Fitter, Happier, More Productive? The Normative Ontology of Fitness Trackers

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Abstract
Fitness trackers promise a longer and better life for the people who engage with them. What is forgotten in their analysis for HCI, though, is how they re-conceptualise the very notion of what constitutes a 'step'. We discuss everyday edge cases illustrating how fitness trackers fail to address goals and ideals of people using them. They merely re-affirm the fitness of already fit people and can have an adversarial effect on others. For future designers, we offer strategies to become aware of their own biases and provide implications for designers potentially leading to more non-normative and diverse designs of trackers.

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Started from the Bottom
Take a step. Measure it. For correctness' sake, take another step, and measure it too. Proceed until scientific needs are met. Then average the results: that will be a step. Then take a map. Using instruments as precise as desired, measure the distance between distinct places. Cal-

culate how many steps there are. Then go for a run, safely grounded in the knowledge of how many steps it takes to get from place to place.

Most people avoid this arduous procedure and instead download a running app, strap on a pedometer and let the computers do the work. It promises to be comfortable and convenient – even playful in the best of circumstances in which people can plot their runs on browser-based maps and compete with other runners. But in that perceived comfort, there is a trade-off: To enjoy these fitness trackers[1], people need to trust the data up to the point where they might act according to a tracker's data – regardless of the actual distances traversed.

For those who embrace quantified-self technologies, a human step is whatever a set of algorithms running on a portable computational device can detect and process. These technologies go beyond mediation or interpretation of the world [29] – they create a cyborg-like experience [14]. Fundamentally, the person and the fitness tracker mutually influence each other to the point where they can be considered a coherent entity.

As designers and researchers of interactions between humans and computers, we need to have a long-overdue discussion on how the technologies we develop are not only creating normative ontologies but also how they are situated within the cultural context they act. We focus on fitness trackers as there is a comparatively large corpus of work within the field of Human-Computer Interaction (HCI) discussing the design and research of these technologies without addressing the underlying assumptions and ideologies of the design considerations.

In the form of a critical essay [2], we first take a look at the related literature in Human-Computer Interaction (HCI) and the field of Science and Technology Studies (STS) before we describe the normative ontologies created by fitness trackers. Our further analysis of exemplary everyday edge cases where the design of dominant fitness trackers fails to deliver on its promises is followed up upon by more concrete suggestions how designers of fitness trackers can engage with critiques like this.

Background

To situate our argument appropriately within existing discourses about the design of fitness trackers and already available critique, we introduce both aspects briefly. As is common in essays, we do not aim at a complete overview, but rather critically discuss examples relating to our argument.

Design of Fitness Trackers

The critique of fitness trackers in HCI Literature appears to be limited to *technical* aspects, which in a field where we are confronted with *socio-technical* systems – as fitness trackers are – is a limited perspective. Take the example of people being uncertain about the accuracy of their trackers [31]. Yang et al. describe different problems different people encounter when using fitness trackers. For example, a parent complained that they rarely get awarded steps when pushing a stroller, but do when rocking a baby. However, Yang et al. reframe these observations as 'scientifically invalid'. Even though Yang et al. very aptly state that "[d]ifferent people may fit the underlying models used by the devices better, resulting in systematic bias", the authors do not address the reasons for this systematic bias beyond de-

[1] In this paper, we define a fitness tracker as any pedometer, smartphone/desktop application or combination of both displaying data about physical performance with the goal to encourage the people using them to monitor their physical activity.

A side note on 'Get Fit For CHI'

During the time we prepared this manuscript, CHI conference chairs suggested that researchers engage in a rigorous regime to not only prepare themselves for the conference but become 'better researchers' overall [26]. This move is (not so) subtly motivated with a side effect of losing weight and being happier. It's a call for getting fitter, happier, more productive.
We find it worrisome that the conference chairs in suggesting this also follow a *healthist* ideology where conference participants are encouraged to individually ensure their 'fitness' for the conference instead of systematically implementing incentives for sick people to attend the conference remotely or changing the conference schedule to allow for breaks and quietness.

scribing it as a 'calibration issue'. Their design suggestions then argue for more end-user calibration, increased transparency and support of testability. These potential technical solutions, however, fail at addressing how steps are conceptualised. A fitness tracker continues to judge rocking a baby as a more engaging activity than pushing a stroller and then keeps on presenting concrete and detailed numbers based on mere assumptions on what constitutes a potential step.

Other studies within the HCI community conduct detailed observations of people using fitness trackers. These studies appear to have a selection bias. The only long-term study investigating the use of fitness trackers consists of mainly fitness experts or higher-class participants [11]. The only two participants who did not fit these categories, who were described as working in retail, also used the tracker for a shorter time than others. In another descriptive study of use patterns, Meyer et al. [19] critically reflect their work in that they do not provide a difference of motivation in picking up using a fitness tracker and not doing so as they have no participants who never used one. These studies similarly remain conceptually in a technological space that takes the basic algorithms as given and suggests merely slapping on communicative layers that might persuade people to act differently upon data, which they have no choice but to trust. There is no critical reflection on the presumed 'good' of fitness or health trackers.

Choice and freedom as components of the use of tracking tools are rarely considered, either. For example, Chung et al. suggest considerations for the design of food trackers from observations of how people on Instagram tracked their food intake [4]. They take a practice stemming from personal choice and make generalised design suggestions for similar trackers. However, the use of these trackers might become far less optional – especially for already vulnerable populations. The notion of tracker data being used in clinical contexts is actively being pushed forward – inside and outside [24] of academia. Kim et al. discuss interfaces for clinicians to read tracking data, framed as a purely technological problem from the clinician's view [16]. In contrast, more critical work by Mentis et al. shows how Parkinsons' patients and their clinicians are engaged in a discursive struggle when trying to establish meaning for a tracker's data [18]. However, the goal then is to create better *technical* solution without questioning whether it is a good idea to put vulnerable populations under constant surveillance of their activity patterns in the first place.

Only recently, assumptions inherent in the design of fitness trackers have been discussed within the HCI community [20]. However, Munson also remains within the paradigm of the intrinsic good of tracking and argues for more technological flexibility in the design of trackers. Our work goes further by providing additional theoretical and cultural critique as well as strategies for designers to engage with the raised points of criticism productively.

Healthism

The field of STS situates fitness trackers in the broader critique of quantifying society through (self-)surveillance technologies and uncovers connections to ideological assumptions as well as cultural norms. For example, Lupton describes them as reinforcers of a more extensive neoliberal movement in which the responsibility for health is increasingly delegated to the individual (away from structural factors) [17]. Self-tracking apps then promote techno-utopian, enhancement and *healthist* discourses, and of privileging metric and visual representations of the body [ibid].

Healthism in this context is an ideology and cultural movement placing health and illness as core individual respon-

sibilities [6]. Through disciplining the self while focusing on a particular aspect – e.g., steps in fitness trackers – people engage with a data double, a persona that is constructed as themselves through the tracker [25]. Such empirical observations of people's interaction with the associated visualisations of fitness trackers should, in our opinion, not remain a task only in the hands of STS researchers, but actively sought out by designers for them as an opportunity to critically engage with the artefacts they create and the consequences such creations have.

Normative Ontologies in Fitness Trackers

As fitness trackers are commercially available in the form of wearables, often as a clip or wristband, designers need to abstract the notion of a step for it to become a measurable unit. While this 'step' uses the same semantic reference as the action commonly called 'putting a foot forward to propel oneself', the algorithmic inference of movements based on mathematical formulae conceptually alters what a step means. Through *making the step measurable* fitness trackers alter the reference for what constitutes a step; they are reshaping its ontology. However, the rigidness and restricted realisation of fitness trackers also makes them normative instruments on a scale larger than a step; through the surrounding design components of reminders and minimum step requirements, there is a constant expectation for people to desire and require weight loss, among others. If we want to run, or walk, and calculate that data with the pleasures and comforts of computation, we also engage these normative expectations.

The calculation of step data and its subsequent display constitutes a process of re-ontologisation that changes how we experience and construct the world [10]. Re-ontologisation implicitly demands a partial delegation from human to computer, person to algorithm. This delegation of agency is often coupled with a lack of transparency, which is a deeper problem than knowing what the algorithm does. Without having an understanding of that process, people using fitness trackers are thrown into a world in which their actions and behaviours are encouraged, shaped, and processed by invisible handlers.

Fitness trackers are supposedly benign technologies that will playfully help us get in shape, understand our bodies, and treat them better so we can live healthy lives. But these healthy lives are re-ontologised lives, the health parameter an invisible, remote computation of data, detached from any meaningful interpretation of the complexity of an individual's well-being. These technologies do not facilitate a better life: they define it, without oversight, without transparency, using emotional design tricks to engage in a progressive redefinition of what it means to be human. As HCI designers and researchers, we are responsible for this process. It is in that role, therefore, that we seek to make visible the invisible norms and assumptions of fitness trackers as they are currently designed. We can consequently engage, and help users engage, with the process of re-ontologisation proactively rather than implicitly. Some of these assumptions are preceding the ones that concern those on technological use as discussed by Munson [20].

1) *Every body requires improvement.* While from a medical perspective it can be a good idea (for some) to rather walk more than less, fitness trackers also transform the activity of walking into a "one size fits all" quantification. From the perspective of a fitness tracker then, every body is inherently deviant and has to be altered, improved and perfected. This state, of course, is never reached, as this would mean the tracker would render itself obsolete.

2) *Bodily improvement is under the control of the individual.* The device is located on an individual's body, and the proxy

for fitness is assigned to that individual's step-taking. This neoliberal approach to self-care furthers the highly ambiguous notion of health as something you earn and sickness as something for which you are at least partly personally responsible [6].

3) *Steps, as detected by the device, are the marker of fitness.* Fitness trackers collect a range of sensor data, which must be transformed into some measure of steps. In this process of abstracting to the measurable quantity of 'steps taken', the finer granularity of movement is lost (e.g. fast walking, climbing up stairs, walking up a hill, versus just strolling around), and not all movements are captured.

4) *More steps are always good.* A healthier body - and by healthist implication, a better body - is that which takes more steps. Even though the numeric goals are adjustable, the possibility that more steps may damage the user's long-term health, for example by aggravating an injury, is outside the scope of the tracker's design.

Figure 1: Inferential Racism as a Design Component of the Xiaomi Mi 2

5) *A joyful step and a miserable step have the same value.* Fitness trackers measure only the step itself - not a person's experience while taking it. Additionally, while many people take pleasure in physical activity, the tracker only provides extrinsic nudging, which can effectively hinder intrinsic motivation and autotelic joy [7].

6) *Failure to meet the tracker's terms is the individual's problem.* There are many reasons why a user might skip a day with the tracker, such as illness or religious observance. However, there are no mechanisms inviting them to come back or engaging with their absence.

Everyday Edge Cases

These norms may not seem immediately harmful. However, taken together they exclude a vast number of users; in particular, fitness tracking norms best serve those who are already best served by society (white, thin, abled, neurotypical, not actively practising religion, etc.). Here, we use *everyday edge cases* as a strategy to uncover the limits of fitness trackers on cases they implicitly or explicitly include. These everyday cases may seem like exceptions, but taken together they show a larger issue with the conceptualisation of norms. Our focus lies on edge cases where individuals would be interested and open to interact with aspects of fitness trackers but become disenfranchised as their use cases not only appear unsupported but mainly contribute to the further exclusion of specific marginalised groups in western societies.

A Whiter Shade of Pale

The way fitness trackers construct normativity, and re-ontologise behaviour is necessarily culturally and socially selective. For instance, many fitness trackers also record the heart frequency of their wearers. Products like the Xiaomi fitness tracker[2] (cf. Figure 1) do not work on black people's wrists as the infrared sensors are only calibrated towards light skin tones [22]. Hence, normative assumptions of fitness goals are rooted in a layer of unchallenged racism. The disenfranchisement of non-white bodies in white-only fitness hardware happens both economically and symbolically. On an economic level, black people are excluded as potential customers, constructed as unfit to indulge in the pleasures of measurable health. Symbolically, the technology is coded white-only on several levels, be it advertisement, icons or general visual language around fitness, which in its majority excludes non-white people's bodies from the category of 'fit' body (see for the pervasiveness of this notion, for example [1]). The cultural scholar Stuart Hall has termed such coding *inferential racism*. "By inferential racism I mean those apparently naturalised representa-

[2] http://www.mi.com/en/miband/

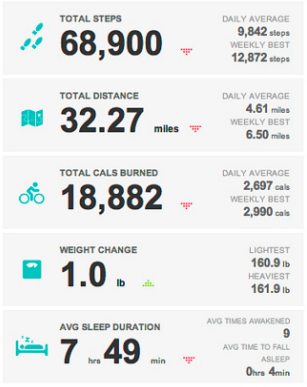

Figure 2: Progress as inherent good

tions of events and situations relating to race, whether “factual” or “fictional”, which have racist premises and propositions inscribed in them as a set of unquestioned assumptions. These enable racist statements to be formulated without ever bringing into awareness the racist predicates on which the statements are grounded.” [12]. The thick layer of invisible, remote health parameters is premised on the unspoken exclusion of black people (see further discussion of this topic [13]). This implicit procedure is what makes design racism so insidious and difficult to track down. The idea that fitness can be measured based on a normative case model is by default discriminatory in that normative usually implies white.

Every Step You Take

Fitness trackers are inherently ageist and ableist in their presumptuous setup. For example, the FitBit[3] weekly progress report codes any increase in numbers as positive with a green arrow pointing up and any decrease as negative with a red arrow pointing down (see Figure 2). With a certain age, however, people might try to manage and reduce their functional decline [28], which might be a continuously frustrating experience over time – especially if facilitated through fitness trackers which assume steady progress. Even particularly active weeks are then discouraging, as they are followed up by a negative performance judgement if the activity is lower again.

In another – quite cynical – ableist conceptualisation of steps, fitness tracker need additional effort to be usable for wheelchair athletes [3]. Even though it appears that it might not require a great effort to incorporate the tracking of wheelchair movements for designers of fitness trackers, the disabled athlete is invisible or an afterthought.

When it comes to mental health, fitness trackers are deemed to have inherent benefits for motivation and subsequently self-worth. However, for adolescents, it has been reported that their motivation for fitness and satisfaction with themselves lowered significantly when using a tracker [15]. Not meeting the high demands the tracker made of them, they ended up disillusioned and frustrated. Considering all these aspects together, the norm of fitness trackers assumes a positive encoding of continuous progress, activity being based on moving one’s legs and being able to continually access an overview of one’s data resulting in an inherently positive motivational effect.

All About that Bass

An often cited motivation for research into fitness trackers is a so-called ’obesity epidemic’[4] (e.g., [5]). Such an argument claims obesity to be undesirable, and that it is the individual’s responsibility to remain slim, fit, and healthy. As fitness trackers work in a cultural space where fitness is tied to slim bodies, they tie into a classification of "the obese, overweight and physically unfit as personal moral failures, immoral and irresponsible citizens, socially, morally and economically pathologized outsiders" [27].

While often trackers allow people to set their goals for weight gain, maintenance or loss, desired loss is the default on which they operate. For trackers like Bellabeat[5] or the Fitbit, an estimated calorie count is always present as a non-optional feature of their applications, even though this can facilitate relapses for people with eating disorders, especially around exercise-based disorders [8]. Ultimately it appears that the technology embodies an attitude of ‘who cares if you are killing yourself as long as you are not fat’, even though body shape and fitness level are entirely un-

[3] https://www.fitbit.com/

[4] As if it were a contagious condition.

[5] https://webshop.bellabeat.com

related [23]. Hence, another norm expressed by fitness trackers is that bodies should be thin and weight control is desired by anyone using a tracker.

Every Day Feels Like Sunday
Fitness trackers expect continuous and consistent use, tracking steps from day to day. However, not all users share the device's undifferentiated approach to time. For example, Orthodox Jews use Sabbath observance as a communally-mandated respite from engaging with technology, even as they also explore ways for technology to support their practice [30]. While some rabbis permit the use of fitness trackers on the Sabbath, the case points up the trackers' assumption that all days provide the same opportunity for fitness activities, and for tracking them.

Fast days on the other hand are part of ordinary religious practice for both Muslims (e.g. Ramadan) and Jews (e.g. Yom Kippur). Physical activities that would be unremarkable for a given individual on any other day may become uncomfortable or even dangerous on a fast day. In other words, the design of fitness trackers assume that religious practice is something that happens in people's heads or hearts rather than their bodies. They further exclude the notion of down-time, where people might not engage with their trackers in their holidays or weekends, but are penalised for doing so.

Implications for Designers

As seen above, the ideal person who uses a fitness tracker is white, able-bodied, mentally stable, already fit and slim. While there might be plenty of people like this using fitness trackers, designing only for these people creates exclusions that counteract the narratives of benefits established by fitness trackers. Designers can now take several steps towards more non-normative and diverse approaches.

Embrace Uncertainty
Reframe the problem of 'accuracy' into one of 'indications'. By being transparent about how a tracker is constantly inferring movement from the position it is placed at, visual representations could display the range of values which is likely indicative of movement instead of aiming at giving the most precise number possible.
Reflect Yourself and your Biases
It matters who you are. When comfortably fat people design for fitness, different considerations emerge than when slim people (or those desiring to be slim) design them (compare [21]). In designing a tracker or associated application, insert a concrete round for reflecting on what assumptions might be inherent, explicitly or implicitly, and whether that is desired.
Engage with the Technology Critically
Seek out critique, especially from people who are different from you. Only through engaging with critique and conflicting viewpoints, we can create technology that supports variable goals people might have without assuming a whole range of associated needs and desires.
Encourage Appropriation
To address a variety of goals and people, different applications for the same device might be called for. Even though a device can have multiple purposes, a unifying application for all is not necessarily what is needed. Make your applications and the technology itself open for easy appropriation. Essentially, encourage people being themselves and mounting the challenges that not you but they have set for themselves.

But not just as designers also as HCI researchers, we need to reflect on how our research buys into ideological assumptions of healthism and who is left out from our analysis. We need more research like Epstein et al.'s examination of potential reasons for people tracking their men-

strual cycles [9]. Through pointing out where the trackers' assumptions individually did not hold, they pointed out further inclusion-oriented design opportunities.

In the End

In this critical essay, we provided an understanding of how the technological design of fitness trackers inherently creates a normative ontology. For future designers to avoid these pitfalls, we offered strategies for becoming aware of their own biases and approach their designs through an explicitly less normative and more diverse lens.

Our aim was it to discuss the far-reaching responsibilities and the implications of technology design on the humans interacting with them. From here, we encourage the community to further develop systematic approaches to analyse human-computer interactions on a critical level and to not only embrace implications for design but also implications for designers.

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