The Quantified Self: Operationalizing the Quotidien

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The quantified self, or personal informatics—the tracking of aspects of daily life—is a growing movement made easier by the introduction of inexpensive technologies. A disruptive technology that has not yet reached its potential, it stands to have an effect on both patient care and medical research.

KEYWORDS quantified self, lifelogging, personal informatics, technology, self-tracking, Fitbit

INTRODUCTION

Recently, in a campus meeting with a few other people, the author noticed that aside from him, two other people at the table were wearing activity-tracking wristbands. These trackers use accelerometers, that is, 3-axis inertial positioning sensors, to sense movement and, combined with other user information, calculate steps taken, distance walked, calories burned, and exercise intensity. They can, using the same kind of movement tracking, measure sleep quality, using movement for proxies for restlessness and
wakefulness. Nearly all come with smartphone apps that allow users to track food intake (sometimes with barcode scanners) and some update their apps continuously, using Bluetooth. These fitness-related activity trackers are, literally, everywhere, so it should be no surprise that there increasingly is a social component to these devices.

Activity trackers, such as Fitbit, Jawbone, Nike+, and FuelBand, are part of a movement that uses technology to track data about broad aspects of a person’s daily life, including mood, activity, food consumed, blood pressure, weight, and other inputs—any kind of biological, physical, emotional, or environmental information that can be operationalized and quantified. This movement is called, variously, life logging, body hacking, personal informatics, and the quantified self. Moreover, this movement is getting a foothold, to greater and lesser degrees, throughout society, starting with those ubiquitous activity trackers. However, experts largely agree that personal informatics is yet to come into its own. The 2013 Garner Hype Cycle For Emerging Technologies places “the quantified self” on its slope of rising expectations with an expectation that the technology will begin to take off in two to five years1 (amusingly, the press release for the 2013 emerging technology cycle reads like a predictor of Terminator’s Skynet revolution with all advances revolving around humanity’s relationship with machines), and the 2014 NMC Horizon Report asserts that the quantified self is important in regard to educational technology but that it has a time to adoption running from four to five years.2 It is clear that experts do not believe that the Fitbit, worthy as it is, is the apotheosis of the quantified self movement. Perhaps this is because the movement has greater potential that even points toward the involvement of big data (for a discussion of big data, see this column, Volume 10, Issue 4 of this journal).

THE QUANTIFIED SELF

The term “quantified self” has been around since late 2007 when Gary Wolf and Kevin Kelly, editors of Wired, began the Quantified Self blog (http://quantifiedself.com/). Their goal was to apply data analysis to all things that may be measured about human bodies and minds. Their categories for data collection included:

- Chemical Body Load Counts
- Personal Genome Sequencing
- Lifelogging
- Self-Experimentation
- Risks/Legal Rights/Duties
- Behavior monitoring
- Location tracking
- Non-invasive Probes
- Digitizing Body Info
- Sharing Health Records
- Psychological Self-Assessments
- Medical Self-Diagnostics

In the intervening years, not much has changed in the framework Wolf and Kelly proposed. In general most of their categories appear to be
common sense and to encompass most needs. Not quite seven years later, there can be no doubt that these pioneers must still feel as though the frontier has moved very little, and that only small progress has been made toward creating an infrastructure for a truly quantified human being. Only this past year, the personal genome sequencing aspect was dealt a great blow when the Food and Drug Administration (FDA) forced 23andMe, a personal genomics and biotechnology company, to shut down its personal genome service; at this point, it seems the intersection of health law and personal genome sequencing may be more of a roadblock to access to this kind of data. Additionally, it is possible that Health Care Access, Portability, and Renewability Act (HIPAA) regulations may place crippling limits on how this data are stored and shared, and certainly any app or tool that involves itself with Medical Self-Diagnostics will meet strict regulatory guidelines or fall afoul of the FDA. This is not an indictment of either the FDA or of HIPAA but rather is an acknowledgement that there are larger forces at play than casual collection of personal information.

Though the Quantified Self categories seem fairly sufficient, it is interesting to see how others have modified or particularized their original vision, for instance Konstantin Augemberg’s elaboration from the Measured Me blog where he lists the following categories people might be concerned about tracking:

- Physical Activities: miles, steps, calories, repetitions, sets, METs
- Diet: calories consumed, carbs, fat, protein, specific ingredients, glycemic index, satiety, portions, supplement doses, tastiness, cost, location
- Psychological States and Traits: mood, happiness, irritation, emotions, anxiety, self-esteem, depression, confidence
- Mental and Cognitive States and Traits: IQ, alertness, focus, selective/sustained/divided attention, reaction, memory, verbal fluency, patience, creativity, reasoning, psychomotor vigilance
- Environmental Variables: location, architecture, weather, noise, pollution, clutter, light, season
- Situational Variables: context, situation, gratification of situation, time of day, day of week
- Social Variables: influence, trust, charisma, karma, current role/status in the group or social network

There are clear differences between Wolf & Kelly’s and Augemberg’s categories, but Augemberg is specifically addressing a app-authoring audience who will be interested only in those things that may be measured without the external expertise of doctors, lawyers, or the FDA. This is a practical acceptance of current reality that partially explains why, for the most part, the contemporary manifestations of the quantified self are fitness tracking devices.
PERSONAL INFORMATICS TOOLS

Activity trackers, the bulk of the products available for consumer use, have already been touched on above. They use accelerometers to detect and interpret motion—when still, they only record gravity, when moved they report acceleration. This means that they may misinterpret activities or miss activities altogether. They ignore bicycling because cycling does not activate the accelerometers; the wrist is generally stationary during a bike outing. Additionally, weight-lifting is a challenge for activity trackers: they can detect motion but not exertion, so the reported number of calories burned during a weight lifting exercise can equal the number burned lifting a dessert spoon to the wearer’s mouth. However, while all activity trackers have accelerometers and can detect simple motion, some manufacturers are taking steps to improve the detection of exertion with other sensors that can measure things like heart rate, perspiration, and body temperature. Nevertheless, problems remain. The image below is an activity tracker’s interpretation of a single night’s sleep. At 3:20 AM the wearer was restless and went back to sleep within two minutes. Or that is what the tracker reports. In reality, the wearer awoke at 3:20 AM, lay in bed for 10 minutes, and, unable to go back to sleep, read an ebook for an hour and a half before falling back to sleep. The tracker had interpreted the stillness of reading as the stillness of sleep. (See Figure 1.)

Fortunately, even activity trackers without elaborate extra sensors come with smartphone or web apps that allow the user to annotate or specify types of activities so that a true picture may emerge. Moreover, as stated above, most apps are able to track food and liquid intake and weight through manual input (see Figure 2).

**FIGURE 1** Detail from a night’s sleep, Fitbit app. © [FitBit, Inc.]. Reproduced by permission of FitBit, Inc. Permission to reuse must be obtained from the rightsholder.
FIGURE 2 Fitbit automatically tracks a number of categories of data, some automatically, some manually. © [FitBit, Inc.]. Reproduced by permission of FitBit, Inc. Permission to reuse must be obtained from the rightsholder.
Other devices within the fitness realm include blood pressure monitors and scales equipped with Bluetooth, making the updating of a smartphone app very simple (see Figure 3).

**FIGURE 3** iHealth produces a number of Bluetooth-enable devices that track weight, blood pressure, activity, blood glucose, and so forth. © [FitBit, Inc.]. Reproduced by permission of FitBit, Inc. Permission to reuse must be obtained from the rightsholder.
Not every self-tracking tool is a stand-alone device, nor is every quantified self-application intended to digitize and record health and fitness-related data. The *Quantified Self* website has a list of 505 self-tracking tools (https://quantifiedself.com/guide) that include goal, mood, and money tracking (see Figure 4).

Unfortunately, one of the drawbacks of self-trackers that require manual update is that users are more likely to participate and for a longer time if the data collection is automatic:

Quantified self works best when the data is captured automatically and the user doesn’t have to actively input anything. Sleep monitors are a perfect example. Once the device is activated and laid on the bed all you have to do is go to sleep. If you do have to input data then it has to be as simple as possible. NetDiary a food monitor, for example, allows you to scan the bar code of thousands of common food products speeding up and simplifying the input process.5

**WHY QUANTIFY?**

So what is the benefit of tracking this information? What does a user gain from knowing that she took 10,000 steps yesterday? Like library statistics, there should be a reason to count anything that we count. In the instance...
of physical activity, the reason can be fairly obvious. On a base level, tracking steps could be in the service of behavioral modification: to inspire physical activity. Setting a goal of 10,000 steps (an arbitrary number with no evidence of its specific efficacy) may eventually turn the sedentary office worker into a healthier person. Additionally, these devices give feedback that adds a motivating element of gamification (for more information on gamification, see this column in Volume 10, Issue 3 of this journal) to exercise. The Fitbit will send a notice to a user’s smartphone to let the user know that he has almost achieved his goal. The addition of social aspects—the ability to add friends to the app—can also help stimulate goal-reaching activities; Fitbit even allows friends to taunt each other for motivational purposes. For already active people, data tracking can create feedback loops that aid in lifestyle management and self-experimentation. For some, the act of tracking an activity is encouragement enough to pursue that activity.

On a specific or personal scale, tracking of activities, moods, blood sugar, etc., can allow otherwise invisible patterns to surface: can sleeplessness be tied to diet? To what extent has a change made in diet or the feng shui of a room affected sleep? Do particular foods cause spikes in blood glucose? Are there ways in which stress manifests itself in the way one conducts daily activities? Are there specific triggers to chronic conditions? This kind of small-scale tracking can be very useful in solving specific problems.

On a broader level, self-tracking could become a foundation for personalized medicine. According to Pew Research, in 2012 69% of Americans tracked health indicators for themselves or others. A bulk of them tracked weight, diet, and exercise, but 33% tracked other indicators like blood pressure, sleep, headaches, and so forth. Importantly, a significant percentage of health indicator trackers say that they use their data to make healthcare decisions. Forty-six percent of trackers say that tracking has “changed their overall approach to maintaining their health or the health of someone for whom they provide care.” Forty percent have been inspired to ask new questions of a doctor or seek a second opinion, and 34% say that it has affected a decision about how to treat an illness or conditions. Unsurprisingly, those with chronic conditions report that tracking has an even greater effect upon their health. Thus self-tracking empowers patients. And this empowerment, this prolixity of data, can be useful to physicians when partnering with patients in multiple ways: informing initial treatment options, determining quickly to see if a treatment is working, and, more broadly, providing research evidence.

This last item—providing research evidence—is perhaps the holy grail of personal informatics: to use all this data gathered by all these trackers to inform research. It is also one of the most problematic, likely to fall afoul of federal law and privacy watchdogs. Who owns the data? How will it be shared? How will it be de-identified? How will app vendors manage this? Where will the data be stored? It is these questions, perhaps, that put the quantified self on a two to five year trajectory for general adoption.
REFERENCES


