads to indifference when disconnection becomes solidified and data ends up becoming ‘dead data’ (p.211) providing nothing useful for the user. The high expectations put on the role of wearables in promoting health and wellness remain unmaterialised.

### Hypes and hopes of self-tracking

In recent years, self-tracking technologies have gathered accelerating interest, even hype or mania, towards them. Hype surrounding novel technologies such as self-tracking devices is essential largely because it allows the mobilization of the future into the present. Expectations on novel technologies are seen to guide activities, provide structure and legitimation, attracting interest and fostering investment. The exaggerated
expectations on novel technologies such as self-tracking devices have often been circulated through the media but the result can be unfounded excitement, and the hype can result in disappointment. Therefore, in the process of mobilization of the future into the present through technological hype, it is important to be aware of the different positions of those who promote technologies and those who try to apply technologies in their personal everyday life.

The distinction regarding the hypes and hopes of technologies between technology promoters and practitioners is emphasised in practice-based theories (e.g. Pantzar and Shove). In general, technology promoters, such as technology developers, designers, professionals in different fields, or businesses, aim to innovate new practices in which the novel technologies play the key role. Typically, technology promoters mobilise concepts that have a widespread and generic appeal, such as health and well-being. Regarding self-tracking devices, technology promoters set high expectations, for instance, on the devices’ abilities to increase people’s self-knowledge, and promote overall health and wellness as well as the development of personalised medicine. These concepts deal with abstract and disembodied versions of skills and techniques related to the use of promoted technologies. Brochures, instruction leaflets, websites and videos are then designed to show how to ‘do’, for instance, life management with the promoted technologies.

When technology promoters try to mobilise novel concepts and practices, technology users or practitioners try to integrate the new devices into their everyday life. The abilities of practitioners to integrate technologies into their everyday life is essential for the domestication of innovations. The domestication of new technologies, following the processes of introduction, institutionalisation and expansion, often represents metamorphoses from ‘toys’ to ‘instruments’, from ‘luxuries’ to ‘necessities’, from ‘pleasure’ to ‘comfort’ or from ‘sensation’ to ‘routine’ (see Scitovsky, Douglas and Isherwood, Pantzar). For the practitioner who is trying to integrate novel technologies into everyday life, the link between expectations, materials and skills related to these technologies is more direct and concrete. Regarding self-tracking tools, the users’ ability to gain personal data that is lively, that is, something that can be reflected on and become, in one way or another, significant in everyday life, is essential. This does not mean that practitioners’ expectations of life management tools such as self-tracking devices are fixed or convergent but, instead, the interplay between the expectations, the material components of new devices and the practitioners’ skills forms an ‘anticipatory assembly’ (p.143) that has a capacity to materialise for different practitioners in different ways, making the self-tracking tools living and performative. Some use self-tracking tools, for instance, in their aspirations to document and make their activities visible, thereby aiming to gain better understanding of their existing daily routines. Besides documenting activities, some people use self-tracking devices in their attempts to reach various goals that can range from losing weight and behaviour change to efficient training for a marathon run. Sometimes people may start self-tracking even without knowing their goal for action but are trying to determine whether they need one. Practitioners then essentially expect self-tracking devices to provide a window into the body. They track sleep patterns or various activity levels from eating to exercise to gain concrete support for self-reflection and even self-care. Some people get involved in self-tracking for diagnostic purposes, trying to detect patterns and find causal relationships, for instance, in health-related matters that may worry them. They hope to reach a diagnosis through self-tracking and thereby gain help, or even a cure, for matters that trouble them. All in all, it is essential that self-trackers can reflectively engage with their data and construct meaningful, even multiple stories about themselves, both for themselves and for others, through the constant negotiation, interpretation and contextualisation of data.

Practitioners’ hopes for lively data may remain unfulfilled, however, as both experienced and inexperienced users of self-tracking devices can experience serious difficulties while tracking and reflecting on their personal data. Practitioners may experience problems in gaining connectivity (see Kolb, Kolb et al., Dery et al., Symon and Pritchard) to their everyday experiences through data when applying modern communication devices and applications as mediating technologies. In self-tracking devices and applications, problems appear when the aspects of everyday life that people want to track do not for some reason properly convert into quantified data. Previous research has suggested that connectivity is a flow or a continuous process requiring constant regulating or managing of the ongoing flow of media or data. At the same time, it has been suggested that connectivity contains a constant duality of connects and disconnects. In the case of technological devices, the connective duality could simply mean turning the device, or having it, ‘on’ or ‘off’.

The connective absences in the connectivity flow leave traces of ‘connective gaps’ when a connection is for some reason not available. The causes for disconnection can be either voluntary or involuntary. One example of the limiting factors of connectivity is ‘temporal intermittency’ when the ‘technical connectivity
temporarily vanishes’ (p.129).\textsuperscript{10} This situation may emerge not only when turning the device ‘off’, but also due to breakdowns or malfunctions of devices that are not necessarily easy to fix (see Graham and Thrift).\textsuperscript{40} Traces of connective gaps may also appear when practitioners do not use their devices properly, either due to a lack of skills (see Hargittai and Hinnant\textsuperscript{41} and Baum et al.)\textsuperscript{42} or because they find data collection and the recognition of behaviour patterns and trends burdensome and time-consuming (see Li et al.).\textsuperscript{34} Due to connective gaps, data interpretation, i.e. extracting meaningful information from self-tracking data, is not necessarily easy and bridging the gaps may require clear tracking strategies or even various material workarounds.\textsuperscript{43} Difficulties in tracking, reflecting and using data can lead to growing scepticism and fading interest in self-tracking,\textsuperscript{39} even device abandonment.\textsuperscript{44} On the other hand, the hope for potential future use of recorded data may be so persistent that sometimes people continue using the devices even when they have lost their interest in the novelty of the data or do not find the data useful in their current situations.\textsuperscript{45} Connective gaps can therefore be considered as moments of technological disruptions or failures that, at worst, may end up in producing long-lasting disconnectivity.

A study of self-trackers’ accounts on personal data in a health and wellness pilot initiative

The empirical setting of this study is a health and wellness pilot initiative\textsuperscript{9} in which the advancement of individuals’ life-style changes played a key role. In the pilot initiative, comprehensive life-style monitoring data were collected over a 16-month period (October 2015–January 2017) from roughly 100 healthy volunteers. To support the volunteers’ participatory role in the studied pilot initiative, the individuals were given an activity wristwatch, the Withings Activité Pop, which is a self-tracking device with a connected smartphone application (Withings Health Mate). This type of self-tracking has been described as a ‘pushed self-tracking mode’, where the incentive to engage with self-tracking is not solely self-initiated but, importantly, also externally promoted (p.7).\textsuperscript{1} The decision to use the chosen device was based on its following features: first, the device was able to measure everyday activity (steps) and sleep; second, it was considered easy to use (the battery of the device lasts relatively long, as it has an estimated battery life of up to eight months\textsuperscript{46} with no need to charge the battery; supplementary devices such as heart-rate belts are not necessary); third, it was considered discreet to wear (the device resembles a wristwatch); and fourth, the price was considered relatively affordable.

The participants received their activity wristwatches in February 2016. The participants were informed by the pilot organisers that the aim of the activity wristwatch was to collect data on their everyday activity (steps) and sleep at a rough level (deep vs light sleep). At the same time, they were warned that the device does not recognise all types of sports activities (such as training at the gym), specific stages of the sleep cycle, or the heartbeat while sleeping.

The device’s key affordances and interface

The ease of use of the device is emphasised in the installation and operating instruction manual of the chosen self-tracking device. The manual says

Your Withings ActivitéTM Pop allows you to track your activity…. Whether you are walking, running or swimming, you don’t have to do anything to start tracking it. All you have to do is wear your Withings Activité Pop, it will do the rest’ (p.19).\textsuperscript{46}

Tracking sleep was also emphasised in the manual to be easy, as it was said that ‘Your Withings ActivitéTM Pop lets you track your sleep without requiring any action on your part. All you have to do is wear your Withings ActivitéTM Pop to sleep: it will do the rest on its own’ (p.22).\textsuperscript{46}

The collected steps and amount of sleep are shown in the connected smartphone application (Withings Health Mate) in multiple ways: in graphs, numbers and percentages. The visual representation of the number of steps consists of bars where each bar corresponds to a time period of 30 min. The user also receives her total number of steps collected during the day as well as the percentage of the daily step goal achieved.\textsuperscript{46} Zöllner et al.\textsuperscript{47} have tested some of the most popular and best-selling activity trackers, including the Withings Activité Pop. In evaluating the devices’ accuracy in counting steps, they found that all of the tested devices often generated unreliable results. However, they also noticed that the Withings Activité Pop produced relatively good results and additionally performed better at counting steps such as jogging. Regarding sleep, the visual representation of the amount and type of sleep consists of bars marked in different colours. The duration of the light sleep cycle is marked in light blue, while dark blue bars refer to the duration of deep sleep cycles. Waking hours are also marked separately in orange. The total time spent sleeping is shown, as well as the percentage of the daily sleep goal.\textsuperscript{46}

Regarding the technical connectivity, the synchronisation of data between the device and the connected smartphone application has a key role. The installation
and operating instruction manual promises that the synchronisation process is easy and automatic, requiring only the enabling of Bluetooth wireless technology. The synchronisation automatically takes place, for instance, when the user has collected a certain number of steps or when enough time has passed since the last synchronisation. The users also have the option, however, to synchronise their data manually. According to the manual, this only requires opening the connected smartphone application and keeping it close enough to the device itself. The manual reminds the users to open the application regularly in order to prevent losing any data.46

Methods

After approximately three months of usage, we asked questions about the participants’ experiences of the self-tracking device use and the data it produced. Twenty-seven of roughly 100 participants were interviewed in May and June 2016. The interviewees were carefully selected based on their answers in the questionnaire that they had completed before the beginning of the pilot initiative. Two questions in particular guided the choice of the interviewees. The first selection criterion was whether the participant possessed any previous or current experiences of using any self-tracking devices. The second selection criterion was related to participants’ expectations regarding the use of the self-tracking device in the course of the pilot initiative. This meant specifically whether the participant expected the learning of the use of the device to be easy or not.

The two selection criteria resulted in the identification of three interesting groups of participants for this study. The inexperienced self-trackers had no previous experiences of using any self-tracking devices, nor did they expect it to be easy to learn to use the device. The opposite applied to the experienced self-trackers. Interestingly, the most experienced self-trackers had quit using all their previous self-tracking devices by the beginning of the pilot study. The extreme self-trackers had in use either two to three other self-tracking devices or one device that they had used for at least two years. They expected no difficulties in learning to use a new device. We were well aware that both inexperienced and experienced self-trackers may experience difficulties while tracking and reflecting on their personal data (e.g. Rapp and Cena39 and Choe et al.).43 Our underlying assumption in the categorisation of the participants was, however, that the inexperienced self-trackers would have more and different types of difficulties than the more experienced participants in self-tracking.

The interviewees consisted of nine inexperienced, nine experienced and nine extreme self-trackers. The age of the interviewees ranged from 28—57 years (nine male, 18 female). All participants gave signed informed and voluntary consent to the pilot study. The shortest interview lasted 13 min and the longest 80 min. The interview questions had received ethical approval38 and focused on the use of the self-tracking application (Withings Activité Pop) in the pilot initiative. Specifically, the participants were asked how they used the application, how they experienced the use of the application and whether they experienced any difficulties or challenges in the use. Additionally, the interviewees were asked whether they had any other self-tracking devices in use and, if so, they were asked to describe their experiences concerning these other applications. All interviews were recorded and later transcribed verbatim, resulting in approximately 17 h of interview material. The anonymity of the interviewees has been guaranteed throughout and after the interview process.

The careful reading and systematic coding of interview material (see Eriksson and Kovalainen)48 showed that all types of self-trackers (inexperienced, experienced and extreme) faced various difficulties when encountering and trying to engage with their data. These moments of disruptions seemed to point to the existence of connective gaps when the interviewees lacked connectivity to their data. We want to emphasise here that there were interviewees who considered their data exciting, interesting and some even unproblematic or motivating but, because most participants considered that they had faced some kind of connectivity problems, we decided to focus next on analysing these connective gaps, i.e. the underlying problems in connectivity between the pilot participants and their personal self-tracking data. This resulted in the identification of the nature of connective gaps, their consequences and the ways in which self-tracking devices can fail different types of self-trackers. Table 1 summarises the number of interviewees facing connectivity problems. The category ‘no essential connectivity problems’ means that the interviewees either considered their data to be completely or at least roughly reliable while the other two categories in the table show the type of connectivity problems that the interviewees faced.

Connective gaps in self-tracking

The participants using a self-tracking device in the pilot initiative were seeking visible, accurate and meaningful personal data but, instead, many of them often faced invisible, inaccurate or indifferent data flows. Many struggled to make their self-tracking data lively, meaning that the data could be reflected on or have some meaning for their everyday lives.9 There seemed to exist connectivity gaps in which the data was invisible or
inaccurate and the users would have wanted to have these gaps eliminated in order to gain meaningful data. The results suggest that in cases when connectivity gaps exist persistently and cannot be removed there is a danger that the data becomes dead (see Nafus), thus solidifying the seeds of disconnectivity. This appeared to be the case regarding all types of self-trackers (inexperienced, experienced and extreme) interviewed in the study.

**Seeking visible data... but becoming confused**

In the studied pilot initiative, the Withings activity wristwatch was chosen to support participants in tracking their activity (mainly steps) and sleep. The interviews revealed that many participants found their personal sleeping data particularly interesting. One reason could be that many of them mentioned getting remarkably less than the recommended eight hours of sleep per night. Many participants were either in expert or management positions and suffered from high stress levels. There were also participants who did shift work. Many revealed that they had problems with sleeping. Many participants said that they immediately checked their sleeping data in the morning. The participants hoped to learn about their sleep from their data, and the prerequisite for this was that the data needed to be somehow visible in the records shown in their smartphone application. This, however, was not necessarily always the case.

We have now had this app for a couple of months, and I had a period that regarding sleep was a bit weak. I think that I sleep better now, but in my opinion the graphs have not changed too much. Then you start thinking how reliable this data is. And, I don’t even know how the device [measures]; whether [the data] is based on hand movements or pulse or what. (Male, 42 years, inexperienced self-tracker)

The participant quoted above said that he was interested in data showing the length of his sleep and its division between light and deep sleep. In particular, he sought data that would show long periods of deep sleep. The reason was that he was able to feel physically that his sleep had improved in the course of the measurement period. It seemed that he wanted to verify his feelings through the self-tracking data but became disappointed when he could find no proof in his data streams. The physical change he felt in his sleep remained invisible in his records.

In some cases, the invisibility of data was even more tangible. The data streams produced by the self-tracking device were fragmented, containing inexplicable gaps.

I don’t know what has happened here. What does it mean that all the colours are missing here? Is it that I have been somewhere in the middle of the night? Where have I been? It is almost exactly one hour... It may sometimes happen that if I have fallen asleep in the middle of [a television programme] I go and let the dogs in at night, but I do not remember that it would have been the case here... Most likely it would have taken me 15 min. It wouldn’t take me long. (Female, 47 years, experienced self-tracker)

The experienced self-tracker speaking above was confused about her data. The data contained mysterious gaps that she could not explain. She had an irregular sleeping rhythm due to shift work and animal care and therefore she was keen on keeping track on the amount of her sleep. Instead of providing answers to the quantity and quality of her sleep, the data presented itself partly as fragmented, thereby raising questions that left her puzzled. She tried to find some clues to explain and thus bridge the data gaps but did not succeed. The invisibility of data was perplexing.

Another example of data invisibility was that many self-trackers (particularly extreme ones) reported on various activities, including steps, that did not materialise at all in the data.

I do sports actively.... This [device] does not record everything. I just checked as I came here by bike whether it shows it. No. I do a lot of things that [it]...
does not record…. There can be days that show no activity. (Female, 51 years, extreme self-tracker)

The extreme self-tracker quoted above was actively involved in different sports. Among others, she also trained for a marathon run. For her, keeping track of all her activities was important since she wanted, even needed, to see the extent of her activities. The visible data was essential for her because at its best it acted as an important reminder to rest and recover in order to avoid physical overstraining. The self-tracking data, however, was misleading and potentially even harmful as all her activities did not materialise in visible data.

**Seeking accurate data . . . but facing doubts**

As many of the interviewees suffered from sleep deprivation or even sleeping problems, they sought help from their self-tracking devices and the data they produced. In addition to visible data they expected accuracy in their personal data.

One evening I went to bed at nine, and I woke up at five. When I opened [the app], it displayed quite normally the roughly eight hours [of sleep] or something. I thought, great, now it shows that I went to bed early. But, in the afternoon, when I refreshed [the app] . . . [the data] was gone! . . . As if I had gone to bed at 0.13 am which is pretty normal for me…. Sometimes, it may just cut out the [data], it has done this to me before and showed only two hours of sleep and I don’t know why it is doing this. (Female, 47 years, inexperienced self-tracker)

The participant above had hoped that the self-tracking device could help her to tackle sleep deprivation. The personal trainers in the pilot study had reminded her about the importance of sufficient sleep and she had given herself the goal of going to bed well before midnight. She was first thrilled to see her success in the data, but shocked when the proof had disappeared. She mentioned reminding herself that numbers do not matter and knew that the self-tracking data was primarily meant for herself. She was well aware that she herself would still know the length of her sleep at night, even when the data was gone. Still, she longed to gain for herself and to be able to give others (such as personal trainers) accurate proof of her sleep and reported feeling unmotivated, even discouraged from trying to make a behaviour change after noticing the disappearing data. The self-tracking data had failed her and made her doubt the correct functioning of the device. Moreover, it had made her doubt her abilities to use the device properly.

Sleeping problems were varied among the participants and some used medication to overcome their difficulties with sleep. They hoped that self-tracking data would provide help in gaining natural sleep without medication. The hopes turned out to be overestimated and the inaccurate data generated feelings of annoyance.

It does not measure sleep in the best possible way. I may lie in bed awake for an hour meaning that I have been still and it has not moved. Then, it has thought that I have been asleep. . . . It praises me for having slept well even if I had slept way too little. . . . This has naturally been annoying. I have used medication [to be able] to sleep. I first thought that this [application] is useful. I could write down those nights when I have taken medication to be able to compare these to my sleeping data. But, it does not work that way as it does not measure sleep properly. (Female, 39 years, experienced self-tracker)

Besides sleep data, the data on activities also proved inaccurate. Extreme self-trackers had many self-tracking devices in use simultaneously. They felt disappointed at not being able to verify their data as they acquired different types of data sets from different devices.

[This device] always shows too much. In 10 kilometres it may show one kilometre too much. I always check the time and distance [that I have run]. Well, I would be an excellent runner if these [numbers] were real. But, they are not. (Female, 43 years, extreme self-tracker)

Different data streams made the participants using multiple devices constantly reflect on the functioning of their various devices and the accuracy of the data streams they provided.

**Seeking meaningful data . . . but feeling indifferent**

The interviewees sought personal data that was lively. i.e. somehow meaningful for their personal lives. In cases when the data had repeatedly failed the self-trackers, some participants seemed to begin abandoning their attempts to interpret their data. Data remained plain data but nothing else; it started to become meaningless and dead, leaving the self-trackers feeling indifferent.

There are bars to show deep and light sleep. But it doesn’t give you accurate data. It is so-and-so. Even if you go to bed early it may show something different. Or, on some mornings it may show that I had woken
up an hour earlier even though I haven’t. I don’t know why…, I do not trust it completely as it acts strangely like that anyway. I just think [about the data] that maybe it [shows what] has been the case or then not. (Female, 32 years, inexperienced self-tracker)

This participant explained that in general she was interested in receiving her self-tracking data and found the device easy to use. She said that she regularly followed her self-tracking data both on activities and sleep. It seemed, however, that the data did not meet the expectations that she might have had, but instead created some frustration. She, for instance, cycled a lot and was disappointed because the device considered her to be passive as if it failed to track her cycling. Regarding sleep, this participant felt that the device did not correctly recognise when she had fallen asleep or woken up. The self-tracking data did not seem to match her lived experiences and the amounting disappointments made her feel indifferent to the data.

Some interviewees talked about the importance of being able to put their self-tracking data in context. In particular, it seemed important for these participants to be able to compare their self-tracking data with others. Some shared their data on activity (steps) in the Withings app with their colleagues who were participating in the same pilot study and took part in weekly competitions on activity levels. The competition was not necessarily taken seriously but, instead, they were just curious about seeing other participants’ data. One experienced self-tracker reported that seeing other participants’ data and thus being able to put his own activity level in context was enough. He had learned that his activity level was about the same as that of others. Moreover, he did not feel that he needed to make any behaviour change. Therefore, after satisfying his curiosity, the data lost any meaning at all for him.

I do check whether I reach my goals for the daily activity. However, if it shows that my activity is less [than 100%, meaning that I have not reached the goal] I have not gone jogging or anything. It does not have any effect on anything. (Male, 30 years, experienced self-tracker)

This experienced self-tracker had also tested other self-tracking devices before the Withings one. Even then, the driving force had been curiosity about current trends in self-tracking and a desire to just gain a feeling about self-tracking. He said that because the data did not seem to offer him anything interesting his whole interest in self-tracking simply faded away.

Not all the participants, however, were able to put their self-tracking data in context through comparing their self-tracking data with others. One extreme self-tracker described his desire for data comparison but, at the same time, he had not even clarified how the sharing of data is done with the Withings app. He also pondered about who he would share his data with and whether the sharing of data would eventually turn into a competition.

It would be great to see other participants’ data to be able to compare. Then you could be able to rate, for instance, this Withings data. How reliable it is and so. When you look at the data just by yourself, you keep thinking is it so or not. But, if you would hear from other people that they have this and that kind of data, you could be able to put your results in the right scale…. If somebody says that she hasn’t slept well and the metrics shows it like this and that, it makes you think too. Can you see it or not? And, can you trust it or not?... If I see that I have five hours deep sleep, am I in reality somehow more energetic? If I would hear from others whether they feel more energetic or not then I would put it in the right scale. (Male, 46 years, extreme self-tracker)

Overall, it seemed that the extreme self-tracker longed for appropriate forums for sharing self-tracking data in the pilot study. The data appeared inadequate and somewhat unreadable to him as he did not see his data in relation to that of others.

Discussion

In modern societies, there exist high expectations of self-tracking technologies and services particularly regarding advancement of life-style changes. There are, however, systematic differences between the technology promoters, who conduct generic associational work on technologies, and the technology practitioners, who try to integrate technologies into their everyday life. This study examined the attempts of technology practitioners to integrate self-tracking devices into their everyday life to advance health and wellness. So far, difficulties in tracking and reflecting on self-tracking data have been largely acknowledged (see Li et al., Rapp and Cena, Choe et al., Lazar et al.). This study continues this critical stream of research by focusing more closely on self-trackers’ connectivity to their everyday experiences through their self-tracking data. Connectivity can be regarded as the lifeblood and one of the fundamental premises for the development of lively, meaningful data.

The results show that the users of self-tracking devices actively search for connection to their data to be able to reflectively engage with it but there exist connective gaps that are hard to bridge. The production of connectivity with one’s own everyday experiences
through self-tracking data is not necessarily a straightforward process. Instead, as Nafus\cite{20} has already pointed out, making self-tracking data lively though engaging with and reflecting on data flows may require hard work for the users. Those moments when data appears vague or is completely missing, or, as Nafus (p.208) puts it, when ‘numbers are in the making’, create an important space for data interpretation and clarification work.\cite{20} These moments can be regarded as manifestations of connective gaps when the person’s connectivity to self-tracking data has to be produced to make the data lively, in other words somehow meaningful.

This study confirms and elaborates previous studies (see Rapp and Cena\cite{39} and Choe et al.)\cite{43} that have shown that connectivity problems not only apply to inexperienced users of digital devices, but experienced self-trackers may also have difficulties in engaging with their own data. Our study followed three different types of self-trackers – inexperienced, experienced and extreme self-trackers. The analysis did not support our preliminary assumption that the inexperienced self-trackers would have more difficulties in gaining connectivity than the more experienced or extreme self-trackers. There were pilot participants in each group experiencing connective gaps, but each group emphasised somewhat different aspects related to connectivity.

The results suggest that connective gaps appear when self-tracking data seems inaccurate, remains invisible or is difficult to interpret. Among the inexperienced self-trackers, many in the study noticed that the data was not accurate but did not find it problematic. Instead, they emphasised the importance of gaining a rough estimate of their activity or sleep. Pantzar and Ruckenstein\cite{49} note that objective accuracy is not necessarily the most important characteristic of the various activity trackers and that ‘accurate enough’ data (p.3) is often sufficient for the practitioners. This did not, however, apply to the extreme self-trackers in our study, who had a different perspective on data accuracy. Many of them were active in sports and faced connective gaps in the form of data accuracy, as the device did not recognise the sports that they engaged in. As an example, for one person two hours of skiing turned into 300 m of swimming. Lynch and Cohn\cite{19} note that in cases when data streams do not seem to match personal experience, self-trackers often doubt the accuracy of the equipment. Doubt may then be regarded as an indication of a break or breach,\cite{50} a manifestation of a connective gap that at best can act as a driver to generate and experiment with possibilities for a solution.

The data inaccuracy was for some of the extreme self-trackers so annoying that they tested or tried to fix the device in different ways in attempting to bridge the connectivity gaps. They wore it on different body parts or added some information manually, hoping to gain more accurate data. The extreme self-trackers clearly put extensive effort into their attempts to bridge connective gaps, which might be because of their previous and existing experience with their other devices.

Some of the self-trackers in all three groups of our sample faced connective gaps where data remained invisible. It is difficult to know whether the data invisibility was a result of the users’ lack of skills or motivation to use the device properly or due to some technological malfunction or breakdown, either of the device or the network connection. It became, however, apparent that these types of connective gaps cause confusion, frustration and helplessness (see also Paasonen).\cite{51} It also appeared that these types of connective gaps are not necessarily easy to fix. The detailed instructions printed in the manual and delivered in the pilot initiative did not necessarily prevent these types of problems. This raises the question of a requirement for technical assistance if these types of technologies are implemented on a larger scale in healthcare.

Beside inaccurate or invisible data, connective gaps may also appear when users of self-tracking devices face data that is difficult to interpret. As noted by Davis\cite{37} and Lupton,\cite{38} self-trackers want to engage with their data and construct meaningful, even multiple, stories about themselves, both for themselves and for others. This raises a question whether self-tracking devices and particularly the data they produce have a somewhat similar role than social media for the users in their construction of identity (see van Dijck).\cite{52} Storytelling, however, is difficult if the data is hard to interpret. In this study, some of the experienced self-trackers in particular yearned for more clarity for data interpretation. One even said that she would like to have help from health and wellness professionals in her self-tracking data interpretation. Nafus\cite{20} has noted that data interpretation work can have two possible outcomes; on the one hand clarity or action, and on the other hand failure or indifference. In this study, an example of a failure taking place in interpretation work is provided by one inexperienced self-tracker who felt that the data depicted her as being inactive or even passive. In reality, she was an enthusiastic bicycle rider, but the device did not recognise this type of activity at all. The difficulty of constructing a meaningful story based on her data resulted in her abandoning further interpretation work, leading to almost indifference towards her data.

A limitation of this study is that the results are based on a relatively small sample of interviews (27) of participants in a large health and wellness initiative. In the interviews, the participants were, however, able to give
Concluding remarks

The empirical study that we have analysed here was part of a large health and wellness initiative ‘Digital Health Revolution’ of which the seemingly revolutionary vision was that in the future, people will also be better able to control and make use of their personal data in the healthcare setting. Self-tracking devices here play an important role as they are seen to enhance proactive, personalised health maintenance for the benefit of individuals, society and business. Thus, in the spirit of the technology promoters’ view, the participants in the pilot initiative used an activity wristwatch and were supposed to obtain livelv, i.e. visible, accurate, and meaningful personal data. Against these expectations, many of the practitioners, i.e. pilot participants, faced invisible, inaccurate or indifferent data flows. The data failed to be meaningful. Participants with different types of experiences in self-tracking (inexperienced, experienced and extreme self-trackers) faced connective gaps in their self-tracking data flows.

The reason that the views of technology promoters and technology practitioner differ so radically is related to two mechanisms. First, in a typical hype cycle it is exactly the technology promoters’ (here revolutionaries) role to generate narratives full of promises not only for the present but mainly for the future in order to involve various interest groups in a novelty (see Brown, Borup et al., Lunde et al., Pantzar and Shove, Fenn and Raskino). However, for the practitioners who try to integrate novel technologies into their everyday life, the link between expectations, materials and skills related to these technologies is more direct and concrete. They want the promises to be fulfilled immediately and not only in the distant future when the need and motivation to use self-tracking devices will also be transformed in time. Second, it is only the technology practitioners who experience a typical technology domestication process, in which sensation, pleasure and excitement turn into instrumentally motivated routines full of contextual requirements (see Scitovsky, Douglas and Isherwood, Pantzar). This means that for the technology practitioners new self-tracking tools can at first produce excitement and pleasure but in time the pleasure fades away and is translated primarily into increasing comfort. Basically, comfort means that the integration of expectations set on technologies and the practitioners’ skills becomes more stable while conscious choices to use the technology move into the background and self-evident routines become almost automatic. This study suggests that connective gaps may act as crucial interference in this kind of automation or routinisation processes and decrease the likelihood that self-tracking tools will capture a permanent role in the everyday advancement of people’s health and wellness.

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Notes
a. The health and wellness pilot initiative ‘Digital Health Revolution’ (DHR) was organized by the Institute for Molecular Medicine Finland (FIMM), HiLIFE, University of Helsinki.
b. The DHR Study was conducted according to the guidelines of the Declaration of Helsinki. The study protocol was approved by the Coordinating Ethics Committee of the HUS Hospital District (51/13/03/00/15).

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