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Alice Thudt, Charles Perin, Wesley Willett, Sheelagh Carpendale

# Subjectivity in Personal Storytelling with Visualization

## **Abstract**

We explore visualization for personal storytelling and investigate techniques for communicating subjective experiences in personal visual narratives. Personal stories are often subjective and storytellers omit, invent, or embellish details to craft engaging stories or to communicate a perspective. As growing personal data collections allow individuals to leverage visualizations, we explore how personal visual narratives can express subjectivity. From an analysis of personal visualizations created by data enthusiasts, designers, and artists, we collect techniques for deliberately expressing subjectivity during data collection, processing, visual encoding, and presentation. Our results prompt a discussion about the role and potential of subjectivity in personal visual storytelling.

## **Keywords**

Visualization, Personal Visualization, Storytelling, Personal Narratives, Subjectivity

## **1. Introduction**

Personal narratives are a fundamental form of human communication and serve as means for strengthening interpersonal relationships, communicating a value system, and offering self-presentation (Langellier, 1989). On a daily basis, people share accounts of mundane and memorable episodes from a personal perspective and sometimes include humor, irony, or embellishments (Langellier, 1989; Labov, 1967). This subjective interpretation is an integral part of personal narratives and distinguishes them from merely factual reports (Robinson, 1981).

While the value and central role of subjectivity is widely acknowledged in art and design (e.g. Manovich, 2002; Dorst, 2006), in the visualization research community objectivity is a core value (Jorgenson, 1995), and minimalist representations that reduce or eliminate the “lie factor” are widely considered the ideal (Tufte, 1983).

The strength of visualization as a communicative medium is frequently discussed in research (Gershon, 2011; Kosara, 2013; Segel, 2010) and data journalism (Cairo, 2012). However, portraying “human subjectivity” and conveying experiences with visualizations is predominantly explored in data art (Manovich, 2002; Viégas, 2007) and only hinted on by a few personal visualization researchers (Donath, 2010; Thudt 2016). We aim to explore subjective expressions in more depth in the context of personal storytelling with visualization. This work exists at the intersection of art, design, and visualization research.

*Personal narrative visualizations* are visual data representations that tell stories about personal experiences from the point of view of the narrator. Today more and more people are using visualizations of their personal data collections to tell compelling stories about themselves, their lives, and their experiences.

In this article we investigate the emerging phenomenon of personal narrative visualizations and the expression of subjectivity in these visual stories. Based on an analysis of personal narrative visualizations, we describe and categorize techniques for subjective personal storytelling with visualizations. We collected personal visual narratives created by data enthusiasts as well as by professional designers and artists. From these narratives, we sought to identify ways in which authors incorporate subjective perspectives with presentations of data. By considering work from a variety of diverse contexts, we offer an integrative perspective of subjective expression in personal visual narratives. We found that subjective perspectives can be introduced at every step of visualization creation: during data collection and processing, visual encoding, and when refining the presentation. Our categorization further sheds light on the diversity of subjective expressions in personal visual narrative practice and can help inform the design of new visualization tools for personal storytelling.

## **2. Background and Related Work**

Subjectivity arises because individuals experience the world in different ways. Those experiences are characterized not only by objective facts, but also by personal feelings and attitudes. To provide the background for our exploration, we describe research on the role of subjectivity in personal narratives and then examine how subjectivity has been discussed in visualization research, information design, and data art.

## 2.1 *Subjectivity in Personal Narratives*

Personal narratives have been studied in a variety of disciplines including psychology, sociology, literary folklore, and history (see Langellier, 1989 for an overview). The “homo narrans” theory considers personal narratives as an elementary human need and the most common form of discourse in everyday life (Linde, 1993b). Kristin Langellier summarizes William Labov’s (Labov, 1967) definition of verbal personal narratives as accounts of personal experiences “from the point of view of a narrator who interprets the significance of the experience” (Langellier, 1989: 245). This definition emphasizes the *evaluative function* of personal narratives, which reveals the narrator’s subjective attitude through emphasis and personal interpretation (Labov, 1967: 37), distinguishing personal narratives from reports (Robinson, 1981).

Personal narratives are a means of self-evaluation (Linde, 1993a), of sharing one’s value system (Langellier, 1989), of self-exploration, and of shaping identity (Labov, 1967; Worthham, 2001). Personal narratives can also evoke sympathy, approval, or amusement (Goffman, 1974), show others how the narrator wants to be perceived (Linde, 1993a; Linde, 1993b), and create intimacy, trust, and social connections (Linde, 1993b). For these important functions of personal narratives, a subjective interpretation of the described experience is beneficial.

## 2.2 *Subjectivity in Visualization and Data Art*

The positive aspects of subjectivity are rarely discussed in the visualization research community. The community largely agrees that an objective visual representation that produces repeatable insights is the ideal. Subjectivity is viewed with caution and should generally be avoided. However, researchers have argued that completely eliminating subjectivity is impossible (Jorgenson, 1995; Valle, 2015; Van Wijk, 2005). For example, the choice of a visual encoding is subjective as it relies on personal experience and intent (Jorgenson, 1995; Van Wijk, 2005). Several research efforts have explored alternative strategies for creating more “truthful” visualizations. Approaches include integrating multiple perspectives of the same data (see Baldonado, 2000), visualizing errors and uncertainties in the data itself (see Bonnau, 2015), and supporting provenance by making change histories transparent (see Ragan, 2016). In their discussion of critical visualization, Marian Dörk et al. discuss potential benefits of subjective visualizations such as empowering creators to have their voices heard (Dörk, 2013). We discuss the

value of subjective choices as a means to communicate personal perspectives, feelings, and experiences in narrative visualizations. Subjectivity as discussed in this paper is therefore distinct from the prevalent and widely condemned notion of lying with statistics (Huff, 1954) and visualization (Tufte, 1983), which refers to deliberate deceit and misrepresentation of the truth.

In data art, subjectivity and the focus on a “point of view” is considered a defining quality (Manovich, 2002; Viégas, 2007). Portraying personal subjectivity allows artists to evoke emotional and visceral responses (Gaviria, 2008). Fernanda Viégas and Martin Wattenberg suggest that techniques that are often considered unconventional in visualization design, such as distortion or cluttered representations can be means to communicate artistic intent (Viégas, 2007).

While storytelling is a common topic of discussion in the field of visualization (Cairo, 2012; Gershon, 2011; Kosara, 2013; Segel, 2010; Lee, 2015), there is little research on *personal* storytelling with visualization. In their survey, Huang et al. identify sharing, privacy, and personalization as challenges for personal visualizations (Huang, 2015), hinting at the importance of giving the data owners control over representations and the messages they convey. Donath et al. define the related concept of “data portraits” as “subjective renderings” for “self-representation” (Donath, 2010), but do not describe specific techniques for creating such subjective representations. Similarly, Thudt et al. describe “expressing subjectivity” as a design goal for visual mementos and provide an example system as a proof of concept, but do not examine the variety of options available for creating subjective representations (Thudt, 2016). Our investigation complements these discussions of the value of subjectivity in personal visualizations and provides an initial list of techniques for introducing deliberate subjectivity.

### **3. Techniques for Deliberate Subjectivity**

To understand how subjective perspectives can be communicated in personal narrative visualizations, we examined a set of examples created in a personal context as well as work by professional visualization designers and artists. Some of these examples use data to provide accounts of personally significant or sentimental episodes that are similar to personal stories shared by individuals in everyday life. Meanwhile, others are artistic and more conceptually complex. We deliberately include a broad spectrum of examples to illustrate the diversity of techniques applied to express subjectivity in visual

accounts of personal experiences. We collected examples from visualization blogs such as [flowingdata.com](http://flowingdata.com) and [infosthetics.com](http://infosthetics.com) using tags and keywords referring to personal visualizations (e.g. “personal”, “self-surveillance”), as well as from [vis4me.com](http://vis4me.com), which focuses on personal visualizations. We manually sampled a collection of over 100 initial results to identify a diverse set of 20 personal narrative visualizations that present data in a subjective fashion. We excluded descriptions of life-logging devices or applications and focused on stories about personal experiences from the point of view of the narrator. We also sampled to maximize the diversity of approaches and creators. However, we do not claim that our list of techniques is comprehensive. Figure 1 shows an overview of subjectivity techniques identified from the collection we explored along with selected examples of each.

Step of Visualization Creation	Technique for expressing subjective perspectives	[E1]	[E2]	[E3]	[E4]	[E5]	[E6]	[E7]	[E8]	[E9]	[E10]	[E11]	[E12]	[E13]	[E14]	[E15]	[E16]	[E17]	[E18]	[E19]	[E20]	
		Atlas of the Habitual	Feltron Annual Report 14	Good Night SMS	201 Days	Wheel of Worry	Dear Data - Distractions	Tactile Emotional Map	Smell Map of Newport	Heart Rate During Sex	Deadline Vis	Heart rate during marriage proposal	Autobiography, ver 2.	Weight loss over 20 months	Shades of my memories	visits - Peru Trip 2013	Rocky Beginnings	Instagram Suggest	8 Years of Dating Data	The Grasses of America	2010 Paths Travelled	
1. Collection	Collecting subjective data																					
	Capturing data selectively																					
	Reconstructing data from memory																					
2. Processing	Choosing specific data aspects																					
	Clustering into personally meaningful groups																					
	Inferring missing data																					
3. Visual Mapping	Visual metaphors for experience																					
	Encoding based on psychological theory																					
	Poetic use of unconventional encodings																					
4. Presentation	Annotations																					
	Media as contextual information																					
	Style and choice of material																					

X used as an illustrative example in the paper

■ technique used in example, based on project documentation

▨ technique could be used in example, but not explicit in project documentation

**Figure 1. Overview of techniques for introducing subjectivity in personal narrative visualizations with associated examples.**

Three researchers collaboratively analyzed the collection of examples using open coding. In the first coding pass a coarse categorization of techniques emerged, describing visualization creation steps during which subjectivity can be introduced: (1) data collection, (2) data processing, (3) visual encoding, and (4) presentation. Steps 2 to 4 align with the widely used pipeline for creating information visualizations (Card, 1999).

Our categorization extends the pipeline by including data collection (1), since it can be an integral part of the creation of narratives, particularly if narrators collect data specifically for this purpose. In a second pass we refined our categorization and identified several specific techniques that fit within each step (see Figure 1, column 2).

Given that documentation for each project was limited or not available, we relied on our own subjective interpretation of the work to define the use of a given technique. In Figure 1 we distinguish between *explicit uses* of subjectivity techniques described in the project documentation (descriptions and images) and *potential uses* of techniques that we identified during coding. Many examples use multiple techniques concurrently. In the following sections, we describe techniques for each step and illustrate each by discussing one example (highlighted with an x in Figure 1).

### 3.1 Data Collection

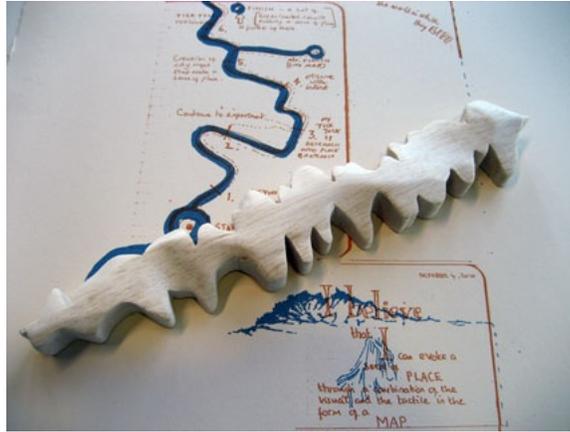
During data collection, narrators can introduce subjectivity by (1) collecting inherently subjective data, (2) capturing selectively, and (3) reconstructing data from memory.

#### 3.1.1 Collecting Subjective Data

Some types of data, such as dreams, hopes, emotions etc., inherently include subjective perspectives. Such data originates from the point of view of the narrator and cannot be separated from its personal interpretation. We exclude the use of biosensors to infer emotional states from measurable body data (e.g. heart rate, sweat level, etc.), as such data does not contain the narrator's interpretation.

Using subjective data as a basis for visual representations dates back to the 50s and 60s with the Situationists' "psychogeography" (Pinder, 1996). Members of this political art movement appropriated geographic maps to investigate "the actual human experience of a city" (Lynch, 1984), for instance "the evident division of a city into zones of distinct psychic atmospheres" (Debord, 1981, pages 6-7).

Kate McLean, a contemporary artist inspired by Situationist psychogeography, also uses subjective data in her sensory maps ([E7][E8]). Her "Emotional Tactile Map" ([E7], see Figure 2) shows the artist's emotional state during her MFA. The wooden visualization is inspired by Inuit coastal maps and contrasts fear and elation on one side and surprise and anticipation on the other.

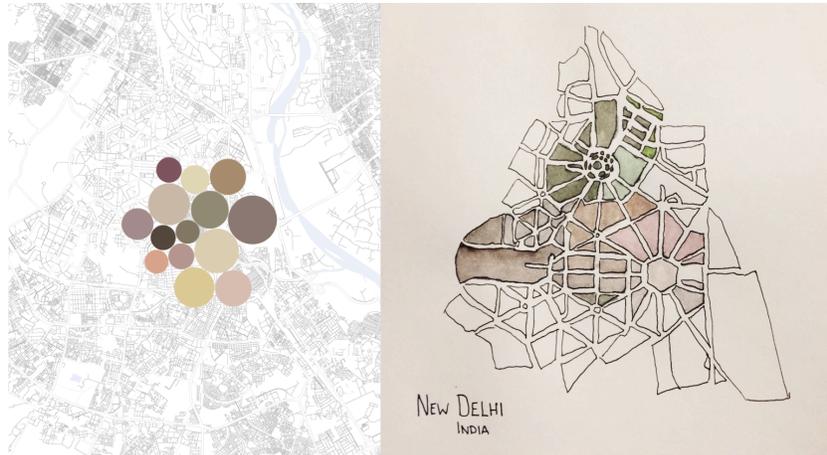


**Figure 2.** McLean's “Emotional Tactile Map” visualizes the artist's emotional state [E7].

### 3.1.2 Capturing Data Selectively

Autobiographical memories are a selective repository of experiences that are filtered by people’s evaluation of their significance (Conway, 2000). Selective data capture entails a manual collection process where each potential data point is individually assessed for its personal significance or relevance to an intended story. Unlike when capturing subjective data (see Section 3.1.1), here the data itself is not necessarily ambiguous. Instead, subjectivity is introduced through the active selection of certain data points and the omission of others. The practice of taking personal photos is a familiar example of this technique. By consciously deciding if and how a particular moment should be recorded – rather than using automatic logging devices running in the background – people create subjective data collections.

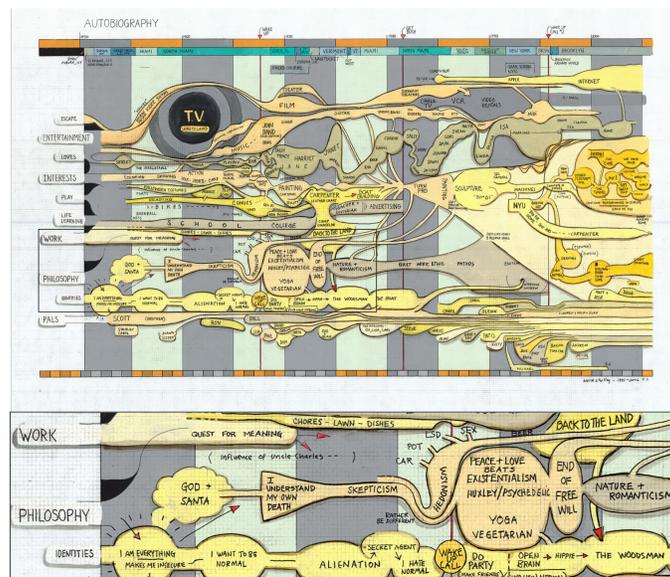
Alice Thudt used *selectively captured* photo collections as data source to show which colors she perceived as characteristic for Indian cities visited during a trip [E14]. She algorithmically extracted dominant colors from her photo collections in which she gives subjective preference to certain scenes over others. In a second iteration of the project Thudt created watercolor paintings inspired by the output of the algorithm and the city map outlines (see Figure 3). Before painting she selected and corrected the set of color values to bring them closer to her memory, hence adding an additional layer of subjectivity to the data source.



**Figure 3. a) Algorithmically extracted colors from selectively captured travel pictures, b) an adaption of the algorithmic output painted with watercolors and adjusted to match personal memories of New Delhi [E14].**

### 3.1.3 Reconstructing Data from Memory

When reconstructing data from memory, rather than capturing it in the moment, the collected data inevitably contains subjective elements. Autobiographical memory is an inherently subjective view on the past that is constantly reinterpreted and adjusted (Conway, 2000). Therefore, data that is reconstructed from memory is a retrospective subjective interpretation of personal experiences.



**Figure 4. Shelley's visual autobiography uses data that appears to be reconstructed from memory [E12].**

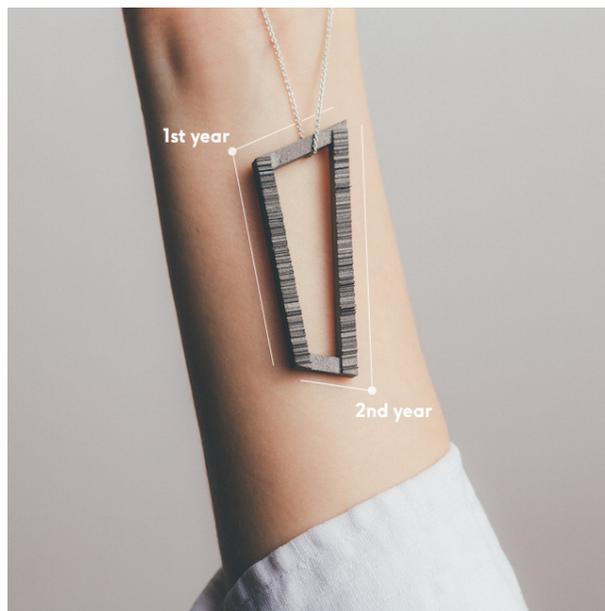
We assume that Ward Shelley's 50-year autobiography ([E12], see Figure 4) was *reconstructed from memory*. It shows how different areas of his life evolved over time. Some aspects of the data, such as his philosophies and identities, show a strong subjective interpretation based on retroactive reflection.

## 3.2 Data Processing

During data processing narrators clean, filter, and prepare data for visualization. Techniques for introducing subjectivity during data processing include (1) choosing specific aspects of the data to visualize, (2) clustering data to create personally meaningful groupings, and (3) inferring data points from other sources.

### 3.2.1 Choosing Specific Data Aspects

Specific aspects of an existing data source can be extracted to support a point of view, to isolate personally meaningful excerpts, or to hide data that the narrator does not want to share. This can be achieved by filtering a dataset based on criteria that the narrator identifies as relevant for the intended story, or by manually processing the data and selecting which data to include or omit.

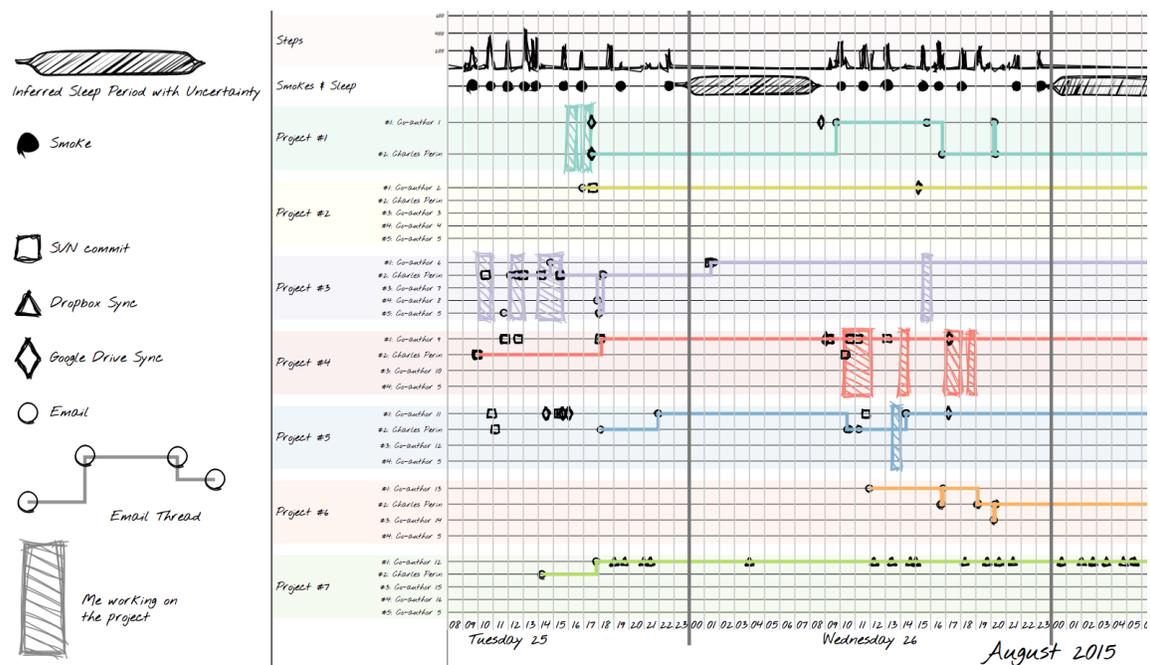


**Figure 5. For Heinicker's necklace showing good night SMS, the relevant data is isolated through intricate data mining [E3].**

To create a necklace for his girlfriend, Paul Heinicker extracted all good night SMS from a 2-year long chat history [E3]. The necklace shows the frequency and length of the exchanged messages (see Figure 5). Rather than visualizing the entire communication record, Heinicker chose an aspect that contains personal meaning. In his description of the project, he discusses the process of isolating good night messages from the rest of the collection as a complex data-mining task.

### 3.2.2 Clustering Data into Personally Meaningful Groups

Clustering data points into groups is a common scientific technique that can be applied in personal visual narratives to convey a subjective interpretation of data. Personally meaningful clusters of values can be created *algorithmically* using subjectively chosen methods and parameters or constructed *manually* based on personally selected criteria. When individual logs are clustered, the grouping may contain additional personal meaning not inherent in the raw data and can therefore convey a subjective perspective.



**Figure 6. In this visualization of work during a paper deadline, the intended notion of paper revisions is conveyed by clustering Dropbox and Google Drive syncs into personally meaningful groups [E10].**

In Charles Perin’s visualization of his working habits and paper revisions during a conference deadline ([E10], see Figure 6), the clustering conveys personal meaning. Perin used Dropbox and Google Drive syncs as data sources to show paper revisions.

However, these services create syncs for each minor edit, obscuring his intended notion of revisions. He therefore experimented with different thresholds to cluster syncs by the same author within a specific timeframe. The resulting clusters reflect his subjective sense of how the revisions for each paper progressed.

### 3.2.3 *Inferring Missing Data*

When personally relevant aspects of an experience were not recorded, narrators either reconstruct the missing data purely from memory (see Section 3.1.3) or infer it from existing data sources. This requires choosing an appropriate data source as a basis and extrapolating the required data. Methods can be based on general heuristics (e.g. inferring the mode of transportation from the speed of movement) or include additional subjective interpretations based on narrators' personal experience and knowledge of their own habits.

Perin considered his lack of sleep nearing a deadline as an important element of his intended narrative ([E10], see Figure 6), but lacked sleep tracker data. He therefore inferred his sleep patterns from pedometer logs, counting six consecutive hours with no logged activities as sleep. The inferred sleep data is tied to his subjective sense of the relationship between sleep and steps during this time. His choice to include sleep patterns communicates a personal message about his intense work schedule.

## 3.3 *Visual Encoding*

During visual encoding, narrators associate data with visual properties and create visual forms. While researchers have discussed the inevitable subjectivity in the choice of visual encoding (see Section 2.2), here we describe techniques for conveying a personal experience or message through the encoding: (1) visual metaphors for experiences, (2) layout algorithms based on psychological theory, and (3) unconventional encodings to create poetic representations.

### 3.3.1 *Visual Metaphors for Experiences*

Visual metaphors in visualizations suggest an association with an internal mental image and therefore shape the interpretation of the presented information (Ziemkiewicz, 2008). They are widely used in narrative visualizations and can support memorability and interpretation of a visualization (Eppler, 2006). By purposefully evoking a mental

image that relates to a personal experience, narrators can express a point of view and make their experience more relatable.

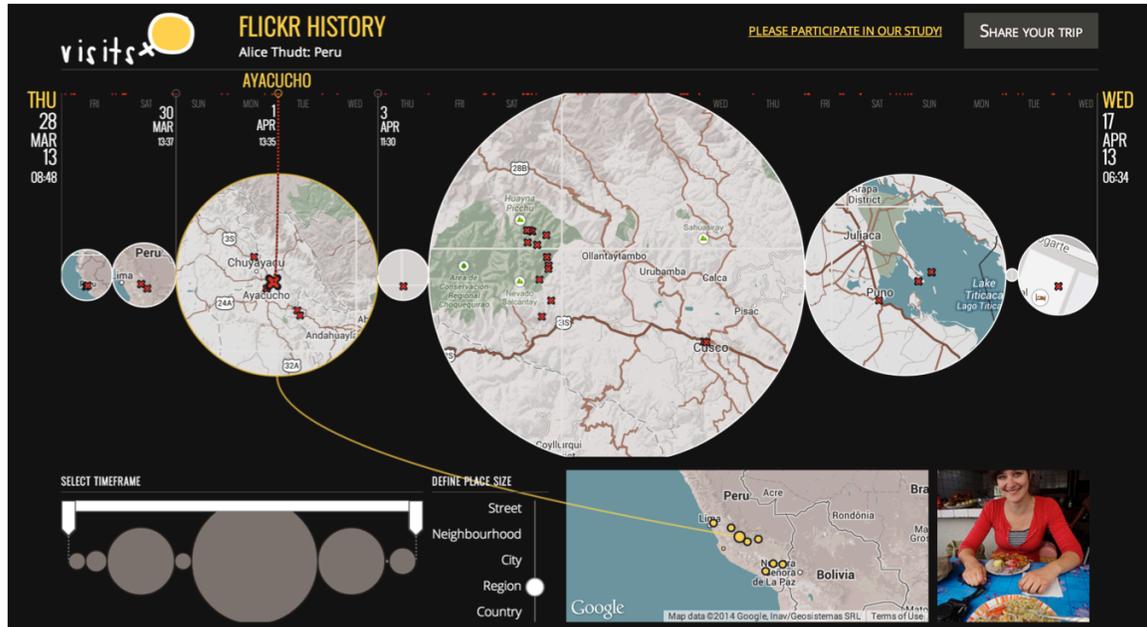


**Figure 7. Dear Data showcases how two designers pick different visual metaphors to represent personal experiences (here, “distractions”) [E6].**

In their “Dear Data” project, Giorgia Lupi and Stefanie Posavec sent hand-drawn postcards about one aspect of their lives to each other each week over the course of one year [E6]. Figure 7 shows their distinct visual metaphors for “distractions”. While Lupi showed them as drops symbolizing interruptions that dribble in unexpectedly, Posavec chose lines that “were drawn as though they were veering off-track, alluding to how I feel whenever I am distracted”. Their distinct visual metaphors demonstrate how the same phenomenon can be experienced and encoded in personal ways that make their subjective experiences relatable.

### 3.3.2 *Encodings Based on Psychological Theory*

Psychological theories model human thoughts, emotions, behaviors, and experiences based on empirical evidence. Such theories can be used for developing visual encodings that more closely reflect specific human experiences. This technique can be used to emphasize aspects to which people subjectively give more importance, or to align concepts that people experience as related. Narrators can further manually adjust such encodings to make them fit better with their subjective experiences.



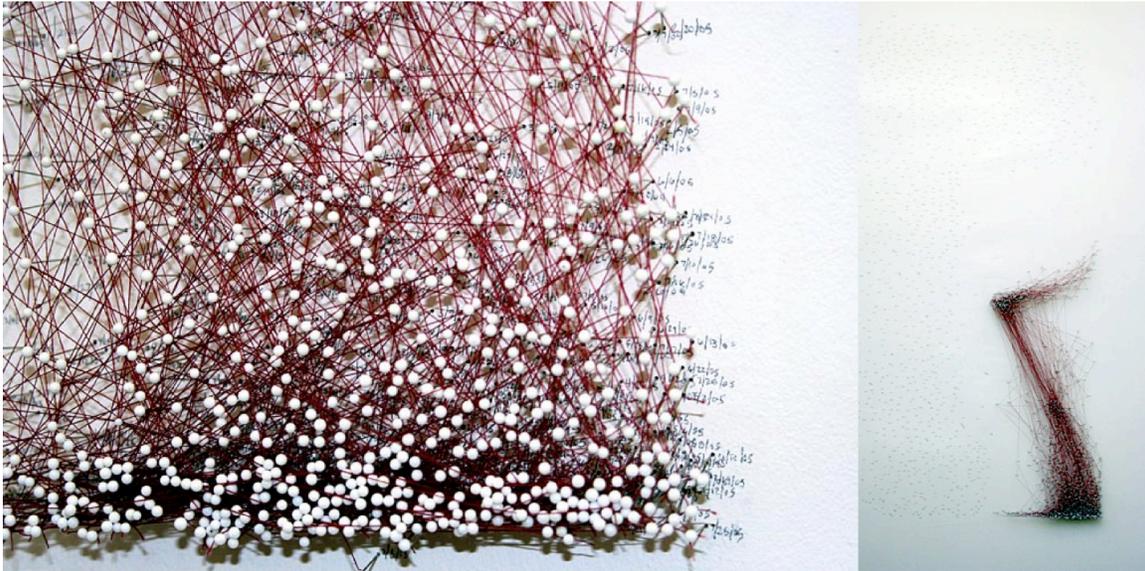
**Figure 8.** The tool “visits” uses an algorithmic encoding based on psychological theory to represent travel histories as a sequence of stays at different places [E15].

When creating the tool “visits”, Thudt et al. aimed to algorithmically encode location histories in a way that reflects how people remember their trips (Thudt, 2016). Psychological theories suggest that episodes of autobiographical memories are organized both chronologically and spatially (Tulving, 1972), and that people remember journeys as a sequence of visited places (Brown, 1998). The map-timeline visualization in “visits” builds on these theories by encoding the data as a sequence of stays in different places. Figure 8 shows Thudt’s trip to Peru in 2013 [E15]. She manually adjusted the timeframe to show this personally significant time period and chose to focus on stays at different geographic regions. Compared to common pins-on-a-map approaches, “visits” algorithmically creates an approximation of how the travel was experienced, by giving more emphasis to places where she spent more time. By customizing the time period of interest and by choosing to group points by region, Thudt created a representation that matches her subjective memory of the trip.

### 3.3.3 Poetic Use of Unconventional Encodings

Using visual encodings in surprising or unconventional ways can add power to a personal message. For instance, Viégas and Wattenberg discussed how clutter or distortion can be used to expressively communicate an experience (Viégas, 2007). While such encodings might distort or obscure the data, they can make emotional experiences

relatable on a visceral level. Another way to create an element of surprise and stimulate reflection is the use of encodings in personal narratives that are typically applied in other contexts (e.g. business reports or scientific publications, see [E2]). Such an intentional breach between the type of data and its visual representation can reinforce a subjective message.



**Figure 9. *201 Days* shows the artist’s sensations felt in different body parts. The clutter symbolizes the complexity of human experiences [E4].**

In her work, artist Katie Lewis visualizes data from different personal data sources, such as bodily sensations, in intricate webs made of physical pins and thread [E4]. The deliberately cluttered representations convey the chaotic and complex nature of human experience (see Figure 9). The deterioration of visual clarity alludes to the insufficiency of rigid systems and “scientific” encodings for capturing human sensations. Although this example presents an incident rather than an episode from the life of the artist, it is included due to its focus on personal data.

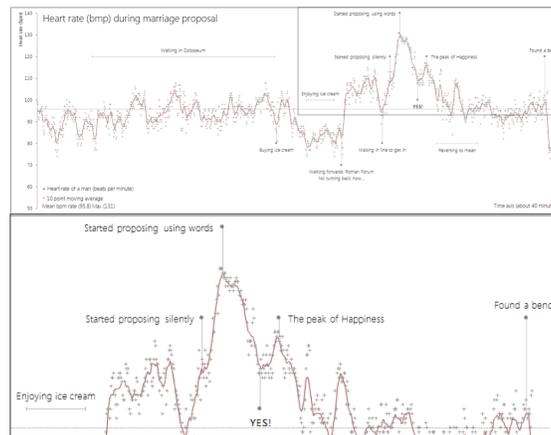
### 3.4 *Presentation*

Narrative structure is mostly introduced during presentation, where the graphic is laid out and rendered. In this step, we observed (1) annotations, (2) the addition of media to provide context, and (3) personal choices of style and materials as ways to add subjective interpretations. While most techniques discussed earlier in this paper require

a substantial level of expertise, adding a subjective interpretation through annotations or style is accessible to non-experts and often supported by tools for broader audiences.

### 3.4.1 Annotations

Annotations are a common way to introduce narrative in visualizations (Segel, 2010). In personal visual narratives, annotations can convey personal interpretations that turn a visual report into a personal story. Annotations can add interpretations to the graph as a whole, or point out personally significant points in the visualization.



**Figure 10. Visualization of the narrator’s heart rate during his marriage proposal with humorous annotations [E11].**

We found several examples of annotated personal stories created with widely accessible tools such as Microsoft Excel or the Fitbit App ([E9][E11][E13]). One example shared on Imgur shows a simple line graph of the heart rate during the narrator’s marriage proposal that is annotated with brief anecdotes ([E11], see Figure 10), while another depicts weight gains and losses by pointing out the causes, such as “all-inclusive holidays”, “new year’s resolution”, and a breakup [E13]. The simple annotations turn these visualizations into personal and humorous narratives.

### 3.4.2 Media as Contextual Information

Inclusion of media (e.g., photos, audio, hand-drawn sketches) in visual narratives can add personal context and enrich representations with glimpses of individual experiences. Photos are familiar and accessible ways to capture personal experiences. Similarly, music can be powerful in expressing emotions. Some services for sharing personal workout data (e.g. Endomondo or Garmin connect) incorporate features for enhancing visual stories with photos. We found storytelling examples that integrate a broad variety of

media as contextual information, including photos ([E2][E15][E17], see e.g. Figure 8), hand-drawn sketches ([E7], see e.g. Figure 2), flipbooks that create an animation from automatically captured photos ([E19], see e.g. Figure 11), and music ([E16]).

In “Rocky Beginnings”, for instance, the narrator enhances the visualization of her music listening history and associated emotions with short audio snippets [E16]. This additional contextual information allows the audience to relate to the narrator’s subjective experience of moving to a new city and provides an emotional musical background for the visualization.

### 3.4.3 *Style and Choice of Material*

In most of the examples we analyzed, narrators adjusted the style of the representation, including fonts, color schemes, or physical materials to reflect their own stylistic preference. Some examples, however, convey a deeper symbolic meaning through stylistic choices that go beyond surface aesthetics. For instance, Perin’s representation uses sketchy rendering to convey uncertainty in his data collection and processing ([E10], see Figure 6).



**Figure 11. Wilson's physical visualization incorporates grass found on a walk as material, allowing the audience to relate to her experience of her surroundings [E19].**

In physical personal visualizations the choice of material becomes an important way to express a subjective perspective beyond stylistic preferences. For example, Julia Lines Wilson weaves tapestries from grasses found on walks in chronological order to visualize her movement ([E19], see Figure 11). By using these materials, she allows the audience to relive her personal experience of her surroundings.

## **4. Discussion**

While research in visualization predominantly recommends objective data representations, we think that a discussion of personal and subjective approaches, such as those discussed in the art and design communities, can benefit the creation of narrative visualizations. Through our initial categorization of techniques for subjective visual storytelling we intend to open a broader discussion of subjectivity in personal visualization and outline opportunities for future research.

We presented several benefits of subjective displays of personal data. However, as in all media, it can sometimes be difficult to draw a clear boundary between a subjective account and a misrepresentation. In verbal communication people have learned reading between the lines and interpreting certain forms of rhetoric, such as exaggerations. When we use visualizations to tell personal stories, it is probable that a high degree of visual literacy is required to understand similar subtleties. Furthermore, we need to better understand how to make subjective interpretations of an experience apparent. Identifying techniques that indicate the extent to which a representation conveys a personal perspective is an exciting avenue for future research that can have impact beyond personal visual storytelling.

The expression of the narrator's sense of humor and irony is part of the appeal of personal narratives. So far, it is not well understood how such subtle undertones can be conveyed in visualizations. In the examples we presented, we identified some particularly amusing narratives. Humor can originate from data collection choices, as in Shelley's autobiography (see Figure 4), or from particularly amusing annotations, as in the visualization of the heart rate during a marriage proposal (see Figure 10). Investigating techniques for conveying humor and wit through visualizations could be a valuable addition to the ongoing discussion of storytelling with visualization.

Most subjectivity techniques, especially during data collection, processing and visual encoding, require considerable skills and strong data and visualization literacy. Didactic

approaches that teach people necessary skills could empower wider audiences to tell their own stories with data. However, further research and development is necessary to provide accessible and expressive personal visualization tools that allow narrators to do more than just annotate and restyle existing charts. These could include systems that let narrators edit, remove, add, and cluster data on the fly in order to visually curate narratives. Physical and digital tools that let novices manipulate or even invent new visual encodings could also make it easier for novice narrators to express their personal perspectives.

We explored the role of subjectivity for creating compelling personal narratives with visualization by illustrating how people are injecting personal meaning in all steps of the creative process. Our initial categorization sheds light on the various ways in which everyday narrators as well as professional designers and artists use visualization as a medium to tell subjective personal stories. This work can further inform the development of visualization tools for personal storytelling, making the creation of subjective personal narratives accessible to even wider audiences.

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## 6. Appendix

Example personal visual narratives analyzed in this paper:

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