Negotiation in Tools for Building Hand-Crafted Physicalizations of Personal Data

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Abstract

This paper describes the development of a free-form data exploration tool. The process begins with work done on a generative crochet tool to incorporate data and self-made crafted objects using personally tracked data. I describe the initial work in crafted personal visualizations and describe the themes around agency of materials, tools, data, and self; negotiation of narrative; and subverting the expected and normal. I end the paper discusses how these themes informed the design of the data exploration tool and the role the tool plays in the creation of these hand-crafted data narratives.

1 Introduction

Data holds a sense of authority and purity to many who might unintentionally overlook the fact that (1) the data comes from somewhere, possibly even someone, in the real world and (2) every decision on what to collect creates a bias. And yet, data is often seen as objective. Thus, when we visualize data, those visualizations also feel authoritative of what the knowledge and conclusions from the data should be. This paper describes an exploration into crafting physicalizations around personal data. It presents one artefact created from device-tracked, two from self-tracked data, and a web-based data exploration tool that was designed through knowledge learned from creating the physicalizations.

2 Related Work

Visualizations have been around since the 17th century with a golden age in the 19th century and the recent resurgence in the 21st century [2]. Throughout that time, there have been various best practices and exploration into new forms of visualization.

Visualizations are often meant to compress the knowledge of hard to read data into a more readable and comprehensible format. Research in visualization often focuses on bettering existing visualization forms [7, 11], the use of colors [3, 14], interactions [1, 13], and tools for building visualizations [9, 12]. But a major consistent theme of this work is the search to create visualizations that allow people to intuitively understand the data being visualized and to be able to explore new information.

In addition to visualizations on screens, there is also work on creating physicalizations [4,5], physical visualizations. These can range from educational about the lifespan of butterflies [6] to laughter [10]. Even tools have moved towards physical manifestations [15].

Within the realm of personal data, there has been work around looking at more intimate data–personal data [8, 10]. What is interesting about such work is the authority people give the visualization of their own data, as if they didn't know until the visualization told them. While I am not suggesting this is not something that might happen, I do think we can question this authority and to take some authority back. This is what motivated my work.

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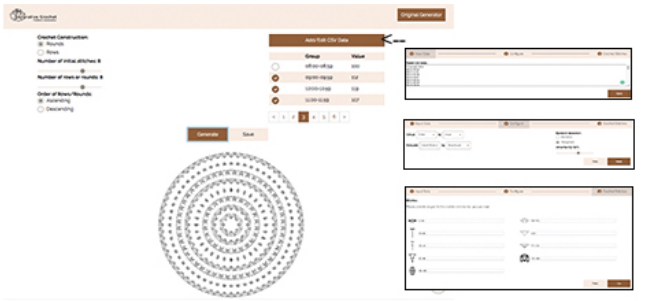

Figure 1: The interface of the generative crochet as well as the way a crochet pattern is generated using data. You can see the user is asked to choose a grouping and evaluation and define the boundaries for groups. Then the user can select specific groupings to visualize before hitting generate.

3 Crafting Personal Data

This section will describe my personal exploration into crafting my own data. The first subsection describes my journey crafting with data supplied through a device (i.e. my FitBit heart rate data) and the development of a data analysis tool onto a crochet generator. The second part describes the exploration into a by-hand data analysis of self-tracked data around the topics of commuting and forgetting. The motivation from these artefacts stem directly from a desire to have more agency in the design and to better incorporate an experience into a visualization.

3.1 Generating Crochet Patterns with Data

This project stemmed directly from tensions with my fitness tracker and a desire to reclaim my personal data and present it back in a way I felt would better reflect what I was feeling. Being tired with an impersonal dashboard that labeled me as in 'average health' (not that it is necessarily wrong) for a 25-30 year old woman, I desired to turn the data the app turned into bar graphs and line charts and create something new.

There are a plethora of devices meant to help people understand and interpret biofeedback, ranging from fitness trackers (like Garmin and Fitbit) to emotion and stress trackers (like Spire and Pip). However, the way these systems are interpreting biosignal data is not transparent to us as users and may even conflict with how we interpret our own data. By assuming our devices cannot accurately interpret our biosignals, we will be able to produce new ways of visualizing our data and reclaim agency over our biofeedback. This project aimed to combat the tensions and torque between device-tracked data and the experience of the person producing that data.

To explore this, I added a data analysis tool onto a generative crochet application that had been created by an artist and businesswoman Kira Street. The original application randomly generated a symbol-based crochet pattern in a row or circular form. I used this as a starting point and creating a tool (see figure 1) that allowed you to input data organized as CSV text and had built in functions to group and quantify text, number, and time data. To mirror the

Figure 2: Crochet object depicting heart-rate data (with interjected uncertainty) from Denver Pride and Minneapolis Pride. In the figure, (a) is an above view and (b) is a side view showing the texture of the material.

randomness and free-form nature of crafting, I added the ability to introduce uncertainty and randomness into the pattern.

For this project, I wore my FitBit and used the API to grab my heart-rate data for specific days. I chose to grab data from 2 different weekends: Pride in Denver and Pride in Minneapolis. Next, I inputted the heart-rate data for each day, chose to group by hour, and to quantify the data as the maximum value for that hour. I chose an uncertainty level of sixty percent and made the randomization be weighted. Thus, maximum values that appear most frequently throughout the day will be more likely to appear. For each of the days, I chose 9am to 5pm to be each row in the circle, starting in the center. Then to turn them each into a square, I purposely added stitches in the four corners, making the yarn naturally warp into a square. Figure 2 shows the finished product of these squares.

In reflecting on this project, I was concerned I was quantifying too much, and that there was not enough agency in how to group items or in designing. These frustrations led to the next project, where I had nothing but control on the process–every step.

3.2 Hand-Crafting Self-Tracked Data

In order to have full control of the narrative of a personal data visualization, I shifted to having a hand in everything. From the what data was being collected to what exactly the design was going to look like. In this section I discuss two of these objects in more detail and discuss some of the themes and values I noticed while reflecting on this work.

Figure 3: Crochet object depicting typical and atypical commuting data from a Monday in November.

3.2.1 An Atypical Commute

For the first of these physicalizations, I collected information around my weekly commutes, including anytime I used any form of transportation to get from one place to another. The week after I started designing the piece. I started by exploring triangles, creating a couple mini pieces as tests. I knew I wanted to create a blanket of some sort, and I thought combining triangles and squares would create an interesting pattern. Exploring different layouts, I decided that having 2 times more triangles than squares would make it easier to connect them together.

I then turned to my self-collected data and explored different groupings. Buses vs. cars–which didn't split in the sizes I wanted. And then typical transportation (my car or the FF1) and atypical transportation (anything else). This second division created the sizing I wanted. Next I decided on colors, I first turned to my yarn pile. A series of three yarn balls (blue, green, and orange) that I had bought on sale mid-summer stood out to me. When choosing how to commute from point A to point B, I often weigh cost, convenience, and time. These colors were selected because I had purchased them because of their low cost and I already had them ready to go, making them convenient and saving time as well.

I started to hand-designed a couple of the triangles, but decided to give myself free-form to create within parameters. I did want to use size and color to describe items of the commuting data, but I also wanted to be a little inconsistent to *hide* the information. I decided that the shape was to signify whether it was a typical (triangle) or an atypical (square) transportation. The color of the shape signified whether it was by car (blue), by bus (green), or if I was in a rush (orange). Being in a rush overtook the mode of transportation. The additional plots of color signified convenience (blue) or a frustrating (orange) event, like a missed turn.

Crocheting these shapes took longer than expected, so I was only able to complete the Monday commute. The placement of the shapes (seen in figure 3) has nothing to do with the data besides the fact I didn't want the colors to touch.

3.2.2 What Does Forgetting *Feel* Like

The second object was creating using self-tracked data on forgetting–or rather remembering I forgot something. Before even starting to track my remembrances of forgetting, I knew that I wanted to make something that felt like how I experienced it.

Collecting this data was difficult for me, especially because I might remember things that I forgot when I was in a hurry going from teaching to class to a meeting all back-to-back. So by the time I got where I was going and could write down what I remembered I forgot, I had forgotten it again. This led to a small data set of only 8 items with the knowledge that I had remembered things that weren't

Figure 4: Hand-knitted scarf featuring bulbs and holes depicting the act of remembering I forgot (bulbs) something and the act of forgetting (holes).

written down and other things I had probably never remembered at all.

When I started the design, I already had two decisions made. The first decision is that I wanted to make a scarf of some sorts and as luck would have it, I found two thick yarn balls at Jo Ann's for a total of three dollars in gray and red. The second decision I had decided on is that I wanted to represent the remembering I forgot as bumps on the scarf. I felt that bumps would disrupt the scarf in a way similar to how I felt that remembering I forgot something creating a small disruption in that moment to my day. Brainstorming with others, they often brought up holes. And though holes didn't seem right for what I had remembered to write down about forgetting, it did start to feel like a great way to describe the idea of never remembering what you forgot in the first place. Forgetting is gaps or holes in your memory.

Drafting the design, I rated the remembrances on how disruptive I remembered them to be in the moment, which determined the number of bulbs created for that remembrance. Then I distributed them across the page to create an even distribution. Next I added several holes across to represent forgotten items that were never remembered. Lastly, I created a divide of color, just to have both colors be used and to create the aesthetic I wanted.

At one point in the design, I wrapped the yarn the wrong way around the knitting needle and decided to create a rough fix instead of redoing it. This caused a much larger hole than I anticipated and I liked the look of it, so I then made that mistake a couple more times going forward. Once I reached the end of my pre-designed pattern, I started to randomly place holes and interweave the colors as I felt fit until the scarf would be long enough to wrap around my head. The finished product is show in figure 4.

3.3 Reflecting on Themes

In reflecting on my work this past year, I realized there are a few key themes I have noticed in my work: subverting authority from technology, fighting the norms of interaction design and visualizations, and conveying experience over certainty of data.

With subverting authority of technology, my first project took device-tracked data and decided to visualize it different from the way it was handed to me in the dashboard of the application for the device. Additionally, I removed technology from the process completely in the second project.

Fighting the norms of visualization and interaction design was the main motivation between the generative crochet project and the self-tracked data physicalizations. I was unhappy in how I limited the types of analysis to those that might often happen in creating typical charts and graphs. Within the design of the objects of the

Figure 5: The interface of the generative crochet as well as the way a crochet pattern is generated using data. You can see the user is asked to choose a grouping and evaluation and define the boundaries for groups. Then the user can select specific groupings to visualize before hitting generate.

second project, I purposely chose to overlap attributes (like color being mapped to two different aspects in the commuting object) or the introduction of an attribute that means nothing (like the colors of the forgetting scarf). Part of these decisions are to further hide the information within the design as well as decisions of aesthetics of the object.

This theme of queering or ignoring norms leads directly to wanting to convey experience over data certainty or knowledge. The story of the object is not about the data itself, but more the narrative of the object as a whole. This is most visible in the forgetting scarf, as the pieces of data dispersed through the design are not in a specific order of occurrence, more of an order of balance. And forgetting completely was added as holes even though I have no idea how many items I have actually forgotten or when they occurred.

4 Data Exploration Tool

After completing the second project and doing it without technology, I wondered how might a tool become a part of the process without hindering the agency of the human, materials, and narrative. I realized that often I had an idea of where I wanted the design to go, and that sometimes involved hacking the data into the form that would allow for my design to coexist with the data narrative. This is why I chose to create a data exploration tool instead of a visualization tool.

4.1 Inspiration from Previous Work

Looking back to my themes, in designing this system I wanted to make sure that I was not giving the tool too much authority. This theme was a major influence in choosing to create a data exploration tool instead of a tool to help design a visualization. Additionally, I did not put in any computational quantification of the data. This is different from the first tool I built, which had a lot of quantifying of data, but also came with a lot of trade offs on minimizing the type of data it could process.

Because the design of my objects often involved hacking the data to fit into a pattern that would convey the experience and narrative I wanted to get across, I knew I wanted to leave the grouping open ended and able to be whatever someone might need. When I analyze my data, I often search for groupings that lead to the numbers I need and I might also non-rigorously perform thematic coding of the information if I can't decide on groups right away, or if I am looking for an additional attribute. To include these types of interactions in the system, I decided on two main features, grouping and highlighting.

The use of regular expressions to choose the grouping and highlights started as a decision made on time and convenience. As it was implemented I realized that I enjoyed the hacky nature of using regular expressions and its ability to allow the user to make the system work exactly as they wanted (if they put in the time) or the system will do weird things (if they don't put in the time). It represented the negotiation between human and machine.

4.2 Workflow

The tool works as a way to explore data to search for the narrative and to find how it can become the object that one wants it to be.

The first thing is to input CSV organized data as text into the data field. This will initialize the table and create the first tab labeled 'All Data'. Next, the user can create more groups, using regular expressions to select records to pull into a subset and a new tab and new table of the subset is created for each group. The regular expression input will look through all fields, pulling any record with a match in any field. Next, you can create highlights. Similar to groups, a regular expression is used. With a highlight, the specific match is highlighted using the selected color. Groups and highlights can be edited and update on any change.

The exploration tool allows the user to search, explore, and discover interest aspects of the data around the narrative they wish to tell. For example, if I were to input journal entries around busy-ness, I could highlight negative terms (such as rejection, stress, overwhelm) and terms around making time for myself (such as reading, watching movies, and relaxing not doing work) to see possible patterns of stress and then purposeful shutdown to keep from getting burnt out.

This tool is not meant to be an authority of the data itself, but act as a tool in creating the data narrative wanted by the user.

5 Conclusion

The work presented in this paper is an exploration in shifting the authority of visualizations from knowledge-based and data as an authority to a more experience-based narrative, leaning into the creator's decisions, regardless of uncertainty of the data being presented. Though this may be counter to a lot of research in the area, I believe it offers an important questioning of how we apply techniques for visualizations meant to portray information and knowledge to data that is connected to a human experience.

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