

Living the metrics: Self-tracking and situated objectivity

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Abstract

This paper evaluates self-tracking practices in connection with ideas of objectivity via exploration of confrontations with personal data, particularly with reference to physiological stress and recovery measurements. The discussion departs from the notion of ‘mechanical objectivity’, seeking to obtain evidence that is ‘uncontaminated by interpretation’. The framework of mechanical objectivity tends, however, to fall short when people translate physiological measurements to fit their expectations and everyday experiences. We develop the concept of ‘situated objectivity’ with the goal of highlighting the everyday as a domain of interpretation, reflection and ambiguity, proposing that the concept offers an analytical entry point to a more profound understanding of how people engage with their personal data. Everyday data encounters are not methodical and systematic, but combine knowledge in an eclectic manner. Framed in this way, self-tracking practices are less occupied with ‘facts of life’ than translating and transforming life based on earlier experiences, cultural understandings and shared expectations. Paradoxically, new measurement devices and software, which are supposed to be based on sound, universal and generalisable principles, hard facts and accurate descriptions, become raw material for daily decisions, as people seek bespoke answers and craft personalised theories of health and life. From this perspective, self-tracking measurements can be used to experiment and learn, gaining value in relation to the communicative processes that they promote and contributing to possibilities for rethinking health knowledge and health promotion.

Keywords

Mechanical objectivity, situated objectivity, data valences, self-tracking, temporality, stress

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Introduction

The digital health field has seen an explosion of applications designed for tracking physiological responses and everyday behaviours. Tens of thousands of devices and applications have been developed to support people’s goals of behavioural change and help them lead healthier lifestyles. Initial enthusiasm for the capacity of self-tracking technologies to aid in self-optimisation and health promotion has given way to scepticism and disappointment, however. Studies suggest that the devices fail to do what they promise,^{1–3} and designers, manufacturers and promoters alike talk about a need for the digital health market to move beyond technological solutionism and utilitarian notions of the self.^{4,5} We propose that the fact that self-tracking devices fail to aid in self-optimisation efforts and health promotion has less to do with self-tracking *per se* than with how digital health promoters expect these aims

to materialise. Self-tracking technologies are situated and imagined in terms of rational outcomes and impacts within the realm of preventive health, and suggest target rates and behavioural patterns that users of technologies are gently, or more briskly, instructed to follow in order to become healthier and happier. Devices and applications are seen to operate as risk assessment frameworks and behavioural aids, telling people how to relate to their physiologies and bodies through the monitoring of individual numbers measured against values calculated at the level of the

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population.⁶ Expectations of normality and health are implanted in the self-tracking devices as target numbers, risk scores and gamified incentives.⁷ It is, for instance, customary to associate pedometers with a daily target of 10,000 steps; users do not know the ‘science’ behind such targets, but they orientate and adjust their everyday practices to fit the recommended metrics.⁶

The aim of our discussion is not to deny the importance of new digital metrics and their moral and normative forces, but to argue that self-tracking devices operate in a less straightforward manner than is often imagined. People tend to have different expectations in terms of self-tracking and data encounters which vary according to social setting and users’ aims, ultimately affecting whether self-tracking devices can produce data that are seen as valuable or meaningful.⁸ Self-trackers actively translate physiological measurements to fit their expectations and experiences of day-to-day life and define the value and importance of measurements in a manner that complies with their purposes and self-understandings.⁹ It should be noted that the emphasis placed in this article on the translation work that is applied to physiological measurement data has meant downplaying both the power of digital metrics to constrain human agency and the exploitative or coercive elements of data-driven initiatives in the digital health field.¹⁰ We have done this deliberately, however, in order to make human interpretative powers visible.

Following these preliminary insights, we evaluate self-tracking practices in connection with ideas of objectivity via exploration of confrontations with personal data, particularly with reference to physiological stress and recovery measurements. We depart from the notion of ‘mechanical objectivity’ that attained dominance as a scientific ideal in the middle of the 19th century, one associated with observation tools and medical devices such as cameras or microscopes.¹¹ Much like photography, self-tracking devices can be seen as displacing human agency in the production of images of life; visualising the heart rate or the number of steps taken per day proposes a seemingly mechanical and objective way to capture aspects of self and the everyday through data-gathering and analysis. Mechanical objectivity plays a crucial role in how self-tracking renders bodies and day-to-day life knowable, as mundane practices such as sitting, eating or walking are transformed into arenas of observation and intervention.^{5,12}

Capturing these aspects of life, however, is only one of a number of starting points for an account of self-tracking suggested by the empirical material we have gathered. We build our case on a research project focusing on heart rate variability (HRV) measurements and participants’ accounts of measured stress and

recovery. Conforming to the notion of mechanical objectivity, measurement results are treated as truthful and accurate depictions of physiological states. Lupton argues that self-tracking technologies encourage people to understand their bodies and health states ‘predominantly via quantified calculations, predictions and comparisons’ (p.449),⁷ yet, once the measured data are contextualised in the everyday, accuracy might no longer be their most important aspect or value. Fiore-Gartland and Neff propose the notion of data valences ‘to reflect the multidimensional differences in the expectations for and values around data’ (p.1470).⁸ Their ethnographic research focused on the value of health-related and medical data among technology designers, medical practitioners, patients and self-trackers to find that different ‘communities of practice’ conceptualised the same data very differently. Consequently, their study elaborates six data valences: self-evidence, truthiness, actionability, transparency, connection and discovery. The self-evidence valence, for instance, treats data as obvious, requiring little or no interpretation by experts; actionability refers to the expectations that the data triggers, or data that becomes a driver for action.

Given the move away from the mechanical objectivity that we describe as characteristic of confrontations with personal data, the data valences of discovery, emphasising the possibility of finding unknown patterns in the data, and connection, defining the data as providing space for conversation, are particularly interesting. As previous empirical studies of self-tracking have argued, personal data encounters produce material that self-trackers use for self-discovery and to construct stories for themselves and others.^{13–16} In this shift towards narration and sense-making, the truthiness and accuracy of data are evaluated in light of the relevance of the measured data in a specific context. Nafus and Sherman describe how self-trackers ‘traverse between what is inside and outside the body’ and ‘put things out in the world (software, reminders, routines, and sensors) in order to reflect on, and reorder, what is inside the body (the sensation of energy, mood, or productivity)’ (p.1789).¹³ We add to this stream of scholarly work on self-tracking by a further investigation of how personal data encounters are interpreted in particular situations or life transitions. In terms of objectivity, we explore a move from mechanical objectivity towards other types of objectivity. Before elaborating this hypothesis further on the basis of our empirical findings, we briefly present aspects of objectivity on which we rely in our account, introducing the notion of ‘situated objectivity’ that we see as emerging from, and defining people’s encounters with, their personal data.

Towards situated objectivity

Objectivity is a historically and philosophically thought-provoking concept which can highlight the diverse and changing aspects of knowledge formation, including observation, interpretation and reasoning.^{11,17} Rather than specifying all possible modes of objectivity, or discussing how to capture relevant aspects of it,¹⁷ we develop the concept of ‘situated objectivity’ that emerges from partial perspective and situated knowledge¹⁸ with the goal of highlighting the everyday as a domain of interpretation, reflection and ambiguity. We propose that situated objectivity offers an analytical entry point to a more profound understanding of how people engage with their personal data. In particular, we aim to demonstrate how the metrics of life promoted by self-tracking can generate new types of discussion wherein the encounters with personal data and culturally shared understandings can inform each other and promote new ways of addressing questions of health and health promotion.

Mechanical objectivity is a fruitful point of departure for discussing confrontations with personal data, because the transformation of life into quantified measures and numbers is a driving force behind the cultural and economic logic of self-tracking.¹⁰ The notion of the quantified self, for instance, advocating self-optimisation and behavioural change by means of feedback loops, relies on the idea of ‘living by numbers’.¹⁹ From this perspective, the goal of self-tracking is to obtain evidence that Daston and Galison (p.139)¹¹ describe as ‘uncontaminated by interpretation’: numbers are meant to offer a ‘pure’ and ‘authentic’ view of the self. Concepts such as accuracy, consistency, dependability, stability and precision are important in this regard. In compliance with the notion of mechanical objectivity, users of tracking devices want results to be precise and accurate. Yet, typically, they do not expect scientific accuracy from self-tracking: it is sufficient for them to get ‘accurate enough’ data to aid in externalising and objectifying aspects of the self and the everyday. Mechanical objectivity transforms life, in all its ambiguity and messiness, into something manageable; numbers and data visualisations provide a stable frame of reference that stands in opposition to subjective forces of knowledge formation.

Yet mechanical objectivity becomes tainted by other forms of objectivity when self-trackers start evaluating their expectations and day-to-day life in light of measurement results. A single physiological measurement offers ‘a slice of life’,⁹ functioning as a diagnostic view reminiscent of what Foucault described as the ‘clinical gaze’,²⁰ in line with the medical mode of knowing which came into being in the early 19th century and rapidly attained ascendancy. The clinical gaze relies on

mechanical objectivity: it detects pathologies, abnormalities and irregularities by exposing and localising them. In what may seem a paradox, the aim in undertaking self-tracking may be one that is precisely the opposite of the clinical gaze: that of gaining a holistic view of life, rather than focusing narrowly on some aspects of the self at the expense of others. With this aim, self-trackers want to get beyond the mechanical objectivity upon which they initially relied, and the route through is provided by ostensibly objective data which offer a common language that they can understand, becoming ‘a medium of connecting with others’.^{15,21}

While the notion of mechanical objectivity is still foundational in many areas of life and research, another kind of objectivity, referred to as ‘trained judgement’, became more prominent in the 20th century.¹¹ In contrast to mechanical objectivity, trained judgement acknowledges that knowledge is socially situated and open to various interpretations, thereby deviating from the notion that objectifying tools, such as imaging or self-tracking technologies, offer ‘pure’ or ‘authentic’ mirrors of reality. Trained judgement rests on expert knowledge and respective disciplinary traditions; in terms of self-tracking and personal data encounters, forms of trained judgement can manifest in the way data encounters are contextualised. As we aim to demonstrate, however, instead of being anchored in the realm of mechanical objectivity, or trained judgement, experiences of HRV measurements should be seen as encompassing features of both forms of assessment. The notion of situated objectivity takes advantage of mechanical objectivity and trained judgement, but in an eclectic and less systematic manner. By using the concept of situated objectivity we acknowledge that the self-trackers’ way to approach life is not methodical and systematic – it might not even be logical – but, rather, combines knowledge in a selective manner that follows a different course of knowledge formation. Framed this way, self-tracking practices are less occupied with ‘facts of life’ than with translating and transforming life based on earlier experiences, cultural understandings and shared expectations. In the following sections, we demonstrate why experiences of HRV measurements should be seen in the light of situated objectivity, and what we think can be learned by doing so. After methodological considerations, we offer individual accounts of physiological measurements to support our case and suggest that the kind of experimental research that we have pursued, taking advantage of people’s interpretations of personal data, allows the exploration of the complex dynamics of physiological measurements, bodily felt stress reactions and cultural understandings of those reactions.

Methodological considerations

The empirical research we build our account on is from a participatory HRV study combining qualitative and quantitative approaches.^{9,22} The material, gathered in Helsinki, Finland in March and May 2012, comprises an average eight days of HRV measurement. The electrodes recording the small electric waves being generated during heart activity were attached to the participants' chests at two points: the device needed to be removed only during water sports and when showering. The 36 research participants, 15 men and 21 women, were healthy, mostly employed, aged between 28–52 years. The measurement device used in our study, Firstbeat, follows the principle that a change in HRV reflects the ability of the heart to adjust to changes in external conditions.²³ In short, the more stressed the heart, the less it reacts. This idea aligns well with the scientific understanding that physiological stress consists of a state wherein the requirements of the environment exceed the capacity of the organism's homeostatic regulatory system.²⁴ We accepted Firstbeat's algorithm, developed for measuring stress and recovery, as sufficiently valid, while remaining aware of the scientific debate on the connection between HRV and stress. HRV measurement is particularly useful when the cause of stress is no longer present – that is, when HRV is low yet the pulse is higher than is considered normal. After an athlete has over-trained, for example, periods of low HRV are often characterised by a state of hormonal imbalance in the nervous system.

In the qualitative part of the study, we encouraged the participants to write their own detailed diary entries during the monitoring period in order to provide a contextual locus for the measurement results. The research participants gave us their written consent to use their diary entries as research material, agreeing that the material could also be used to present individual-level rather than aggregated data. After the monitoring period, the subjects received an illustrated report based on Firstbeat HEALTH-software analysis of their HRV, including their own entries about everyday doings. These reports were used as a starting point for interviews and group discussions (see Ruckenstein).⁹ As suggested above, the measurement data offers a common language, becoming a medium of connecting with others. In our study, the reports summarising the results of the personal data gathering opened space for negotiation about the value and meaning of self-tracking and measured stress.

In earlier research, we examined the discrepancies between physiological measurements and subjective experiences in our HRV study, noting that the 'heart' and the 'mouth' disagreed about the experience of

stress or recovery.²² Here, we take inspiration from the notion of data valences in order to reflect on the diverse expectations for, and values around, the data. Fiore-Gartland and Neff use data valences to highlight the diverse ways social groups conceptualise the same digital data.⁸ Healthcare workers value actionability of health and medical data for managing patients and their conditions, while self-trackers collect data to produce material for self-narration. Rather than focusing on the different groups with dissimilar data valences, we instead highlight the way in which self-trackers exercise situated objectivity – also in terms of data valences. When contextualised within the everyday, people's confrontations with a single data stream can 'reflect the multidimensional differences in the expectations for and values around data' (p.1470).⁸ In finding value for personal data, one data valence might shift into another and there might be disagreement among valences or unexpected alignment in the course of self-narration. Importantly, detection of stress by instruments of measurement also introduces other kinds of forces than the data valences: emotional and visceral reactions to measurement results, in light of which personal data can appear as deeply awakening and meaningful, or completely irrelevant.

Personal accounts of stress and recovery

We present the findings in the format of personal accounts of stress and recovery, documenting expectations that self-trackers have in terms of measurements and how they position themselves in relation to the knowledge gained through the new metrics of life. With this goal, we want to go deeper into the question of how personal data streams are selectively used to interrogate the self and the everyday. Making data 'talk', in the sense of its gaining value and meaning through the interpretation of data flows produced by self-tracking devices, is not a self-evident or straightforward process; rather, it requires interpretative effort.^{13,16,25} Most participants in our study had specific questions in mind, or certain aims that they wanted the self-tracking study to address. Many of them also relied on the data valence of actionability and expected the devices to encourage them to become more physically active or fit. This is a testament to the somewhat unrealistic expectations that people have in terms of self-tracking: the devices and applications are expected to answer very precise questions about sleep, nutrition or exercise. For instance, one of the participants wanted to learn about the physiological effects that a certain recovery drink, which he consumes after a session of vigorous exercise, has on him.

Instead of answering predefined questions and persuading participants to change their behaviour, however, contextualisation of the measurements raised questions that the participants had not even thought of asking. For us, this was one of the most important findings of our research, making the practice of self-tracking much more thought-provoking and surprising than is suggested in the marketing materials.²⁶ Rather than confirming prior expectations, the measurement results can work against them. Many participants were positively surprised, because their concerns related to health and well-being were unfounded. One participant had concluded, for example, that since she was nearing 50 years old and experiencing menopause, she was probably not sleeping well, yet physiological measurements revealed that the commonly shared understanding that sleep quality deteriorates with menopause did not apply in her case. As she put it: 'It was a happy surprise that sleep was restorative'.

Not unexpectedly, many participants were culturally tuned to perceive stress reactions in particularly stressful situations. They operated with the expectation that causes and manifestations of stress are typically connected with situations of uncontrollability and unpredictability.²⁴ When, against their expectations, stress reactions were not evident in the measurement results, they were relieved and sometimes surprised. Marjo, a mother of two in her early thirties, found, to her astonishment, that intense shouting fights with her husband elicited no signs of stress according to the report. Instead, the HRV measurements indicated physiological recovery during this seemingly stressful social encounter. In a similar vein, one of the younger men learned that quarrelling with his girlfriend did not manifest itself at all in the measurement results. Pondering on the result, he mused: 'I have to listen to her and listen to myself and it is hard work. Is that what makes for a more laid-back atmosphere? Perhaps keeping things in is actually more stressful?'. Instead of offering participants the clarity that they might have expected, the results reports prompted amazement, doubt, self-reflection and the re-evaluation of familiar situations. This kind of questioning introduces a space for reflection, where participants transform objective stress peaks, measured through the proxy of HRV, into questions and evaluations of their lifeworld. For some, the reports were a call for action, but not in the manner of the data valence of actionability: they had to rethink their daily actions in light of the new knowledge of their stress reactions. In the following, the personal accounts of stress and recovery summarise the participants' interpretations of stress measurements with the aim of demonstrating that these always depend on the larger context of day-to-day life.

When stressful is not stressful

Mia, a mother with two young children, decided to participate in the self-tracking study because she wanted to become more physically active and learn to control her unhealthy eating habits; she saw self-tracking as having the potential to uncover what triggers her craving for sweets. Yet, rather than providing understanding of her eating, the self-monitoring period gave her other kinds of everyday perspectives: she realised that her life was actually quite balanced, and that her sleep quality was much better than she had thought. She still felt that she should engage in more physical activity, but the overall view of her life proved more positive than she had expected, something she summarised by observing, 'I am not exactly a coach potato'.

In terms of stress and recovery, her views were consistent with those of other participants. Stress reactions are typically discussed as being conditioned by the familiarity of the situation and consequent feelings of control over it. Alongside her studies, Mia worked as a cashier at a grocery store. She pondered on the nature of the stress that she feels at work: 'If I had a lot of interaction with others, stress peaks can be seen [in the measurements]. While I do not experience these interactions as stressful, the heart rate may be quite high. Perhaps it is positive stress?'

Mia spoke about queues in the store as potential sources of negative stress. As proposed above, exceptional and unexpected social events tend to be culturally experienced as stressful, providing a reminder of the fact that causes and manifestations of stress are typically connected with situations over which the subject has little or no control. She remembered one encounter as particularly stressful: she had to place an international call to a customer's credit card company while a queue of other customers waited. To her surprise, no stress peak was visible from the result report. She wondered about stressful situations that are not physiologically stressful and how to distinguish between positive and negative stress. Like other participants, she started paying more attention to the moments of physiological recovery shown by her measurement results: recovery, less ambivalent than stress, is detected during periods when lost energies are being replenished. To Mia's great surprise, physiological recovery took place while she was studying. 'Is it because of the brain work or what?' she wondered.

When the stressful brings stress

Tiina, who held a job in adult education, wanted to participate in the study because some months earlier

she had had an awareness-raising experience: she had started to cry in the middle of a meeting at work. It was very difficult for her to admit how stressed and tired she was. Her workload was uneven and, while she had less to do on some days than others, she felt unable to shake off the sense of being constantly in a hurry.

For Tiina, the physiological measurement results suggested lack of recovery: she noted that it was ‘pretty shocking to see how little recovery takes place during work hours’. When she studied the results more carefully, one finding in particular demonstrated recurring stress reactions. Opening her work email before 10:00 corresponded to a clearly noticeable daily stress peak, shown in red in the report. Considering this finding, she said, ‘I do not really know yet what to make of it. Now that I’ve realised that I stress so much, it stresses me even more’. Detection of stress by instruments of measurement can intensify the experience of it, just as evidence of recovery can make the everyday doings that occasion recovery seem more valuable. Tiina started to accord more value to idle moments at work after seeing that they were physiologically good for her: ‘Snacks by the computer, when I have been on Facebook, reading private emails. Even if I am at the workstation, recovery takes place’.

Personal accounts of stress and recovery demonstrate how difficult it is for an outsider to ascertain the emotional dimension corresponding to the measurement results. The deeply personal nature of self-tracking has been highlighted by Van Den Eede, who writes that ‘no one else can make sense of the acquired data in the same “felt” way as I can’ (p.155).²⁷ Tiina said that she wants to achieve, expressing the opinion that people create their own lives; physical exercise and well-being are important to her and of the data valences she particularly values actionability. The self-tracking study led her to think a bit more charitably about her life: as much as she would like to, she cannot control her physiology or her feelings in the face of physiological facts. She still has to open her work email in the morning, and she now knows beforehand that it is likely to cause her stress.

When the stressful requires action

Ari was interested in the self-tracking study because it brought together two things that are close to his heart: technology and well-being. A man in his early thirties, with a family, working in sales, Ari was engaged in sporting activities almost every day. If a more efficient way of reaching a given goal for his performance and development existed, he was eager to find and apply it. His approach to sport extended to his life in general: his expectation was actionability, of being able

to improve his day-to-day life by means of the HRV measurements.

Ari was surprised to see how little the busy nature of his life manifested itself in the HRV data: he was not as stressed as he expected. Yet, when considering the measurements, he stated that some lifestyle changes were probably still needed. During a group discussion, he brought to the fore a pattern of late-night quarrelling with his spouse:

I could go to bed earlier . . . I do recognise why I stay up so late. In a way, that is most fatal for our relationship: productive talks do not take place after half past 11 at night. I must say that is not a fertile time to start evaluating what is on the minus side. Two tired people, and neither of them with the energy to care.

Ari spoke of a call for action that he perceived in his results: he must actively seek a balance among the elements of physical, physiological and mental well-being. He talked about a ‘deliberate intervention’ that he intended to undertake, followed by more stress and recovery measurements. This would entail a change to his daily schedule, experimenting with earlier rising and a more conscious daily rhythm. What he felt he needed to avoid were the late-night conversations. With experience of the difficulty of more dramatic changes, he thought himself able to enhance the quality of his day-to-day life by paying attention to small details, one step at a time.

When stressful is merely stressful

Inka had just turned 40 years old and was recently divorced after 20 years of marriage. She joined the self-tracking study in the hope that it would give structure to her life and encourage her to exercise more. She described how difficult the divorce had been for her: she has two teenage sons and had been the person taking care of household affairs. She spoke of missing the family dog and the routine aspect of domestic chores.

She used to be a good sleeper but had begun sleeping poorly. She described waking almost every night, then staying up for a couple of hours. ‘It is really stressful’, she said. Unlike the other participants in the study, she said that she gained no new knowledge or insights about herself during the measurement period, stating, ‘I knew that I don’t sleep well, so it was not surprising’.

The possibility that self-tracking will reveal nothing of importance is significant in connection with evaluating the role that self-tracking can have in supporting people. Inka said that the measurements felt too detached from the bigger questions that she had to ask herself, commenting, ‘I examined myself through other means’. From the measurement period, she

concluded that self-tracking might be interesting and able to illuminate facets of everyday affairs but that measurement results are not necessary for showing how stressful life is when one is undergoing major life transitions. Inka did not regret participating in the study, but she did note that it made her aware that technologies are persuasive only if the people using them are open to such persuasion. In a related observation, she pointed out that being confronted with personal data can help people recognise that there may be no room for the adjustments recommended on the basis of self-tracking, on account of situation-specific social or economic factors. Stress reactions often have to do with family relations and economic hardships that are difficult, if not impossible, to resolve by means of the stressed individual's decisions alone.

Self-tracking as temporal discovery

The personal accounts of stress measurements are based on evaluations of personal experiences and social situations and they speak of ways in which self-tracking technologies 'participate in the generation of modes of knowing' (p.11).²⁸ The accounts point towards everyday temporalities: the rhythmic order of daily or weekly actions, such as sleep, work habits, online behaviour or ways of socialising.²² By opening the timing of stress reactions to consideration, HRV measurements afford time-series analysis that can uncover temporal aspects of the self and the everyday, and aid in examining time-based foundations of health and well-being.¹⁴ By attending to their data charts, the participants discovered that health and well-being problems often have to do with irregular and harmful time use. For instance, one of the younger men started leaving for work earlier in the morning in order to get a couple of tranquil hours before the arrival of two colleagues whose presence caused his physiological stress levels to rise.

With the intent of promoting their well-being, many of the participants started showing greater appreciation for periods of physiological recovery, particularly during the work day. In their talk, they accorded an additional element of value to idle moments at the computer or to shared coffee breaks in the afternoon (see also Ruckenstein).⁹ In light of our study, self-tracking can be seen as health-related knowledge formation in action: when confronted with a chart that details signs of physiological stress and recovery, the participants of our study search for clues and patterns in the visual information, bringing the data valence of discovery to the fore. As described above, the participants started to pay attention to recurring stress reactions – for instance, those coinciding with opening work email. They adopted a particular stance in relation to their

everyday encounters, aiming to uncover stress reactions in terms of time in order to understand day-to-day discomforts.

Discussion

Living with numbers

From the standpoint of mechanical objectivity, self-tracking practices are fairly straightforward. Truths about the body and the everyday are established with the aid of self-tracking applications and devices, with numbers and scores offering a standardised base for interpretative efforts. Yet, when listening to research participants' evaluations of stress and recovery, other data valences than the truthiness of data and numbers gain prominence in their narratives; the mechanical objectivity approach grasps only an initial or partial view of self-tracking. In contrast, the research participants operate within the realm of situated objectivity, wherein knowledge is not seen as a fixed and secure output of 'clockwork' technologies. Here, personal data are consistently contaminated with different data valences and interpretative forces. The understandings of physiological measurements are informed by various types of expertise, personal and professional, and the interpretations are flexible, contextual and idiosyncratic.

As we have argued above, the notion of situated objectivity borrows from two very different conceptions of objectivity, mechanical objectivity and trained judgement,¹¹ leaning towards evaluating the truth and usefulness of an observation – the *defining* data valence or data value – in the context of daily lives. The notion of situated objectivity attends to the eclectic nature of everyday understanding: the importance of individual variation in defining what matters in terms of measurements and personal data.²⁹ Compared to scientific and professional practices, the everyday is characterised by 'common sense' whereby scientific ideals can either be reified or not recognised at all.³⁰ As suggested by Berger and Luckmann, 'Common sense contains innumerable pre- and quasi-scientific interpretations about everyday reality, which it takes for granted' (p.34),³⁰ a formulation that resonates with the concept of situated objectivity while celebrating taken-for-granted premises and organising the world around the 'here and now' (p.37).³⁰ Significantly, personal data encounters can strengthen the commonsensical, but also contest it by offering evidence that contradicts or challenges personal or publicly shared understandings. When a measurement result disagrees with ideas of how sporty research participants feel they are, or how well they sleep, it prompts a shift in their common sense.

As the personal accounts of stress and recovery suggest, those using self-tracking devices do not necessarily reach any firm conclusions in respect of their engagements with the devices or their personal data. Rather than formulating answers in terms of healthier life choices, the participants might have pondered what such choices require. Everyday interpretations of measurement results are not systematic, nor do they seek to accumulate knowledge systematically; rather, they rely on, and offer evidence of, the interpretative flexibility that people exercise. Interpretations of measurement results might depend on socially shared data valences or energise a variety of skills and understandings in attempts to make sense of everyday life as it is lived. At the heart of situated objectivity is the value, or place in life, allocated to measurement results.^{13,16}

Our study proposes that people cannot follow a metrics of life and ‘live by numbers’ because the numbers lack a constant baseline. Their value constantly changes with both the ‘real world’ and interpretation, and it appears that, rather than ‘living by numbers’, people are ‘living with numbers’. With self-tracking technologies, bodies are measured: qualitative aspects of life are transformed into metrics offering standardised views of physiological worlds, while, at the same time, people ‘feel’ the metrics.³¹ Through measurement data, bodies are reflected on in an experiential and emotive sense, and the measurement results trigger feelings of relief or anxiety, depending on how those results are read in the context of daily lives. When the pedometer informs its user that the daily step count has been reached, it can feel elevating: the data offer validation of personal worth. For those who repeatedly miss the target, numbers can become unsettling or anxiety-provoking.³¹ In light of situated objectivity, physiological stress measurement and related interpretations are ‘read’ with specific expectations, not only in the experiential-emotive sense, but also with regard to social and cultural expectations.

Reflective about health

We began our discussion with the recognition that self-tracking devices have not been able to fulfil the promises made by proponents of digital health technology. The main reason for this is the over-simplified manner in which the relationship between the devices and their users is imagined: technologies are treated in isolation from social situation or context, as a solution rather than a starting point. By paying attention to how data practices and interpretations become active in shaping the everyday, the concept of situated objectivity offers an alternative to crude attempts to use personal data as a solution or an intervention. As others have argued, in order for digital data to become

a meaningful part of processes of change, data practices need to be aligned with ‘the generative processes of everyday life’ (p. 10).³²

Pragmatist philosopher John Dewey advocated more than a century ago that seemingly contradictory findings tend to lead to more profound self-reflection.³³ Following Dewey, we argue that, with regards self-tracking, much more attention should be paid to the fact that health-related knowledge is evaluated and re-evaluated in light of measurement results, personal experience and publicly shared understandings. The unexpected and contradictory evidence yielded by physiological measurements is what promotes self-reflection: states of physiological stress and recovery are felt bodily, but stress is also culturally interpreted and publicly discussed. On a personal level, this means that distinct kinds of evidence are brought together when stress reactions are evaluated: one’s experiences of what is felt to be stressful might be at odds with the measured stress levels, leading to questions that can raise doubt and uncertainty. As Dewey proposes, reflective thinking is typically associated with problem-solving: ‘To reflect means to hunt for additional evidence, for new data, that will develop the suggestion, and will either, as we say, bear it out or else make obvious its absurdity and irrelevance’ (p.13).³³ Importantly, and perhaps somewhat paradoxically, rather than encouraging a mindless following of numbers and measurements, the new tracking tools might strengthen reflective thinking and problem solving.

In other words, our findings advise that self-tracking devices and applications should be seen against this backdrop of open-endedness and reflexivity. The devices offer untapped potential in the realm of communication and learning;^{21,28} insights generated with the aid of self-tracking devices can serve as conversation facilitators that provide support for initiating exchanges and changing conceptions of what might be good and healthy in life. In this development, new sensor technology and active interpretation of measurements could lead to health-related concepts losing their universality and generalisable qualities as they are transformed into more individualised and eclectic notions of what ‘healthy’ means. In the accounts of stress and recovery presented above, conventional dichotomies, such as objective vs subjective/experiential data, or quantitative vs qualitative data, tend to blur. Seemingly objective data are placed in a personal context, and the metrics of life lose their grounding in the realm of mechanical objectivity. The situated objectivity that people apply to evaluating measurements transforms numbers and charts into ‘qualitative metrics’. Again, in a paradoxical development, the new measurement devices and software, which are supposed to be based on sound, universal and generalisable

scientific principles that support hard facts and accurate descriptions, become raw material for daily decisions as people seek bespoke answers and craft personally modified theories of a healthy life.¹⁴ In resonance with Dewey's ideas pertaining to how we think, self-tracking can generate a lack of clarity, which is essential for critical thought, or even thinking in general: 'The origin of thinking is some perplexity, confusion, or doubt' (p.12).³³ From this perspective, self-tracking does not offer facts to which people must conform but a unique path to thinking about health and health-making.

Concluding remarks

The concept of situated objectivity proposes a focus on the everyday, offering support for understanding how personal data become meaningful, and how they are 'felt' in the everyday. By doing so, a focus on situated objectivity offers methodological support for uncovering the potentials and limits of self-tracking practices in the digital health field. We are aware that exploring self-tracking through personal accounts of physiological measurements can contribute to an overly optimistic story of the possibilities of knowledge and understanding gained by means of the interpretative powers of individuals. The emphasis on the individual can steer the discussion away from social and political aspects of health. When read from social and political perspectives, however, self-tracking data and individual interpretations of that data can also aid in rendering the social and political underpinnings of health visible in new ways. The time-based foundations of health and well-being indicate that everyday timings and rhythms that promote physiological stress and recovery are not issues to be controlled by individuals alone.²² Health, considered from the standpoint of insights generated through self-tracking, is both a societal and an individual issue, with political and existential implications.

By placing the emphasis on situated objectivity our intention has been to avoid positioning self-trackers as unbiased and rational users of digital technologies, demonstrating instead that self-tracking practices could work better in terms of health promotion if they acknowledged the everyday as a domain of reflection and ambiguity. When people bend measurement results to their own purposes and search for alternatives to bald injunctions, they highlight what they see as worth promoting in terms of health. Importantly, health does not remain compartmentalised; rather than restricting it to a 'health context', self-reflection aims at a more holistic understanding of everyday life, a 'new awareness of one's being in the world and in time' (p.27).¹⁴ Given these observations, we suggest that self-tracking offers considerable potential for communication and learning,

providing an access to the elements from which daily lives are composed and the possibility to rethink temporalities of daily lives and design environments that encourage healthy outcomes.^{32,34}

If self-tracking were approached more as 'an unknown' (p.165)³⁴ than a pre-defined set of aims, diagnostic tools and risk assessment frameworks that offer technological certainty and solutions for modifying life, self-tracking could contribute to the range of possibilities for rethinking health and health promotion. As advocated elsewhere,³⁵ self-tracking practices can become part of a new regimen of enacting care in order to experiment, connect and learn, gaining value in relation to the social and communicative processes that those practices promote. Importantly, it may be impossible to judge the likelihood of success in this endeavour in advance: the role of both patients and health professionals becomes more explorative in nature when self-tracking technologies are applied in care work. Only by experimenting with self-tracking technologies can one discover exactly what each device promotes in terms of health-making and what it requires from patients and professionals. The benefit of such an approach is that it actively avoids trivialising people's experiences and promotes a more mediated and socially responsive definition of health.

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