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Data won't change your behavior: A critical design exploration of quantified self technologies

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Abstract

Data is becoming a ubiquitous phenomenon in our culture. Technologies that collect data about us on our behalf, such as lifelogging and quantified self devices, have been presented as able to help people change behaviors. This paper presents a study exploring the meaningfulness of these devices and their use. To investigate this topic, we designed our own QS device, using a critical design approach, called Feeler. We also conducted an experiment in which five participants used the device. Feeler guides users to meditate, study, and play. When the user is engaged in these activities with the device, it collects biological data (EEG) from the user and further asks users to share their own impressions about their attention and relaxation levels. From the experiment we collected about 7.5 hours of audio data, including think-aloud and semi-structured interviews. The audio was processed by marking interesting sections for further analysis and contextualization. Our results indicate that people are trustful of QS technologies and the ability of such technologies to help them initiate behavioral changes. We also found out that the use of these technologies is targeted towards productivity and self-improvement, such as avoiding procrastination, improving focus, and avoiding social media.

Keywords

Lifelogging, Quantified self, Critical design, Automated data collection, Technology design.

Introduction

We are living in the midst of a data revolution. Automated collection, storage, and analysis of data and media originating from various sources are changing our perception and experience of the world, the society we live in, our social relations, and ourselves. In general, these new forms of data are having a growing impact on our culture. Today data is currency. With it, we pay for the use of social media services. Sometimes data provide us hints of challenges and opportunities for action connected to our goals. Data also supposedly help us to make better decisions and solve problems.

Personal informatics, personal analytics, and quantified self (QS) are areas of research and practices in which individuals collect data about themselves (Rooksby, Rost, Morrison, & Chalmers, 2014; Swan, 2013; Wolfram, 2012). Such practices, including the collecting of *biomarkers*—or indicators of the user's biological state or condition—and *lifelogging*—or wearing computers to capture in various ways the user's entire life—are said to help people reflect on their life (Gurrin, Smeaton, & Doherty 2014). The expectation is that the new and deeper understanding will lead to behavior change and thus better living.

Ubiquitous computing has enabled people to collect data at any time and everywhere in a non-invasive, almost invisible way. Wearable devices based on self-tracking have become affordable and people have started to self-track a myriad of things, including physical activity, location, sleep, emotions, and mental states, to name a few.

The motivations for self-tracking are diverse, although a common theme is the augmentation of human capabilities. For instance, in lifelogging the ultimate reason for engaging in such a data collection endeavor is to surpass the limitations of human memory (Bell & Gemmell, 2009; Mann, 2004). Inspired by Vannevar Bush's (1945) utopia of a Memex—a machine that could contain all the books in the world, as well as personal records of action and communications—lifeloggers pursue the dream of complete recall of everything they have ever done in their life. Although the question of how to retrieve the data or how to transform the massive amount of data into usable information and knowledge remains open, the vision is clear: by recording everything, we can know more and therefore be wiser, better, and more productive human beings.

"Self-understanding through numbers" is the slogan of the QS movement. Similar to lifelogging, QS involves the attempt to record important data about yourself to drive change and access means for personal improvement (for example, wearable sport, wellbeing, and health devices) (Rapp & Cena, 2014). The emphasis is on continuous development. Therefore, many QS systems have some sort of automatic data analysis, coaching services, or gamification in order to motivate users to achieve their goals. The underlying idea is the classical business adage "If you can't measure it, you can't manage it."

Most of the criticism of lifelogging and the QS movement has revolved around concerns about privacy and ownership of data. Often, users of these services are fully aware that the service provider will also have access to the data and will use it for commercial purposes. Although some critical voices have suggested different models

wherein users have a right to manage data gathered about themselves, there is very little critical analysis of the practice itself and its more general implications for our culture (see, e.g., O'Hara, Tuffield, & Shadbolt, 2008).

Personal data is also seen to provide power. Knowledge is power, but can lifelogging and QS provide us with knowledge that will truly help us in our lives? If so, in which aspects of life can they be useful? An interesting question is whether lifelogging and QS is driving us deeper into a competitive culture, in which the primary goal is to beat others and where the winner takes it all.

In this paper we present a study exploring the above questions by experimenting with a new practice and a device designed to collect biological data while the participant is studying. We describe the Feeler prototype—a speculative design artifact—which was developed to further understand how people relate to data collected about themselves and how the data may or may not have an impact on their behavior. We conducted an experiment with five participants (students) using the Feeler in 15 sessions of approximately 30 minutes each. In the following sections, we present the Feeler prototype itself, the research conducted, and the main results.

Feeler

Feeler is a set of computer devices with a tangible user interface (Figure 1) combined with an electroencephalography (EEG, also called "brainwaves") data monitoring device. The Feeler system includes software running on a desktop app. The software collects the data and visualizes them after a study session. Feeler software gathers data about the users' attention and relaxation levels from the EEG device (a Mindwave helmet that uses Neurosky sensors) and communicates with the Feeler boxes via a Bluetooth connection. Feeler smart boxes consist of Arduino microcontroller boards connected to sensors, vibrators, infrared lights, and LED lights.

Figure 1. Feeler smart boxes.

When using Feeler, participants follow a specific script that divides a study session into three different stages: meditation, study, and play. Each stage is associated with one of the smart boxes, which leads the student's actions through visual and haptic feedback. The boxes give guidance and monitor the time spent on each activity, indicating the end of each task through a gentle vibration. After each stage, an icon illuminates and asks the user to connect the box to the next one in order to proceed to the next stage. Below we describe the functionalities of the Feeler smart boxes and the stages facilitated by the boxes:

1. Meditation: Before beginning to study, people are invited to perform a five minute meditation exercise through deep breathing. In the meditation box, a pulsating LED light helps the user to maintain a calming breathing rhythm.
2. Study: The study portion is scheduled to take 20 minutes at a time. The study task consists of searching relevant content online and by reading, watching, and listening to the content found. A screenshot of the activities is taken every time a user's attention and relaxation levels surpass certain thresholds based on measurements taken by the EEG device. In the Study box, a grid of LED lights gradually illuminates as time passes. The lights provide visual information to users about the time spent studying and the time remaining.
3. Play: The Play-box is a device with a memory game. Similar to the 1980s Simon Says game, the user must repeat a light and sound sequence by tapping round touch sensors on the box. The game gets more difficult by adding a step to the sequence every time the user correctly completes a level. The game ends when the player makes a mistake. There is no time limit for this box, so the user can play as long as he or she wants.

While using the Feeler boxes, the user's EEG activity is monitored. After completing the Play-stage, the software running on a laptop asks the user to assess how she felt while meditating, studying, and playing. Users are also asked to estimate, based on a percentage scale (from 0 to 100), their level of attention and relaxation during the different activities. After recording this information, the Feeler software shows (Figure 2) a visualization of the EEG data compared to the user's own impression.

When looking at the EEG data visualization and her own estimation of her attention and relaxation levels, the user may reflect on her feelings and performance during the different stages. She may also go back and check from the screenshots what she was viewing when her attention or relaxation levels changed dramatically. This is expected to help users reflect on their study habits.

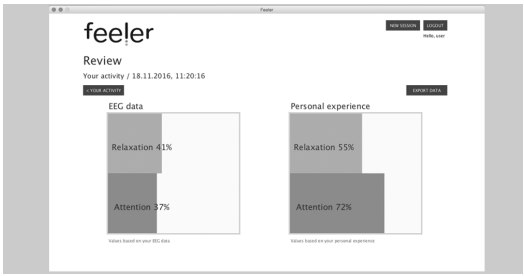

Figure 2. Visualization of EEG data and the user's personal experience from a session in the Feeler software.

Research

To explore participants' thoughts about self-monitoring of biological data, we conducted a study with the Feeler. Our main interest was to determine the key issues and the implications of the integration of self-monitoring technologies into study situations. We did not aim to analyze the EEG data; rather, we wanted to explore how people make sense of the tracked data and how they feel about it. The key questions that guided the research were as follows: How do people react to automatically collected biological data in light of their personal impressions? What happens when the data does not match their personal experiences? Do people modify their thinking or behavior based on the feedback provided by the QS device?

In order to further investigate these issues, we designed Feeler utilizing a critical design approach. In critical design, the aim is not to solve a problem or to find answers but rather to make us think and ask questions. Therefore, it resembles art forms that are critical, provocative, and challenging. One of the main questions asked with critical design is about what we really need (Dunne & Raby, 2013).

Speculative design is a critical design practice that focuses on the production of ideas by presenting possible future scenarios of use in which science and technology play a central role. It provokes questions about the impact of science and technology on people's lives by creating opportunities for interventions with possible products that are brought into an everyday context. As opposed to commercial product development and design carried out in product development units, critical design and speculative design bring possible products under public criticism (Dunne & Raby, 2013; Malpass, 2013).

A key aspect of Feeler is the juxtaposition of two data sources: (1) the EEG measurement, which in our time and culture is broadly considered to be objective and scientific, and (2) the participants' own impressions provided after using the Feeler boxes. By presenting different types of data, users are expected to reflect on the possible differences between the different data sources and to identify existing assumptions regarding attention and relaxation.

As part of our research we designed an experiment in which five graduate students would use the Feeler. Students taking part in the experiments were between 25 and 33 years old, originally from Finland, India, Colombia, and Poland. All were fluent in English and the sessions were held in English. The experiment consisted of a session lasting approximately 30 minutes using Feeler (Figure 3), followed by a think-aloud protocol and a semi-structured interview. Students committed to use Feeler once per week over the course of three consecutive weeks. In total, 15 sessions of 30 minutes each were conducted. The study work that participants agreed to perform during the sessions consisted of searching for online information related to their independent study projects. Before the participating in the sessions, participants answered an online questionnaire that collected information about their backgrounds and study habits.


Figure 3. Typical Feeler experiment session.

Students' main motivation for taking part in the study was personal curiosity. It is important to mention that none of them considered themselves to have extensive difficulties with their study work. In addition, most of the students were familiar with the concept of QS and with self-tracking practices. Specifically, 66% of them had, in the past, collected data about some aspect of their life, such as sleep, exercise, or nutrition habits.

We followed a qualitative approach for analyzing the audio recorded from the Feeler experiment. By listening to the recordings of the sessions (N = 7.5 hours), we identified a set of themes connected to our research questions and, from those, expanded our interpretation to wider contextual questions related to the use of biological data in human activities.

Results

From the recording of the think-aloud and semi-structured interviews, we recognized and marked interesting insights presented by the participants. The marked sections were then analyzed and contextualized to the wider research context presented earlier in this article.

Initially, we tried to extract from the participants' interviews how they reacted to the automatically collected

brainwave activity data. Four out of five expressed strong trust in the data captured through the EEG device.

"It's interesting that I thought I was attentive, but I was actually not attentive" (participant 1).

It seemed that, somewhat surprisingly, participants assumed that the data collected by the EEG device and computer were more accurate than their own impressions. In one case, this belief reached the point of changing the participants' perception of self.

"I'm actually surprised with the relaxation thing. I perceived myself as being too tense when I was researching but I realized that I was not that tense. I think it was actually positive to see it happening or see it being measured" (participant 3).

Second, we examined the participants' verbalized thoughts about mismatches between the results from the two different data sources. We discovered that the mismatch between the EEG data and the personal impressions from the first time participants used Feeler affected their assessments in the following sessions. Since participants were aware that their impressions would be juxtaposed with the data captured by the EEG device, they tried to match their impressions to the results they thought the Feeler system would return.

"I learned from previous data, from the EEG data. I kind of felt that (...) however much I think that I paid attention, I'm not actually paying that much attention" (participant 1).

Third, we analyzed whether people modified their thinking or their behavior based on the feedback provided by the QS device. According to the experimental design, Feeler was used three times during three consecutive weeks. This allowed us to observe whether participants modified their thinking or behavior after using Feeler.

Although behavior change is a long process that involves many factors, we can report that, to a certain extent, Feeler contributed to a change in participants' perceptions about their study habits. In a few cases, participants tried to develop new habits (it is impossible to assess via this study whether this experience led to lasting, long-term behavior change). Interestingly, what seemed to motivate students' changes (in their ways of thinking or their habits) was more connected to their personal experiences using Feeler than to the collected data. The observation and analysis of the EEG data played a role, but it only led to a change when participants connected this data to their experiences.

For instance, one participant was motivated to try meditation on her own in order to gain focus when studying. In this case, as well as in others in which participants mentioned their interest in meditation, the collection of data was considered less relevant than how they actually felt after meditating.

"I tested the meditation [aside from the experiment sessions] and I feel that it helps when writing my thesis or when I'm studying for an exam" (participant 5).

Another way students made sense of the data, was to use the collection and visualization of data to confirm their existing ideas. One of the participants explained that, before the experiment, he had been considering trying to focus on the same task over a continuous period of time. Because he was hesitant about the benefits of adopting this new habit, he never made the effort. However, once he realized the effects of task switching on attention, he became convinced about the need to modify his behavior.

"It's [decrease of attention when switching tasks] raising interesting thoughts for me, about, for example, doing some continuous work for a long time (...). It's strange because I felt I had felt this first, or like I was addressing this consciously sometime during the last year or two, that it is good for me, for example, to read a book in a continuous manner for a few hours but (...) I do something so rarely continuously for few hours that I think it's crazy (...), being like this. So I think that brings that up more strongly. And now I feel like scientific data is backing it up" (user 4).

In other cases, rather than thinking about how to change their behavior, the participants were more interested in getting more automated data analyses that incorporate suggestions for behavior changes. Participants found it difficult to make sense of the EEG data and wanted some help from the system to develop new insights and modify their behaviors.

"If I get something like this [referring to Feeler], then okay, I have taken one step to do something about my lack of concentration (...). And then, this should help me through that process" (participant 2).

In the last session of the experiment, two participants reported having tried new practices when studying on their own as a result of the Feeler sessions. The fact that all participants recognized having learned something during the sessions using Feeler allows us to infer that, to a certain extent, the tool did modify their thinking.

Through this research—by developing a speculative design artifact and running an experiment with it—we also aimed to explore whether the method of recording life with lifelogging and QS-type devices can truly help us in our lives. The answer to this question depends on what we want to achieve through these technologies.

According to the participants, technologies based on automated data collection are connected to productivity and self-improvement. Participants took for granted that increasing productivity was the end-goal of using Feeler. In consequence, they expected to see higher levels of attention and relaxation after using Feeler for a period of time.

"I would give it a couple of weeks to see if helps me improve at what I do, because I do all of these things, you know? I use these different techniques… there are productivity blogs and things like that, I do read them and I try to exercise what I read and things like that, so if it helps it's great" (participant 2).

"If you use it on a daily basis, it will definitely make you more relaxed" (participant 1).

The emphasis on individual improvement brought us to conclude that at some level, lifelogging and QS, as cultural phenomena, are part of a competitive culture. Participants seem to have internalized a certain standard of what is con-

sidered "desirable," even if the definition of what is desirable or not has not been discussed before. It is interesting to note that in certain cases, it is not clear who the participants are competing against.

> "Yes, it was a surprise… I don't know what I could do to have more attention, to be honest, because 40%, which it is what I had, I think it is low" (participant 3).

By design, Feeler does not include comparisons between users' activity nor give indications about what would be the expected attention and relaxation levels. We interpret that this design decision disturbed participants since at some point all of them asked if it would be possible to see other people's data or if it would be possible to know if their levels were similar to the average.

> "I don't know, does the attention usually go like this? Do some people have it really like this?" (participant 5).

Going back to the question of whether *lifelogging and QS provide us knowledge that will truly help us in our lives,* Feeler research has helped us identify some of the embedded values of lifelogging and QS technologies, such as productivity, self-improvement, and competition. With regard to whether these technologies are truly helpful for life, we can state that they are perceived as tools for achieving individual goals and higher levels of efficiency in a competitive environment.

In light of the results obtained during the analysis of the Feeler participant interviews, we might ask in what aspects of life can lifelogging and QS technologies be useful?

For some participants, avoiding procrastination and maintaining their focus was an important need. For instance, some participants felt that social media is causing a lot of distraction and that they would like to get rid of it.

> "A lot, it [access to social media] really troubles me that I do! But that's why I have that application that I'm showing you, right? So, normally, if this was part of my system I would sync these two in a way that when I connect this I would also press this. And what this does is that it locks it, so when I'm using *Clear Focus*, like today I will be doing that a lot, I keep my 4G off, so when I put the *Clear Focus* on, I'm not online, and then if I try to open Facebook it should not work" (participant 2).

Do we need to solve problems created by technology with more technology? Although there seems to be an app for any imaginable problem, sometimes the solutions provided by these tools tend to create more problems while encouraging technology dependency.

Even though the design of Feeler can be regarded as similar to other lifelogging and QS technologies, its main goal is to support reflection rather than behavior change. The three sessions scheduled as part of the experiment were not enough to detect or track any significant changes in the ability of participants to be attentive or relaxed. All participants expressed satisfaction with the work conducted during the sessions and most of them were willing to use Feeler in the future. Only one of them showed interest in having access to the data from the sessions. In the end, perhaps it was not that relevant to collect data.

Discussion

Lifelogging and QS technologies act as mirrors that people use for building the "self" and to guide future actions. The values embedded in these technologies connect to wider discourses or metaphors that people live by, as Lakoff and Johnson (2008) described. One of most powerful metaphors presented by the authors consists of considering "the mind as a resource." A good example of this view can be found in the opening words of Gordon and Gemmell's book *Total Recall: How the E-Memory Revolution Will Change Everything*. The books starts with the words "I'm losing my mind" followed by the authors claiming that forgetting means that we lose something (Gordon & Gemmell, 2009, p.3). *Total Recall* is the authors' reflections of the MyLifeBits project, in which the aim was to have lifetime digital store of everything: video of every moment of life, emails, letters, memos, photos, pictures, phone calls, television, and radio programs watched and books read. In the book, Gordon and Gemmell highlight the potential benefits that such e-memory systems could have in different areas, ranging from health to work, learning, and even afterlife.

Gordon and Gemmell adopt a technological utopian view in which increasing the productivity and efficiency of the mind through technology is a desirable future. The data captured by these technologies are trusted and regarded as a neutral and objective truth. However, no matter how much we trust the collected data, one important question to ask at this point is whether it is desirable that technology mediates such intimate experiences as our memories and mental states. Who are the real beneficiaries of such a level of technological dependency?

According to Nye, "The penetration of technology into all aspects of being means that "our new character is grounded in human technology symbiosis," and that "prior to reflection, technology transforms character"" (2007, p.199–200). The analysis of the interviews conducted during Feeler research highlights the connections between lifelogging and QS technologies and well-accepted values in neoliberal economic systems such as productivity, self-improvement, and competition.

As Winne does in his article "Do artifacts have politics?" (1980), we must question the politics of lifelogging and QS technologies. Feeler speculative design is not able to answer this question, but the research has created the conditions for people to think and talk about the effects of self-monitoring and the value that the collected data might have in people's lives. Over the course of these sessions, the initial excitement of some of the participants for lifelogging and QS turned into a more critical and hesitant attitude towards the potential benefits of these technologies.

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