On Teaching Narrative Infographics in an Information Visualization Course

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ABSTRACT

Although not currently a standard topic to teach in a technically-focused information visualization course, I have found assigning a Narrative Infographic an effective way to introduce narrative and story into the presentation of data visualization. By teaching the skills explicitly, I guide students towards using pictorial components responsibly for engagement, staying on the right side of chart junk. Although the assignment requires the creation of a stand-alone static design, I have observed positive transfer to web-based final projects.

I also report on strategies I have developed to reduce problems of student anchoring on prior chart-based assignments. The most successful has been the instigation of a before-to-after practice assignment paired with a mid-project in-class progress review check.

1 INTRODUCTION

For the last four years, I have been developing and testing methods for active peer learning (e.g., [8, 15, 20, 22]) in my Masters-level information visualization course.

I presented the foundations of this approach at the 2015 IEEE Infoviz panel on new methods of teaching Infoviz [13] and details of some novel exercises at the first Infoviz Pedagogy workshop in 2016 [12]. In this paper I describe and discuss the benefits of another exercise that I have been refining over the last four years: the design of a Narrative Infographic.

2 MOTIVATION

When I taught Infoviz in the 1990's and 2000's, my course was influenced by the research literature, the psychology of visual perception as related by Kosslyn [17], Bertin [3] and MacKinlay [18], and the writings of Card [7] and Tufte [25]. As I was teaching professional masters students, I was early to adopt Stephen Few's books [9], and include a focus on teaching the basics of charts, graphs, and dashboards in addition to advanced research topics, multidimensional visualization, interactive visualizations, and exploratory data analysis. This instruction focused on the critical role of effective graphics and the avoidance of misleading or confusing depictions of quantitative and qualitative information.

However, a conjunction of factors – including reading Alberto Cairo's book [6], the explosion of use of infographics online, and the introduction of Illustrator by a guest instructor (Michael Porath) – convinced me to increase my focus on narrative and storytelling. In the intervening years, more evidence has accumulated in the research literature about the efficacy of iconography in the design of information graphics (e.g., [2, 4, 5, 10, 16]), in contradiction to Tufte's emphasis on spartan simplicity. It has become clear to me that an Infoviz course must teach students how to use visual elements alongside the encoding marks, in addition to color choice and layout of the context for the visualization, in order to support a holistic infoviz education.

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3 ASSIGNMENT GOAL

The primary goal of the assignment is for students to learn how to compose a visual narrative that presents data in an engaging manner while employing good design principles. The narrative must present some kind of data and must present information truthfully and accurately – no exaggeration or errors of omission are allowed in the service of making a better story. The design must have "flow" and create a narrative that is more than a list of charts. Headings, layout, graphic design and narrative structure are all equally important in the design. The deliverable is a static information graphic, which is printed on a 12x16" poster and shared in a class exhibition showcase. A successful example is shown in Figure 1.

Students are expected to find their own topic and data and if necessary do some data analysis (at this point in the class they will have already learned how to do exploratory data analysis using Tableau). They are also expected to learn the basics of Adobe Illustrator for this project. The text of the assignment reads as follows:

> Your narrative infographic must include a combination of quantitative data, text, and illustrations. It should make a point (or some points), have a focus, tell a story and use some data in the telling. When making your design, try to follow Cairo's process for designing Infographics:
>
> 1. Define the focus, story, goals, tasks,
> 2. Do preliminary research (this should be minimal; use existing sources with attribution),
> 3. Choose graphic forms according to 1,
> 4. Structure the information, sketch, storyboard,
> 5. Write the text,
> 6. Create and assemble the graphics, maps, and/or diagrams,
> 7. Include relevant citations to references used.

4 PROCESS

The unit takes place over a period of two and a half weeks. During this period, lecture topics include the topic of narrative itself, the contrast with Tufte's teachings about the data ink ratio [25], the role of iconography and Isotypes in information visualization, and the role of color and visual hierarchy in the design of information visualization. Examples of narrative infographics are examined, discussed, and critiqued during the lecture portion of class. Students are asked to identify the application of Gestalt principles (which have been taught in an earlier unit) and design hierarchy in sample infographics.

4.1 Readings

Over the period of the unit, students are assigned to read relevant chapters of Cairo's *The Functional Art* [6]. Most relevant are Part I (Foundations, which mentions Isotypes) and Part III (Practice). I assign the case studies of Part IV as optional reading. Another

required reading is the taxonomy of information graphics by Segel and Heer [21]. Optional reading includes Borkin et al [4] and Haroz et al. [10]; Bateman et al. [2] is discussed in class but not assigned since it is summarized in the Cairo readings.

During this unit, students are also assigned readings on the role of color in information visualization, including two papers by Stone [23, 24] and readings about modern scientific color maps. Color lecture notes and suggested tools are based on design guidelines distilled from a color tutorial presented at IEEE Vis 2016 by Theresa-Marie Rhyne.

4.2 Activities

As mentioned above, my teaching method is active peer learning, meaning that class periods are a mix of lecture and exercises, and many of the exercises require students to work together. Furthermore, students are required to complete an activity before almost every class period; that activity is usually a mix of reading and deliverables turned in for small numbers of points. (The points are necessary to motivate the students to prioritize classwork in their schedules; surveys of students every semester confirm the value of these point requirements.) Active learning research confirms the importance of variety in activities; I use a mix of quizzes on the readings, having students write their own quiz questions, creation of designs, peer reviews of designs, and programming exercises.

During the narrative infographic unit period, students are instructed in Illustrator during two lab sessions. An assignment due midway through the unit requires them to replicate an existing design in Illustrator; the lab session helps them with this assignment.

Class activities include running the online Isotype experiment of Harotz et al. [10] and experimenting with color palette creation tools to identify color strategies used in high-quality examples.

4.3 Exhibition

As mentioned above, the primary artifact developed by students is a static information graphic, which is printed on a 12”x16” poster and shared in a class exhibition showcase. During the showcase, all students place their posters along the wall of the classroom. For the first 45 minutes of class, half the students look at the other half’s designs and are expected to give constructive peer feedback, and then the roles switch for the final 45 minutes. I and TAs walk around the perimeters of the room and give oral feedback as well. Class sizes range from 35-45 students, therefore, there are too many students for me to view all of their designs during the class period, unfortunately. After class I and the TAs given written feedback to students on the assignment and assign points according to a pre-specified points-based rubric that takes into account the following criteria:

- Does the design successfully tell a story?
- Is the design a narrative infographic, as opposed to just a series of charts?
- Does the quantitative visualization portion subscribe to the principles we’ve learned in class?
- Is the design consistent and supportive of the story (e.g., fonts chosen to contrast and create hierarchy appropriately, colors that highlight rather than obscure, layout and blank space support the flow of the story, etc.)?

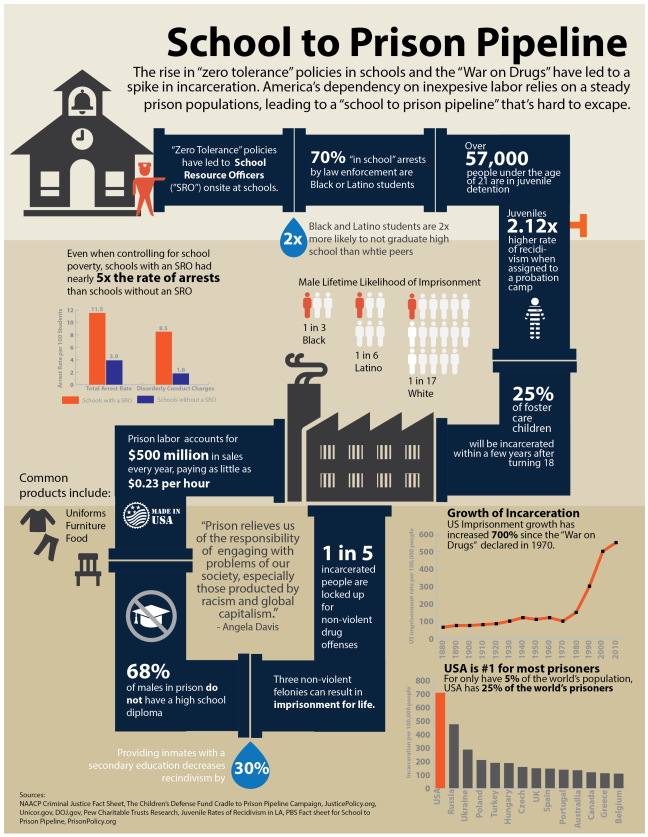

Figure 1: Sample Student Infographic (by Michelle Carney). This design was much improved after consultation with the student in the in-class mid-project review.

5 Combating Anchoring

5.1 The Problem

In teaching this assignment, I found that while many students understood its intentions, quite a few others did not. Rather than penalizing students with a poor grade for not fully understanding the intent of the assignment (this would violate my “Teaching as Coaching” ethos, see [11]), I worked with each student to explain what was incorrect and allowed them to revise their design over spring break. However, this causes students to get behind on other classwork and is generally undesirable.

I determined two major reasons for students failing to achieve to their potential. By far the most prominent was a fundamental misunderstanding of the goal of the assignment; rather than creating a narrative, students stayed in a safe zone and produced a series of charts and graphs. This is understandable given that earlier parts of the course focus in part on following design principles and not violating perceptual properties (e.g., not using area or color to indicate quantitative differences, etc.) or because students have absorbed admonitions from Tufte before taking the class. Using terminology from psychology, students “anchor” on what they have done before, such as creating posters for technical conferences, rather than opening up to doing something new and different.

The second common (and much less serious) problem pertained to students not having enough experience with design, and failing to take into account consistent and well-chosen (usually minimalist) colors and fonts with appropriate contrast, visual hierarchy, and so on, or presenting data in a misleading or difficult to understand way. These I consider usability problems; in the past most of our students had either come to our program with an HCI background or took the HCI course before the Infoviz course; with the rise of data science that is no longer a safe assumption and Infoviz is often their first exposure to HCI. These can be corrected with standard HCI instructional methods.

5.2 Initial Attempts

The first year I did not have a transition assignment of any kind, and this made clear the need to help students bridge from creating charts and graphs to moving to a more narrative style of design.

The next year, to aid the transition from the prior assignments to the narrative infographic assignment, in lab we asked students to critique existing well-designed infographics. However, even when supplying a rubric, for some students this tended to lead to finding problems with the design, rather than appreciating what was well done in the design and using the design as a model for their own design.

The following year, I supplied a model design and asked students to trace out the flow of the design directly on the design and comment on the positive aspects by annotating the design. This as well did not seem to a better solution than the prior year's approach.

5.3 Current Solution: Before and After Designs

What was needed was an approach in which students are required to do more of the work directly themselves. Although this is more time consuming for all involved (for students to do and for instructors to give feedback on), as far as I can tell, this approach was successful, but in a surprising way.

The method I used was as follows. I took a design from the prior year's class that had a very good theme and initial choice of data and colors, but that consisted primarily of a list of charts. I had coached the student who had produced this design on how to improve it and make it into a narrative infographic, and she produced outstanding results in response. She subsequently agreed to allow me to use this "before and after" pair of designs in an assignment for other students to help them improve.

The wording of the before-and-after preparatory assignment was as follows:

> The attached file contains a great start at a Narrative Infographic by a former student. It has a good story with a real message, and compelling data. It also does a good job of using a reduced color palette, and a title which effectively and visually evokes the theme of the infographic. It is also sourced by a detailed report.
>
> However, this design can be improved in several ways. It does not use layout, imagery, or text to tell a story as effectively as it could. The charts could use some small improvements as well.
>
> Your challenge is to improve this design by adding components, rearranging components, and revising components. The goal is not a total redesign, but just small changes to improve it. Challenge yourself to see how much can you improve it, in how small a number of changes, to be a real narrative. Use the principles of narrative infographics, and get some practice with Illustrator at the same time.

I would like to report to you that students produced what I was looking for as a result of this assignment. For the most part, that was not the case. Because we had had the lecture and exercises on color the day before, many of them thought the goal was to change the color (despite the instructions). Others just changed the charts, and so on.

However, the positive impact came *after* the exercise was complete and I showed the students what I was looking for. *Then* the lightbulbs went off. Although some felt frustrated because they had not initially understood the goals, they most definitely did understand the goals after attempting to do the job directly themselves. (A few understood a bit too well and started to make infographics that listed a bit too far into chartjunk, and so that took a bit of correcting post hoc.) It was clear that they learned the difference after this

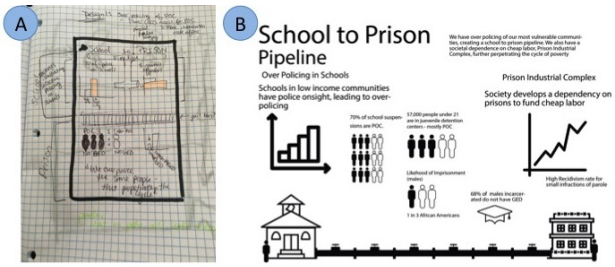

Figure 2: (A) Initial low-fidelity sketch (one of three) and (B) high-fidelity design for the narrative infographic of Figure 1 (by Michelle Carney).

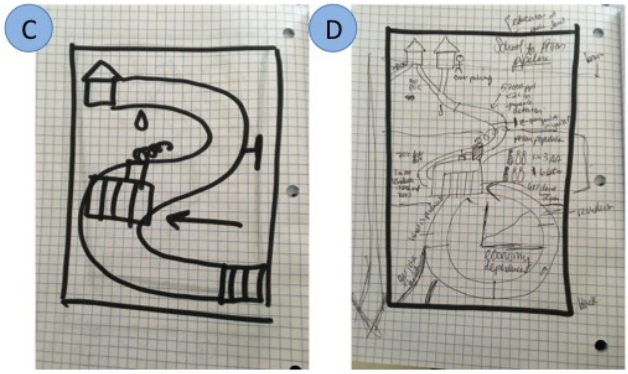

Figure 3: Sketches made as a result of consultation between student and instructor during in-class mid-project review (by Michelle Carney). (C) Idea that those students who escape the system can be shown as water droplets squeezing out of the pipeline. (D) Sketch of how to show the cycle and include the role of school, prison, and manufactured artifacts.

assignment, and no students turned in a list of charts for the final assignment. A mid-semester survey confirmed that most students found this to be a valuable exercise.

5.4 Current Solution Part 2: Mid-Project Review

The other major change I made to the assignment was to devote part of a class to a mid-project review. Students were required midway through the time period in which the infographic was assigned and when it was due to bring their current designs to class and discuss what they were thinking in small groups with other students. I and the TAs went around the room and worked with the students on their designs as well.

Figure 2 shows initial designs for the infographic whose final design is shown in Figure 1. The student came to class with three sketches on paper (as requested by the assignment; only one is shown here) as well as an initial high-fidelity design for the infographic done in Illustrator. The student wasn't sure if she should put the facts inside the pipe or treat the pipe as a timeline. The initial designs centered around following an individual through the system with the pipe acting as a timeline of what an individual encounters. The sticking point was how to integrate the notion that students become trapped into the prison system as well as show the path from school to prison, the racial bias, and the artifacts that play a role in the exploitation of these people. In our discussion, we decided that the metaphor of a pipe should be taken advantage of more fully and to show the cycle explicitly; we decided to put the prison in the center of a pipe containing a cycle within it; we realized that drops of water at the joints could be used to show those students who leak out of the

pipeline (see Figure 3). If the student had not come to class prepared with these initial designs, I as the instructor would not have been able to work so effectively with her to refine the design.

As usual, I did not have time to talk with every student, but I was able to make some mid-project corrections, and many students benefited from comments by the TAs and by peers. Time permitting, I now do this with all of the major assignments, as the time spent in class greatly reduces correcting problems after assignments are turned in.

6 Transfer to Final Projects

A major benefit of this assignment is that the skills acquired from creating a static infographic seem to transfer to improve the presentations in students' final projects. Each final project team is free to determine their own topic and format. A few create stand-alone visualizations, but the vast majority create a web site that is organized around a narrative infographic interwoven with interactive visualizations. This has since become a common way to present visualizations online, but was not a widespread norm when my students began producing such designs.

It is my contention that having the students create a stand-alone static infographic aids in the creation of the more complex interactive web-based design for the final project. These are often innovative and highly expressive designs; one is described in detail in [1] and a second will appear in [19].

An example from 2017's class is illustrated in Figure 4. The students in this final project group were presenting statistics surrounding cultural differences around the world pertaining to at what age women marry and how this effects their future work and family lives. By employing consistent design elements and iconography, the relationships among the main points became clear and the team understood how best to cull and organize the data and messages they wanted to present.

7 Conclusions

I have described the path I have taken over four years time to design and improve a Narrative Infographics assignment. At this point I feel the assignment is a strongly positive learning experience for the vast majority of students in the class. However, the process of giving feedback for this assignment does not scale. My next goal is to devise some method to address this problem, perhaps using some kind of mechanism along the lines of one I developed for the design-with-constraint assignment [14].

Acknowledgements

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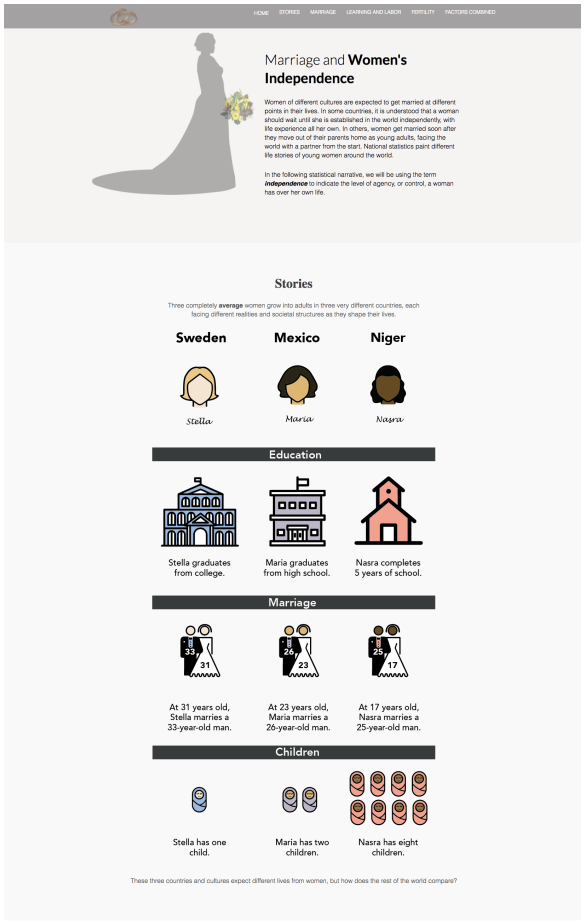

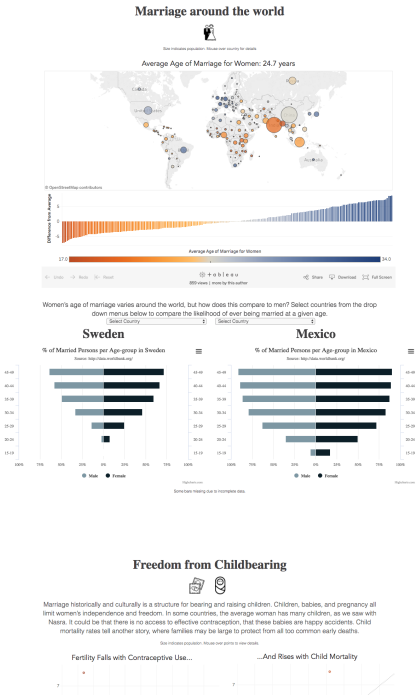

Figure 4: Partial view of final project web site using components of narrative infographic to tie themes together (by Nancy Stetson, Rachel Thorp and Monicah Wambugu).