Recipe 1: Reformatting Your Data

Skill level: Intermediate to Advanced
Time needed: 30 min to 4 hours
Ingredients: Garmin device; Garmin Connect account; computer; grit

Summary: To extract data from the Garmin dashboard, you must first download it and then convert it from a proprietary file format (.fit) into a standard format (.csv). This requires a Java command line tool. This recipe also includes a cautionary note about how easy it is to accidentally select "Delete" instead of "Export original" and a guide to adjacent activities like spending time searching for solutions on Stack Overflow and going down dead ends.

Figure 1: Without conducting the complicated liberation steps outlined in this recipe, we are relegated to mousing-over visualizations in order to read individual data points.

Recipes for Breaking Data Free: Alternative Interactions for Experiencing Personal Data

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Abstract
How do the specific, predefined ways data brokers like Garmin or Fitbit render personal biometric data for us hinder—or enhance—our ability to find meaning in our data? Using a Garmin activity tracker as a platform, I present a series of recipes for alternative modes to experience personal data. Recipes are sets of instructions people can follow or remix to create personal, novel data interactions. These recipes highlight how the under-used medium of sound can be a creative material for producing meaning. When we allow our personal data to be brokered by companies like Garmin, we exchange the hidden labor of data representation for an easy-to-access personal data experience; but in doing so, we forfeit the ability to do unexpected things with our data. By exposing these tradeoffs, these recipes encourage us to reclaim control of our own data and embrace the effortful process of data representation as a sense-making practice.

Author Keywords
Quantified self; data sonification; sense-making.

CSS Concepts
• Human-centered computing→Human computer interaction (HCI); Sound-based input/output; Participatory design.

Recipe 2: Voicing a Heartbeat

Skill level: Beginner to Advanced
Time needed: 45 min
Ingredients: Garmin device; Garmin Connect account; audio recording device; metronome (physical or in a web-browser); audio editing software (optional)

Summary: Map 24-hours of heart rate data onto a 1-minute time interval by estimating the average heart rate for each 2-hour period, which will be performed for 5 seconds. (It may be useful to log this in a table.) Record each 5-second heart rate block by listening to a metronome and matching the tempo by making a "ba-dump" sound with your voice. For added emphasis, simultaneously tap the microphone.

When I performed this recipe, I edited it into a 1-minute data sonification clip.
Listen to the performance:
http://bit.ly/performing-heartbeat

Figure 2: This recipe for creating a voice-based data sonification can be recorded or performed live (for advanced practitioners).

Introduction

The rise of smartwatches outfitted with biometric sensors has brought the quantified-self movement from the fringes to the mainstream. As it becomes easier for anyone to track personal data—heart rate, sleep quality, step counts—how is that data represented? How will those representations influence the way we relate to our selves and the world around us? Hidden decisions made by companies like Garmin about what to measure, analyze and display dictate the meaning data brings to our lives. It is unclear whether having access to personal biometric data supports reflection and contributes to a deeper understanding of personal wellness [12, 16, 11].

I examine these issues through a series of design explorations drawing on my experience as a runner who uses a Garmin Forerunner 235 GPS-enabled activity tracker. When interacting with my data in Garmin's dashboard system, I felt restricted to specific, predefined ways of consuming my data. While self-tracking raises privacy concerns in the context of the surveillance economy, there is more at stake than who has access to our personal information. Zuboff writes that surveillance capitalism threatens "the elemental right to the future tense, which accounts for the individual's ability to imagine, intend, promise, and construct a future" [19]. In the context of personal biometrics, when Garmin serves us our data via a highly-designed dashboard, these predefined representation patterns show us the "proper" way to interact with our data. This is convenient and opens up bioinformatics to people who may lack analysis and visualization skills or opportunities to learn them. Yet it also precludes other self-defined interactions that we might have with our data. To explore this tension, I created a series of recipes that highlight how difficult it is to interact with your data in ways that aren't dictated by companies that mediate personal data collection. I performed these recipes individually and collaboratively. The result is a set of provocative data sonification artifacts that leverage Bennett's concept of thing-power [2], using sound to ask how we might reclaim our right to the future tense through making with, rather than simply consuming, our personal biometric data.

Related Work

Many design projects have explored the role of information visualizations in everyday contexts and their relationship to behavior change [5, 4]. In the area of electricity consumption, the Power-Aware Cord employs glowing, changing pulses of light to "visualize energy, as opposed to hiding it" [15], inviting critical reflection on our behavior and our relationship to technology. Reflective [18] and ludic [6] design traditions have also been applied to personal data. Gulotta et al. explored how "curational agents" could help people find meaning in digital data collection systems. Their provocative design, Calendera, facilitates micro-remembrances such as, "This is the first day your dad ever listened to The Beatles. He went on to listen to Abbey Road over 200 times over the course of his life. Listen now?" [7] Personal data can be represented in ways that are simultaneously reflective, playful and interpersonal. Lupi and Posavec's Dear Data project [13] showcases collaborative data exploration through a series of hand-drawn postcards of mundane data points–like the number of times they say "thank you" and the number of times they laugh. Dear Data demonstrates how laborious acts of data collection and visualization can enable deeper personal and situational understanding.

This project employs data sonification, which communicates information with non-speech sounds [9]. Sonification can use explicit data mappings, like conveying the temperature of water during Chinese tea making with pitch [3], or

Recipe 3: Sharing Data with Others

Skill level: Beginner
Time needed: 10 min or more
Ingredients: Friend or family member with a fitness tracker

Summary: This recipe describes the process of contacting a friend or family member to ask for their data. When I asked a collaborator for a day's worth of heat rate data, we found that it was easier to perform the data than to share it in its raw form. When attempting to share data, the results may be completely different from what you anticipated. You might go back and forth, trying to explain your intentions and revising your goals and expectations, participating in a data dialog. This can extend indefinitely.

The eventual outcome was a duet performance of Recipe 2.
Listen to the performance:
http://bit.ly/heartbeat-duet

Figure 3: This recipe is designed to facilitate a shared experience and doesn't lead to any particular "successful" outcome.

abstract models that simulate real-word acoustics, like the motion of a particle through space [8]. Whereas these techniques typically require advanced software tools, this project attempts to facilitate sonification for novices.

What is a Recipe?

The recipe metaphor is inspired by pattern languages in software design, specifically patterns for human action [10], and "scores" performed by Fluxus artists like Yoko Ono [14]. Critical design [1] and data journalism [17] practitioners have used Fluxus techniques to break themselves out of familiar patterns. In this paper, recipes are sets of instructions people can follow to create personalized data interactions. Because recipes are reusable and remixable, they support many levels of expertise and points of view. People can follow them explicitly or adapt and extend them to fit their needs. A scaffold for interaction, recipes emphasize the act of making as a tool for creating meaning.

Creating Recipes for Breaking Data Free

I wrote four recipes that facilitate: accessing data (Recipe 1), sharing data (Recipe 3), and representing data with sound (Recipes 2 and 4). Figures 1, 2, 3 and 4 summarize the recipes[1] and include links to sound files of the performances. Below, I describe reflections from the experience of performing each recipe and the specific provocations each one generated.

Recipe 1: Reformatting Your Data

This recipe (Figure 1) describes extracting data from the Garmin dashboard and converting it into a manipulatable format, a process that is possible but non-trivial. Attempting this recipe, I progressed through feelings of incompetence, elation and anger. I experienced the tension between the

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[1] Full text: https://jwirfs-brock.github.io/recipes-for-breaking-data-free

ease and convenience of having Garmin collect, analyze and visualize my data for me and the frustration and futility of trying to do anything with my data that wasn't sanctioned by Garmin. *When we outsource the hidden labor of data management, analysis and visualization to companies like Garmin, what are we giving up in return?*

Recipe 2: Voicing a Heartbeat

This recipe (Figure 2) outlines creating a data sonification that has to be performed rather than synthesized by software. Performing this recipe elicited slow, careful observation and embodied translation. While extrapolating averages from the data, I spent time noticing through analysis. This led to the insight that my heart rate drops in the final hours before waking–something I had never noticed before, even though I look at my heart rate data every day. Further, by speaking my heartbeat, I enacted a form of translation: Garmin had converted my heartbeat from a biologic signal into a visualization; I converted it back into an embodied physical activity with my voice. At times, this proved to be difficult; I tripped over my lips and tongue when I had to speak 140 beats per minute. Voicing my heartbeat heightened the distinction between my resting and aerobic heart rates. Heartbeats are constantly lived yet rarely consciously felt–*how can performative acts call attention to invisible and unnoticed biologic processes?*

Recipe 3: Sharing Data with Others

This recipe (Figure 3) highlights the friction inherent in sharing personal biometric data. When I asked an outside participant to share a single day of heart rate data with me, we experienced a communication breakdown–the logistic challenges of Recipe 1 were amplified through a game of technology telephone. Instead, I took this as an opportunity to see if another person could perform Recipe 2. She was indeed able to translate her heart rate data into a vocal

Recipe 4: Quarter-Stepping Through Your Data

Skill level: Intermediate
Time needed: 2+ hours
Ingredients: Garmin device; Garmin Connect account; quarters or other coins; audio recording and editing equipment

Summary: This recipe provides instructions for creating a sonic composition representing a single day of step-count data, performed by a human with coins. Using a conversion rate of one step to one cent (1 quarter = 25 steps), record the sounds of stacks of quarters falling on a table. For example, if you walked 253 steps between 6:00 am and 6:15 am, drop two 4-quarter stacks and one 2-quarter stack. Edit them together so they are layered on top of each other but slightly staggered.

When I performed this recipe, the final result was a 30-second audio clip.
Listen to the performance:
http://bit.ly/quarter-steps

Figure 4: This sonification recipe employs coins as both a metaphor and a found instrument.

performance and record it. I edited her vocalizations together with mine to create an asynchronous, virtual data duet. *How can co-experiencing personal data through collaborative performance illuminate the nuances of our individuality?*

Recipe 2: Quarter-Stepping Through Your Data
This recipe (Figure 4) leverages physical objects, external from the body, to sonify step-count data. Although we experience each step as an individual action, we accrue steps in quantities too large to comprehend cumulatively. How can we communicate quantities this large (in the tens of thousands) without flattening their impact? I used the abstract metaphor of money conveyed through the auditory metaphor of jangling stacks of coins. The sonification took several hours to create, calling attention to the labor involved in representing data. Yet it wasn't tedious–as I translated steps into stacks of coins, I entered a flow state. Performing this recipe uncovered new insights: When I sonified data from a 75-minute run, I saw that my step-rate was constant—with the exception of a single outlier interval with a lower step count. This corresponded to running up a long, gradual hill, when I had a slower cadence. *By performing data representations, can we uncover reflections that may be inaccessible when we consume data representations that are created for us, not by us?*

Discussion and Conclusion
By treating sound as a material, this project references vibrant matter and Bennett's idea of "thing-power," which considers that the materials we interact with have a life– perhaps even an agency–of their own [1]. Materials, even if we master them, are inherently unpredictable. Sound's thing-power includes unintended background noise and phenomena like over-modulation. Working with sound as a material exposed how the meaning we draw from data is

entangled with the form and context in which data is presented. Data feels different when it is seen, heard, or physically performed, and each of those acts leads us to draw different conclusions from the same raw information.

Through the exercise of creating and performing recipes for breaking data free from the predetermined ways companies like Garmin have decided we should engage with personal biometric data, I experienced my data in an embodied way that uncovered personal insights: My heart rate drops in the final hours of sleep and my step cadence is significantly lower when I am running uphill. More importantly, it encouraged me to reflect on the tradeoffs I make when I agree to let Garmin serve as a personal data broker. This led to the provocation: *How do the specific, predefined ways our personal data is served to us hinder–or enhance–our ability to find meaning in that data?*

It is unrealistic to expect people to spend the time that I did engaging with biometric data on a regular basis. The participant who performed Recipe 3 with me reflected, "I was very aware when I was doing it. But I don't know that it changed my way of perceiving my heart rate over the long-term." The inertia of experiencing our data in familiar patterns, through a data broker like Garmin, is strong. Garmin takes on the labor of data representation for us. In exchange, we get easy-to-access visualizations on demand. But in doing so, what is lost? We lose control over our data and the ability to do unexpected things with it. These recipes for breaking data free encourage us to reclaim that control– and our right to the future tense–by embracing the human labor that data representation demands. This project points to future research directions: Performative acts of creating data representations can lead to enhanced engagement with personal biometric data, yet they are laborious. How might we encourage effortful–yet insight-producing–acts of data-making on a broader scale?

References

[1] Kristina Andersen, Laura Devendorf, James Pierce, Ron Wakkary, and Daniela K Rosner. 2018. Disruptive Improvisations: Making Use of Non-Deterministic Art Practices in HCI. In *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems*. ACM, W11.

[2] Jane Bennett. 2004. The force of things: Steps toward an ecology of matter. *Political theory* 32, 3 (2004), 347–372.

[3] Jonathan Berger. 2011. Sonifying specific data points in a sequence along with the entire process. Audio file. (2011). Retrieved December 5, 2018 from https://sonification.de/handbook/chapters/chapter15/#S 15.3.

[4] William Gaver, John Bowers, Tobie Kerridge, Andy Boucher, and Nadine Jarvis. 2009. Anatomy of a failure: how we knew when our design went wrong, and what we learned from it. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 2213–2222.

[5] William Gaver, Phoebe Sengers, Tobie Kerridge, Joseph Kaye, and John Bowers. 2007. Enhancing ubiquitous computing with user interpretation: field testing the home health horoscope. In *Proceedings of the SIGCHI conference on Human factors in computing systems*. ACM, 537–546.

[6] William W Gaver, John Bowers, Andrew Boucher, Hans Gellerson, Sarah Pennington, Albrecht Schmidt, Anthony Steed, Nicholas Villars, and Brendan Walker. 2004. The drift table: designing for ludic engagement. In *CHI'04 extended abstracts on Human factors in computing systems*. ACM, 885–900.

[7] Rebecca Gulotta, Alex Sciuto, Aisling Kelliher, and Jodi Forlizzi. 2015. Curatorial agents: How systems shape our understanding of personal and familial digital information. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. ACM, 3453–3462.

[8] Thomas Hermann. 2011. Particle Trajectory Sonification for 1 particle. Audio file. (2011). Retrieved December 5, 2018 from https://sonification.de/handbook/chapters/chapter16/#S 16.6.

[9] Thomas Hermann, Andy Hunt, and John G Neuhoff. 2011. *The sonification handbook*. Logos Verlag Berlin, Germany.

[10] Takashi Iba. 2015. Pattern Language 3.0 and Fundamental Behavioral Properties. In *World Conference on Pursuit of Pattern Languages for Societal Change* (PURPLSOC2015). 200–233.

[11] Elisabeth T Kersten-van Dijk, Joyce HDM Westerink, Femke Beute, and Wijnand A Ijsselsteijn. 2017. Personal informatics, self-insight, and behavior change: A critical review of current literature. *Human–Computer Interaction* 32, 5-6 (2017),

[12] Ian Li, Anind K Dey, and Jodi Forlizzi. 2011. Understanding my data, myself: supporting self-reflection with ubicomp technologies. In *Proceedings of the 13th international conference on Ubiquitous computing*. ACM, 405–414.

[13] Giorgia Lupi and Stefanie Posavec. 2016. *Dear data*. Chronicle Books.

[14] Yoko Ono. 2000. Grapefruit: A book of instructions and drawings by Yoko Ono. Simon and Schuster.

[15] James Pierce, William Odom, and Eli Blevis. 2008. Energy aware dwelling: a critical survey of interaction design for eco-visualizations. In *Proceedings of the 20th Australasian Conference on Computer-Human Interaction: Designing for Habitus and Habitat*. ACM, 1–8.

[16] Amon Rapp and Federica Cena. 2014. Self-monitoring and technology: challenges and open issues in personal informatics. In *International Conference on Universal Access in Human-Computer Interaction*. Springer, 613–622.

[17] Britt Binler Scott Blumenthal. 2018. News Nerd Fluxkit (2017): Inspiration and provocations for people who make interactives. Conference session transcript. (2018). Retrieved April 20, 2019 from https://2017.srccon.org/transcripts/SRCCON2017-new-snerd-fluxkit/.

[18] Phoebe Sengers, Kirsten Boehner, Shay David, and Joseph 'Jofish' Kaye. 2005. Reflective design. In Proceedings of the 4th decennial conference on Critical computing: between sense and sensibility. ACM, 49–58.

[19] Shoshana Zuboff. 2019. *The age of surveillance capitalism: the fight for the future at the new frontier of power*. Profile Books.