Repairing William Playfair: Digital Fabrication, Design Theory, and the Long History of Data Visualization

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Introduction

In her plenary address at the 2014 Digital Humanities conference, Bethany Nowviskie urged the field to consider how "broken world thinking," an approach equal parts ethical, ontological, and methodological, might enrich the practice of the digital humanities (2015, n.p.). Nowviskie borrows the phrase from information theorist Steven Jackson, who argues for a reparative rather than productivist approach to the study of media and technology, and more specifically, for an increased emphasis on the "moments of breakdown" that might allow us to "see and engage our technologies in new and sometimes surprising ways" (2013, 230). In this paper, we take up this shared call and extend it, elaborating an approach to broken-world thinking that is simultaneously informed by examples of historical fabrication in the digital humanities (e.g. Elliott et al. 2012, Sayers 2015) and theories of breakdown and repair from the field of design (e.g. Jackson 2013, Gabrys 2011). More specifically, we take the time-series charts of William Playfair, the eighteenth-century political economist and data visualization pioneer, and recreate them using D3.js, a data visualization library commonly employed in digital humanities work (Bostock 2011). In doing so, we gain valuable purchase on the historical concepts and methods that contributed to the creation of Playfair's charts, many of which-- such as the concept of data-- still hold sway today. By remaining equally attentive to the disjunctures between the original artifact and our contemporary recreations-- that is to say, to our "moments of breakdown"-- we are also able to open new perspectives on the "affordances" of our own visualization tools (Murray 2011). Our digital "fossils," as we term them, following the work of Jennifer Gabrys, suggest a generative new point of intersection between the fields of digital humanities and design (2011).

Project Overview

William Playfair is widely considered the "inventor" of modern data visualization (Tufte 32). The graphical forms that he first developed-- for instance, the bar chart and the pie chart-- remain among the basic building blocks of visualization today (Wilkinson 2005), and his charts of British trade data continue to be employed as examples of the crystallizing power of data visualization (Klein, forthcoming). And yet, the media and tools that Playfair employed in order to create his designs have long been supplanted by newer technologies-- most recently, by digital platforms such as Tableau, programming languages such as Processing, and software libraries such as D3.js. This project seeks to understand how Playfair's tools might have affected the images he created, and how our tools, in turn, might affect the images and interactions we create today.

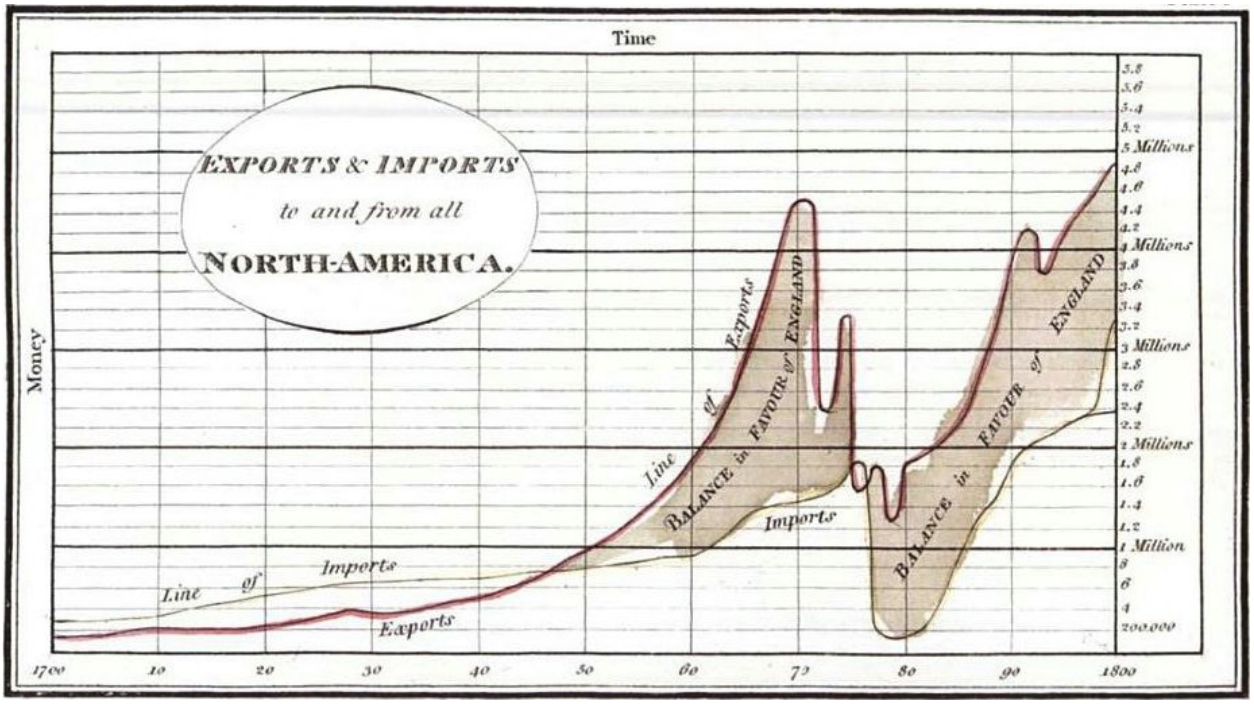

Figure 1: William Playfair, “Exports & Imports to and from all North-America,” from *The Commercial and Political Atlas*, 3rd ed. London, 1801.

To recreate Playfair’s chart, we selected D3, a JavaScript visualization library employed in many contexts, from data journalism to scientific research to the digital humanities (e.g. Meeks n.d., Schmidt n.d). In comparison to off-the-shelf software such as Microsoft Excel or Tableau, D3 provides additional control over the structure and style of the data, an advantage when attempting to achieve fidelity to the original image. In addition, D3 is an open source software library, rather than a closed platform; this allowed us to consider additional aspects of the library’s design. Finally, D3 was developed in an academic context. For this reason, we thought its internal design choices would support a sustained conceptual as well as technical analysis.

We took two approaches to recreating Playfair’s import-export chart: the first by adhering to the original as closely as possible, including the use of the original data, which had to be reconstituted from multiple sources; and the second by adapting Playfair’s design for use with contemporary trade data, taking advantage of D3’s emphasis on data transformation. (We employed the US Census Bureau’s data on foreign trade). In the sections that follow, we describe these approaches in more detail, with particular attention to the “moments of breakdown” that we experienced (and, at times, deliberately induced) and the new perspectives on the original image-- and on D3-- that they granted.

First Approach: Remediating Playfair’s Original Chart as a Digital Fossil

Jennifer Gabrys, a design theorist who, like Jackson, views instances of breakdown and failure in a generative light, suggests that we view cast-off objects as “fossil forms” rather than waste (2011, 7). For Gabrys, these digital fossils provide “evidence of more complex and contingent

material events," as well as "traces of the economic, cultural, and political contexts in which they circulate." By recreating Playfair's chart in D3, we also remediate its "fossil form," granting us access to the various contexts in which the chart initially circulated, as well as the contexts in which the chart in digital form circulates today.

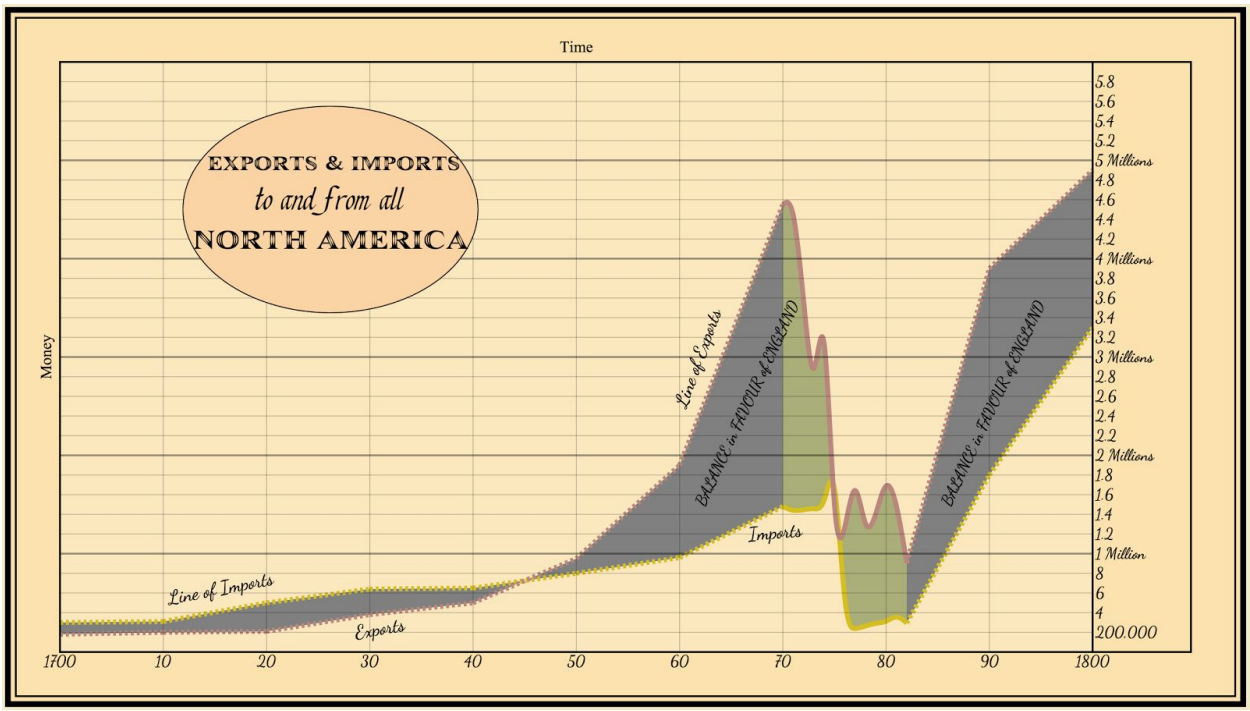

Figure 2: True-to-form recreation of William Playfair's original chart. The gray area emphasizes the uncertainty of the data, while the green area matches the original. Implementation and image by C. Foster.

Our particular interest in creating our digital fossil was to induce the moments of breakdown that, we believed, would alert us to the contextual differences between past and present. The nature and status of statistical data was one such difference, as we soon became aware. Attempting to employ the third and most popular edition of Playfair's *Statistical Atlas* as a reference, we found no actual data to accompany his charts. D3 assumes that the developer will begin with data, so without it, we could not begin. To compensate, we turned to a data table from a previous edition of the *Atlas*, but it contained data for only a portion of the date range, from 1770 to 1782. We began by recreating only that section of time, but the effect was of a "zoomed-in" view of the original. In order to match Playfair's chart more closely, we estimated data points for each decade, resulting in a chart that resembled the original, but had two different sources-- and degrees of accuracy-- that went into its underlying dataset.

This instance of breakdown and repair illustrates how D3 assumes that a dataset will be presented in a certain format, and that the data will be well-defined, clean, and accurate. The context of D3 is revealed as representative of a culture fixated on data-driven solutions, where perhaps people are too trusting of numbers. Rather than present our numbers, actual and

interpreted, as the same, we used a technique developed by Kevin Schaul (2013) to create dashed lines for the interpreted numbers. The code he developed, what some might view as a "hack," might be understood as a "repair" of a breakdown within D3, one that enables the visual presentation of defined and undefined data together. By contrast, Playfair's original chart shows us that precise data were not a necessary component of its initial success.

Second Approach: Creating an Interactive Chart in the Style of Playfair

Our second recreation, an interactive version of Playfair's chart supplemented by modern trade data, revealed additional contexts and biases encoded in the design of D3. D3 was designed to facilitate the creation of interactive visualizations (Bostock 2011). Once the dataset is "bound" to the visual elements, the developer can easily apply various styles and generate interactions. D3's built-in functions for interactivity worked smoothly once we traded out the original dataset for a more consistently formatted, if substantially larger, contemporary one.

It was when we attempted to recreate Playfair's customized labels that we encountered a significant moment of breakdown. Historically, all Playfair did to create his labels was pick an appropriate spot and draw or engrave them. Since we were dynamically generating the charts, we weren't able to use the human eye or its proxies to place the text. Instead, we had to determine a set of rules for where to place text, and then encode them in D3. To ensure legibility, we had to verify three things: 1) that the label was not placed on a part of the chart where the import and export lines were too close; 2) that the label did not intersect with a line; and 3) that the text was placed along a part of the graph that had a consistent slope. As it turned out, determining the points of intersection was a non-trivial task-- a result of D3 being built on another format, SVG. Even though the ability to illustrate the intersections between lines-- or more generally, the relations among different slices of a particular dataset-- would seem to be a basic requirement of any visualization platform, D3 itself was constrained by the affordances of its underlying technologies. Playfair thought hard about how to facilitate a "comparative perspective" through the design of his charts, but employing contemporary tools that are constrained for various reasons can affect the range of knowledge that is produced (1801, x).

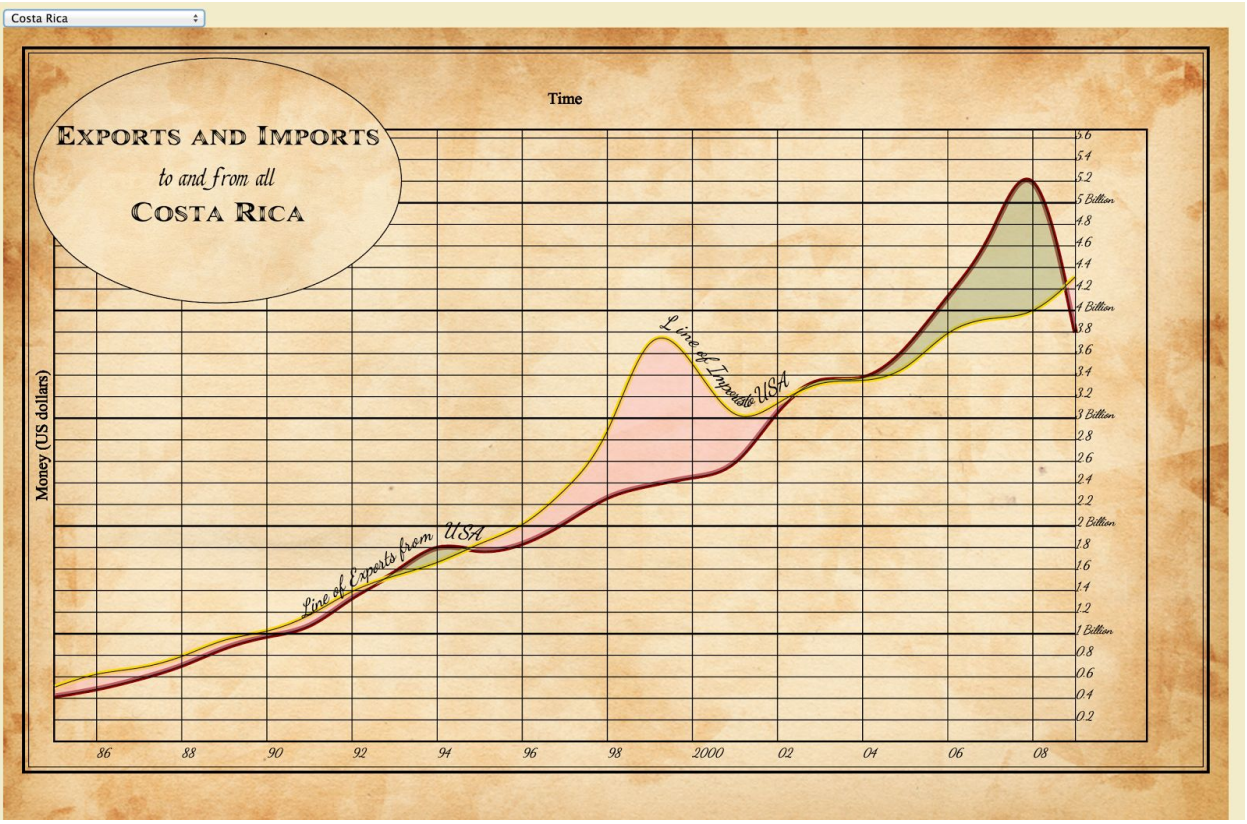

Figure 3: Interactive version of Playfair's time-series charts. The user selects the country to display through a drop-down menu. Implementation and image by E. Pramer.

Conclusions

This project illustrates some of the insights that emerge from broken-world thinking as applied to the tools of digital humanities work. Through the process of recreating Playfair's charts, we introduced moments of breakdown, and prompted our own hacks or repairs. We became alerted to the changed relation between data and image between the eighteenth century and the present, as well as to how the hidden affordances (or constraints) of both software and platform affect the kinds of knowledge that visualization through D3 can produce. In the digital humanities, historical fabrication has thus far been directed to better understanding the past. But such an endeavor, as this project demonstrates, can also be employed to illuminate the present.

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