TAMARA L. SHREINER

Uncovering the Discipline-Specific Value of Data Visualizations in World Historical Writing

Scholars have already established the complex nature of historical writing, which consists of making evidence-based claims while making the research and reasoning process manifest through examples, details, footnotes, and quotations, as well as acknowledgement of contradictory evidence.[1] However, much of the scholarship used to frame the nature of historical writing has largely ignored *multimodal* historical writing – that is, historical writing that integrates verbal information with visual information such as images and graphics. In particular, scant attention has been paid to the integration of data visualizations such as maps, graphs, and tables in historical writing.[2] This is despite the fact that students frequently encounter such multimodal writing in school textbooks and other curricular materials, and that social studies standards sometimes require students to communicate historical arguments and explanations with data displays or visualizations.[3] To be sure, the *College, Career and Civic Life (C3) Framework for Social Studies State Standards* recommends the use of data to build arguments and explanations and to communicate conclusions in history, and that students communicate arguments visually as well as in writing.[4] Similarly, the *Common Core State Standards Initiative* states that students should develop claims with accurate data and evidence, and use graphics in explanations and narratives when they will aid in comprehension.[5] Moreover, multiple U.S. state standards documents require that students integrate different types of data visualizations in their writing, or learn to express ideas in graphic form.[6]

However, we lack a clear picture of how historians use data visualizations in their historical writing, and therefore, what discipline-specific practices should guide the teaching of multimodal historical writing. Scholars who have examined the nature of historical argumentation and writing have mostly focused on the evidentiary uses of verbal written documents such as diaries and letters, or of other visual texts such as political cartoons, or they have neglected to highlight the distinctive uses of different modes of evidence in historical writing.[7] The study presented in this article begins to fill the gaps in scholarship on multimodal historical writing. It focuses on the discipline of

world history, where the use of data visualizations is essential for compressing, analyzing, and communicating large-scale patterns and processes. To describe how world historians use data visualizations to write about the global past, I analyzed a total of 192 journal articles containing one or more data visualizations from existing issues of the *Journal of World History* and the *Journal of Global History*. I addressed the questions:

- To what extent do world historians include data visualizations in their writing? What kinds of data visualizations do world historians use?
- How do world historians make their historical reasoning with data and data visualizations manifest through their multimodal writing about world or global history? What are the functions and purposes of the data visualizations they have chosen?
- What are the implications for standards-based instruction in world history?

Background

Scholars of disciplinary literacy argue that disciplines have their own cultures—their own specialized language and discourse practices in which certain kinds of texts are read and written for specific purposes and audiences.[8] In history, disciplinary literacy entails the ability to analyze, interpret, and use a variety of primary and secondary texts, both verbal and visual, and construct evidence-based narratives, explanations, and arguments about the past.[9] Historically literate people approach texts with an epistemic stance that recognizes the interpretive nature of history. They understand that historians construct accounts of the past based upon remnants from the past, that historical accounts can differ across time and space, and that interpretations are dependent on individual authors' biases and worldviews.[10] When writing about history, historically literate people support their claims with evidence that has been vetted through a process of sourcing, contextualizing, and corroborating, and they attempt to make their reasoning about evidence public through footnotes and detailed explanations.[11] They also acknowledge counterevidence and gaps in their sources of evidence.[12]

Teaching disciplinary literacy in school unveils this discipline-specific culture for students. It gives students access to the language and culture of disciplines as they exist within the current social order, so that they can both enter and challenge the fields that produce knowledge.[13] Moreover, a substantial body of research demonstrates that disciplinary literacy instruction results in positive learning gains for students.[14] Teaching historical writing, for example, can help students better understand disciplinary conventions and important historical concepts (e.g. change over time, causation), providing them with a window into the ways that knowledge is produced and communicated in history.[15]

Yet, there are recent indications that the culture within the discipline of history is shifting. Computers and digitization of primary sources have led to a proliferation of available data, large quantitative datasets, and new methods for processing and visualizing quantitative data. Historians have always used quantitative data to some extent,[16] but as Frederick Gibbs and Trevor Owens have argued:

> *Having access to vastly greater quantities of data, markedly different kinds of datasets, and a variety of complex tools and methodologies for exploring it means that the term using signifies a much broader range of data-related activities than it had previously."[17]*

Indeed, more historians have begun working in the domain of digital history and with big data, while leaders in flagship historical organizations have recently acknowledged that the use and interpretation of data are increasingly important aspects of the discipline and disciplinary training.[18]

In no other area of history has the cultural shift toward big data seemed more apparent than in world history. Large digitized datasets such as those available through the *World-Historical Dataverse* allow world historians to explore phenomena across the globe, and visual representations of data such as maps and graphs help them analyze complex global processes and changes, or compress and analyze broad, otherwise invisible patterns.[19] Yet, despite the obvious usefulness of data visualizations in world history, we lack a clear picture of how world historians, or any historians for that matter, reason with and use data and data visualizations when building and communicating historical arguments and explanations. Absent this picture, teachers may be in the dark about how to help students unpack multimodal world historical writing, let alone write multimodal world historical arguments and explanations themselves. Therefore, this study seeks to illuminate the different ways that world historians use data and data visualizations, including timelines, maps, graphs, and tables, by examining their historical writing. Uncovering and describing these methods can provide guidance for teachers who wish to move beyond traditional forms of historical writing with students and help them both write and critically evaluate multimodal historical texts.

Methods

Historical writing provides a window into historians' reasoning processes—that is, the ways that historians analyze, evaluate, and use information about the past to describe, explain, compare, or construct arguments about historical events and phenomena. Therefore, I analyzed 32 years of world historical writing, treating articles from the *Journal of World History* and the *Journal of Global History* as primary sources providing insight into the ways historians use data and data visualizations to construct historical arguments and explanations. I chose the journals based upon their reputation

within the world history community and because their descriptions clearly describe their global focus. The *Journal of World History* (hereafter, *JWH*) has volumes from 1990 to the present and is described as publishing "research into historical questions requiring the investigation of evidence on a global, comparative, cross-cultural, or transnational scale."[20] The *Journal of Global History* (hereafter, *JGH*) started publishing in 2006 and "publishes articles that examine structures, processes and theories of global change, inequality and stability, as well as articles focusing on smaller scales that are in keeping with, or transcend, the boundaries of historical polities or environments."[21]

Within each issue of both journals, I first scanned the articles for inclusion of a data visualization such as a timeline, map, graph, or table. I recorded each issue number, the number of articles in each issue, the number of articles with data visualizations in the issue, the names of the articles with data visualizations, and the number of data visualizations within the articles. This yielded 192 articles with a total of 698 data visualizations. I then returned to each article with one or more data visualizations and recorded the types of data visualizations used, such as bar graphs, line graphs, scatterplots, or variations within those broader typologies, such as stacked bar graphs or multi-line graphs. Because there was such a wide variety of maps, many of which were unique and hard to categorize, I chose to label them more generally and capture the variety through the codes I applied. I did, however, differentiate between individual maps and "map sets" which included two or more maps used for comparative purposes, as well as between primary source and secondary source maps.

Next, I developed a provisional coding scheme by analyzing five articles from each journal.[22] The coding scheme was divided into two categories: the function of the data visualization itself and the purpose of the data visualization within the article. Identifying the function of the data visualization unveils the information the historian is trying to convey through the data visualization, and identifying the purpose reveals the reason the data visualization exists within the article–that is, its value as evidence or object of inquiry.[23] Through content analysis that involved identification of the author's main argument, examination of the data visualizations and what the author was trying to communicate, and reading of the text used to introduce the data visualizations, I refined my coding scheme to include more codes and precise descriptions (see Table 1). I then employed the help of another experienced qualitative researcher to ensure the codes could be applied consistently. This process involved coding the same four articles containing a total of 20 data visualizations and comparing and discussing the application of the codes.[24] Once we achieved 95% agreement, I used the coding scheme to label and record each remaining data visualization's function and purpose. Throughout the coding process, I also took notes on how authors introduced and discussed data visualizations in the written text. This helped me to determine how and

to what extent they cued readers to consider the data visualization as part of their argument or explanation.

Label	Description
Function of data visualization	
Change over time	The data visualization illustrates how a variable or place has changed over time.
Comparison	The data visualization draws comparisons between two variables or places.
Conditions	The data visualization (i.e., map) shows the environmental conditions of a place.
Connections	The data visualization shows connections between variables in space, or across a network of data.
Correlation	The data visualization illustrates relationships or correlations between variables.
Distribution	The data visualization shows how variables are distributed across space or time.
Location	The data visualization shows only spatial location.
Movement	The data visualization shows movement (e.g., people, goods, culture) over space or time.
Proportion	The data visualization shows the proportion or percentage of variables.
Primary Source	Label applied when the data visualization is a primary source.
Tabulation	The data visualization tabulates or lists data. This may be a map where the locations of phenomena are spatially tabulated.
Visual Reference	This is when an example of a data visualization used in a study is shown. It is not really used to communicate anything other than an illustration.

Purpose of data visualization within text	
Context (Spatial or Temporal)	The data visualization helps the reader locate an event in space or time or provides the reader with an understanding of the physical, cultural, economic, or social circumstances surrounding an event or phenomenon.
Counterargument	The historian is using a data visualization to set up their counterargument or help the reader see breaks from previously observed patterns. This is a piece that adds to the historiography of an event or phenomenon.
Evidence	The data visualization is explicitly referenced by the historian as evidence for their argument.
Historiography	The data visualization is used to help the reader understand the historiography of a line of inquiry. This is usually showing different calculations.
Methodology	The data visualization helps the reader understand the digital, data collection, or data calculation methods the historian used.

Figure 1: Purposes and Functions for Data Visualizations in Historical Writing. Figure created by the author.

After coding, I ran a series of descriptive statistics to identify patterns in uses of data visualizations in general and in uses of specific types of data visualizations across and within journal issues. I also disaggregated data by years and decades to look for changes over time. In addition, I cross-tabulated data to look for relationships among purposes and functions. In the sections that follow, I describe findings organized by the research questions guiding the study.

Findings

To what extent do world historians include data visualizations in their writing? What kinds of data visualizations do world historians use?

In the *JWH*, 85 articles, or 17% of all articles, contained data visualizations, and in *JGH*, 107 articles, or 29% of all articles, contained data visualizations. Across both world history journals, then, 22% of all articles contained one or more data visualizations. In

JWH there were a total of 285 data visualizations, and in *JGH* there were 413 data visualizations, totaling 698 overall. The number of data visualizations per article ranged from 0 to 13 in *JWH*, which calculated to a mean of 2.24 data visualizations per article and a median of 1. *JGH*, a newer journal, had higher numbers across the board. The number of data visualizations per article ranged from 0 to 21, with a mean of 3.72 data visualizations per article and a median of 2.

There were no discernable patterns in world historians' use of data visualizations over the period in which the journal articles were written. For example, while one might expect the proportion of articles using data visualizations in each journal to increase from the 1990s to the 2020s because of access to big data and computer technologies, there were fluctuations in the proportion of articles with data visualizations for both journals (see Figure 2).
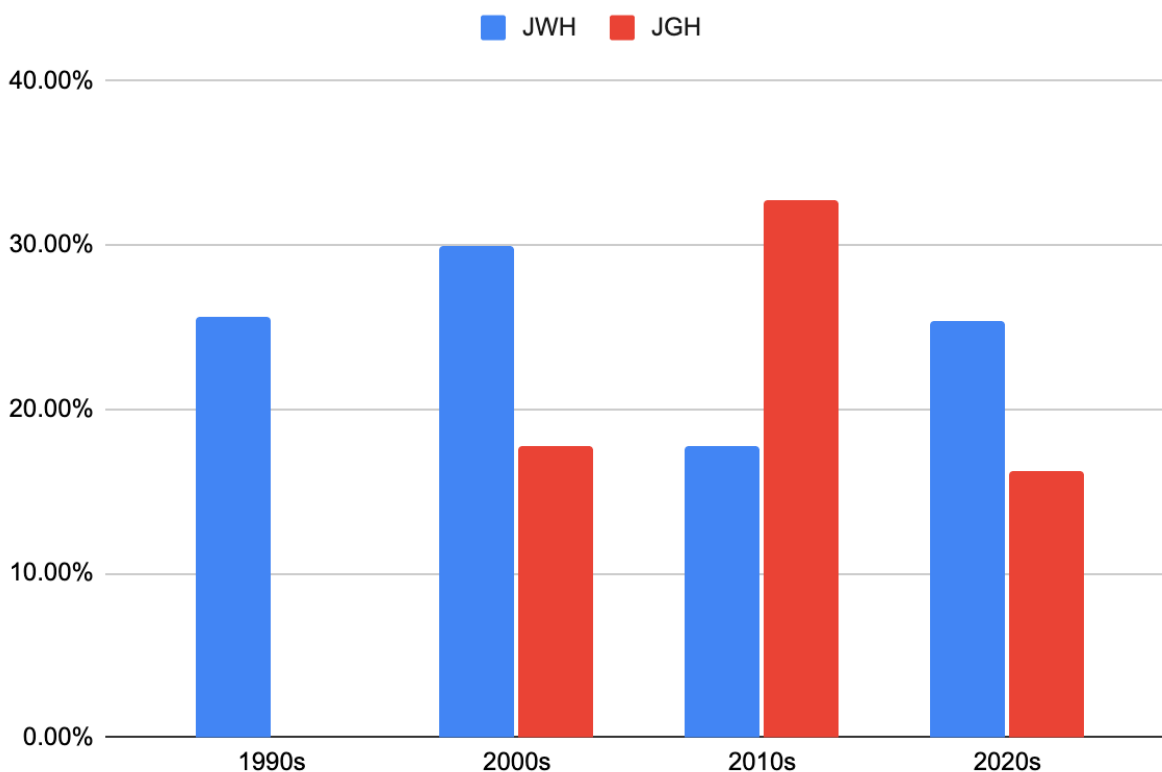

Figure 2: Changes in proportion of journal articles with data visualizations for each journal analyzed. Figure created by the author.

Tables accounted for 296, or 42%, of the 698 data visualizations, making them by far the most common type. The second most frequent type of data visualization were maps. All told, there were 184 maps or map sets, including 35 primary source maps. Following in number were 112 line or multi-line graphs or graph sets, 57 bar graphs (including stacked and multi-set) or graph sets, 14 area or stacked area graphs, and 12

scatterplots. There were several other types of data visualizations as well, but each remaining type accounted for 10 or fewer across all journal articles.

There was a discernable pattern in the types of data visualizations world historians used over time. That is, although tables accounted for the most data visualizations across both journal issues, the number of graphs relative to tables and maps increased over time (see Figure 3). The variety of graphs also increased, with 14 unique types of data visualizations logged for articles between 2020 and 2022, versus only two different types over the entire decade of the 1990s.
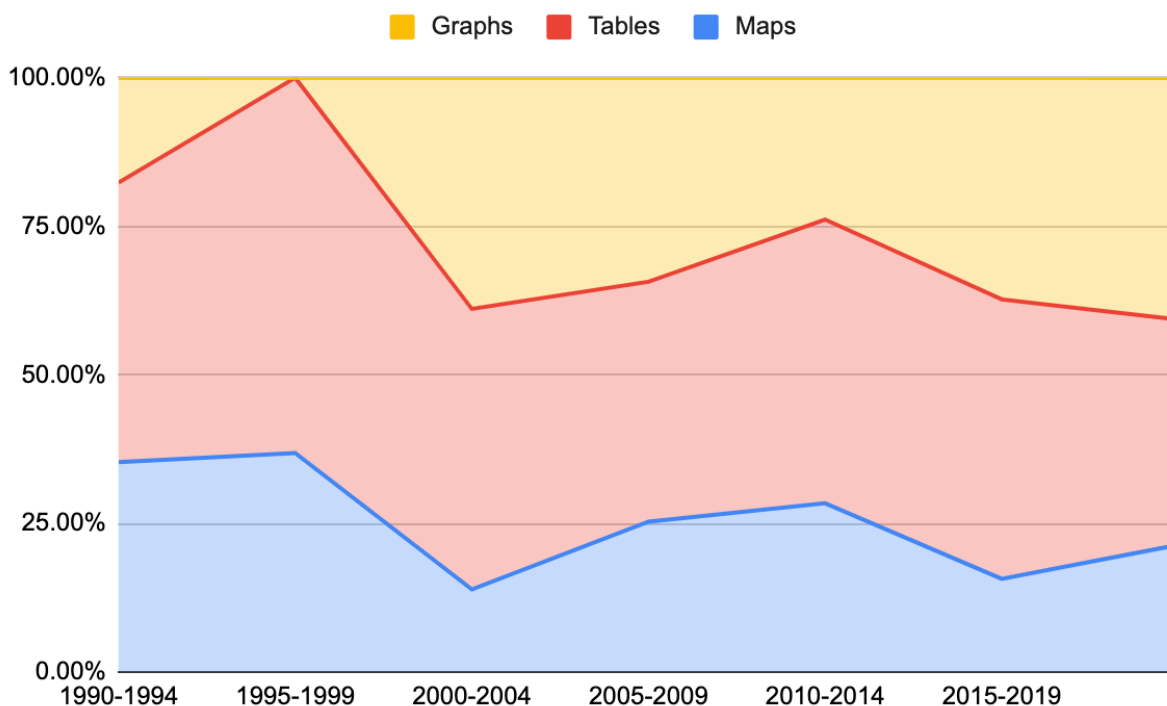

Figure 3: Relative percentage of tables, maps, and graphs among all data visualizations in both journals. Figure created by the author.

Why do world historians use data visualizations in their writing? What purpose do they serve?

Most data visualizations, 546 of 698, or 78%, were used as evidence for historical arguments or claims about causation, significance, local-global connections, and more. Importantly, the historians truly integrated the data visualizations into their writing, cueing readers to consider the data visualization as evidence by using language such as "In Table 1..." or "As the map shows..." Authors also always provided the source or multiple sources from which they extracted their data, and indicated where there were gaps in evidence or when they were unsure about the reliability of a particular source.

Historians also commonly used data visualizations for background or context for readers before launching into their arguments. A total of 104, or 15% of data visualizations were coded for providing context. Tables and graphs were used to provide historical context for the historical problem or case study, and maps were used to provide spatial context for places being discussed or analyzed. In these instances, too, historians almost always called readers' attention to the data visualization and provided the source.

Though less frequent, other uses of data visualizations are nevertheless noteworthy. For example, in 25 cases, historians used data visualizations in providing the historiographical background for the topic under study, sometimes showing data visualizations that had been used in other historians' relevant arguments. Furthermore, there were 13 instances in which the historian used data visualizations to discuss their methodology, such as the ways numbers from across different sources were used to draw conclusions. And in ten instances, historians presented another scholar's data visualization to set up their counterargument. Often, the inclusion of a data visualization for this purpose gave way to a dispute about the other scholar's data sources or calculations (see Figure 4).
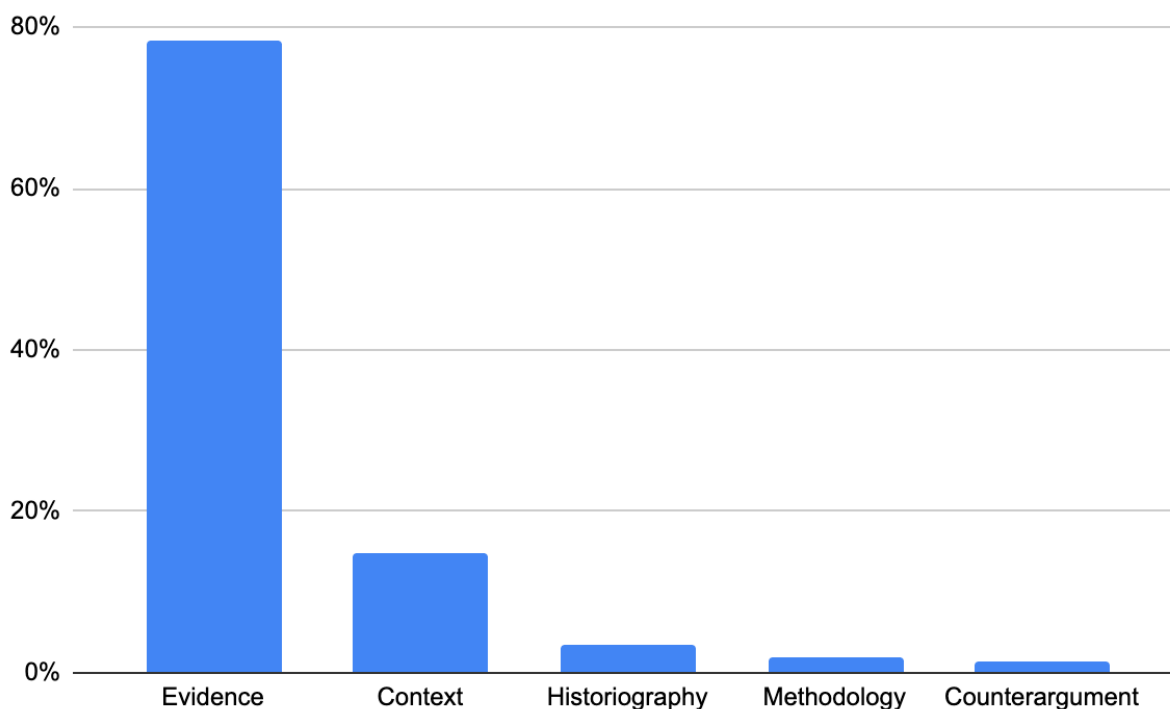

Figure 4: Purposes of data visualizations across all world history articles. Figure created by the author.

What are the world historians trying to convey to readers? What functions do the data visualizations in their articles serve?

Table 1 shows the variety of functions data visualizations played in history articles, but across all types of data visualizations, the most common function was change over time, and historians chose tables, maps, and graphs to display the concept. In total, 356 data visualizations were coded for serving this function alone or in combination with one or more other functions. Comparison was the second most frequently assigned code, with 337 data visualizations identified as such, and again, historians highlighted comparisons in tables, maps, and graphs. Not surprisingly, the most frequent combination of codes consisted of change over time and comparison. Indeed, a total of 249 of the 356 data visualizations coded as change over time, were also coded for highlighting comparisons. These dual functions were fulfilled primarily by tables and graphs.

Tables, the most common type of data visualization across all articles, functioned mainly to highlight comparisons (21.7%), to show change over time (13.1%), to do both (31%), or to do one or the other in combination with some other function. However, nearly 17% of tables functioned only to tabulate information from other sources. In these cases, data might be organized in chronological order but only to provide order to the data, not to show change over time.
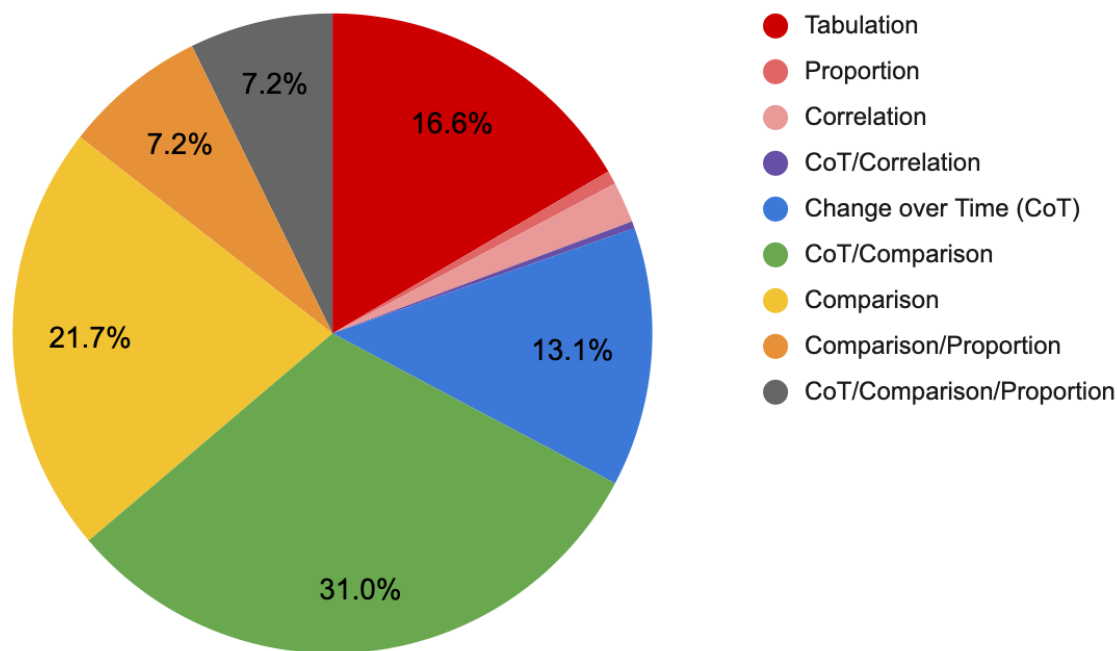

Figure 5: Functions of tables across all world history articles. Figured created by the author.

Maps were often used to tabulate location data from primary sources, or just to show location of places being discussed in the article with the purpose of providing spatial context. In fact, 27.7% of all maps functioned only to show location. Some maps (8.5%) also showed conditions of places to provide context for readers. In addition, world historians used maps to draw readers' attention to distributions of people, places, goods, or occurrences; change (including growth or expansion) over time and space; or movement of people, goods, ideas, or language. And world historians used maps to illustrate connections, usually when making an argument about geographic units of analysis or to help the viewer draw comparisons between places. Sometimes, images of primary source maps functioned as a visual reference for readers to view a primary source that had been analyzed by the world historian (see Figure 6).
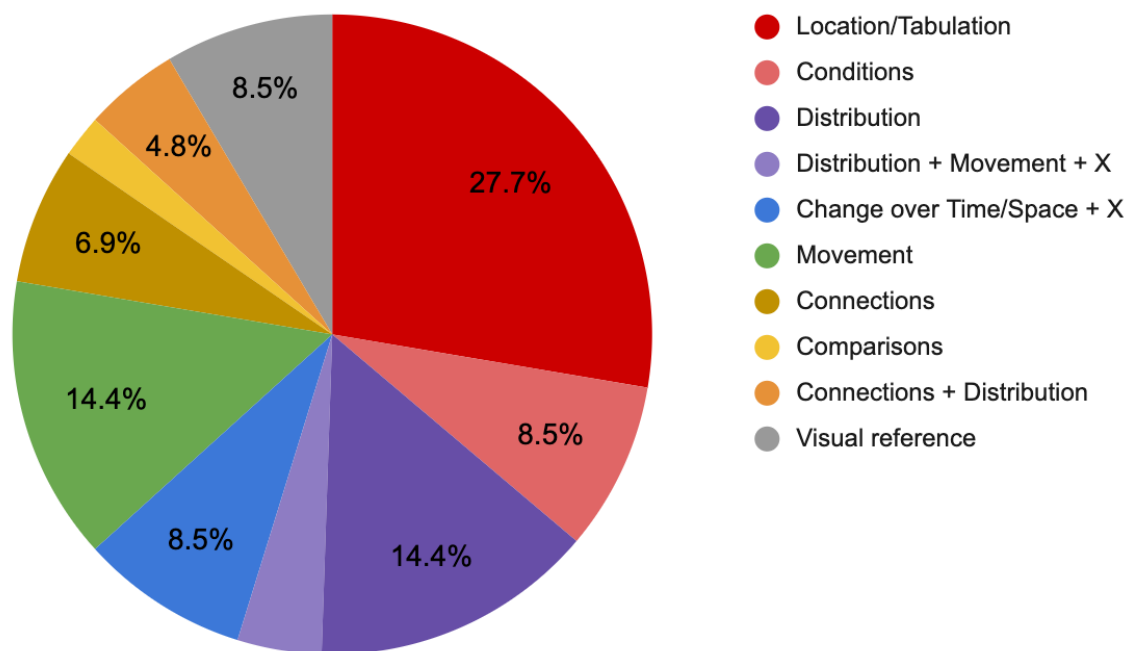

Figure 6: Functions of maps across all world history articles. Figure created by the author.

Graphs also fulfilled a variety of functions, but there were obvious similarities across the most common types of graphs. Change over time, either on its own or in combination with other functions, was once again the most common, and comparison was the second most common function of graphs. Scatterplots were unique in that they showed correlation between two different variables. In several cases, the second variable was time, in which case the function was labeled as change over time (see Figure 7).
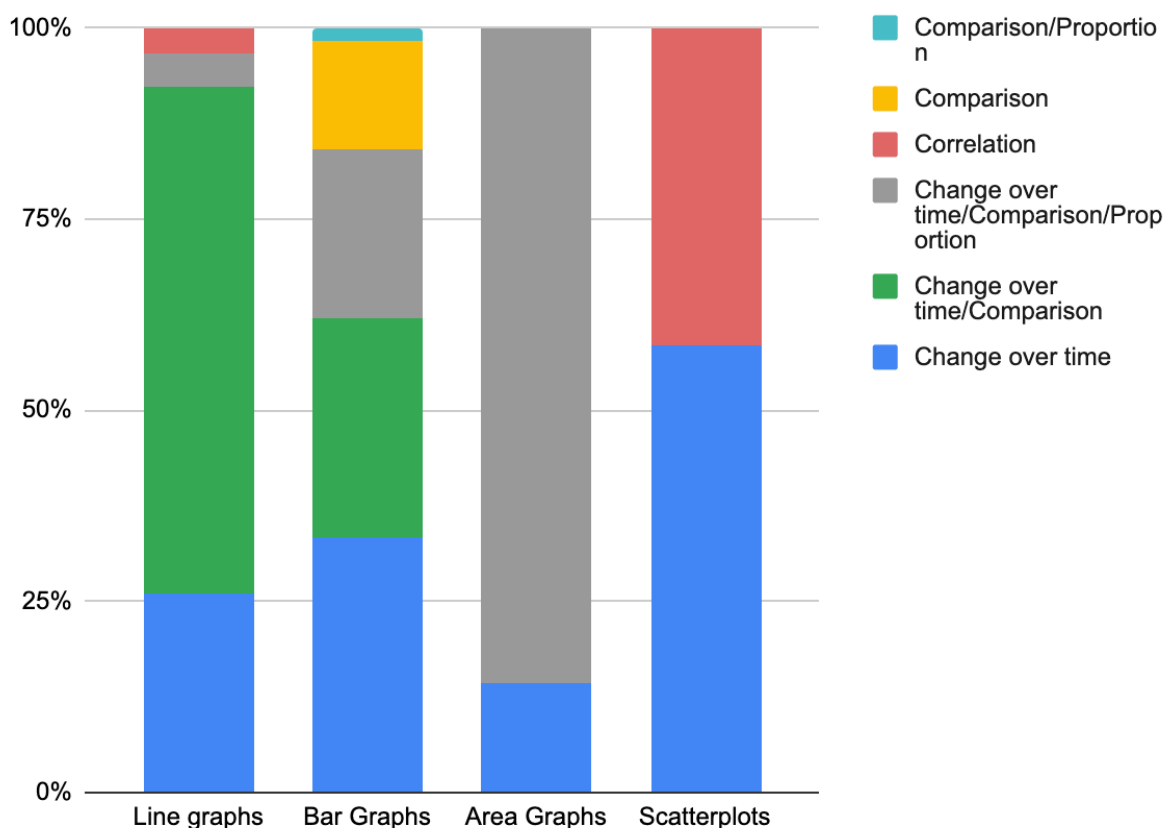
Figure 7: Functions of the most common types of graphs across all world history articles. Figure created by the author.

Discussion

When historians reason and construct accounts about the past, they identify a historical question, use a range of sources of information, create an appropriate context for historical phenomena, develop evidence-based, rational historical explanations and arguments, and use historical meta-concepts like causation and change over time to make sense of evidence and develop explanations and arguments.[25] This study begins to paint a picture of the role that data visualizations play in such historical reasoning, specifically in the field of world history. By uncovering historians' multimodal writing practices, world history teachers may be better equipped to design instruction that fosters students' disciplinary literacy skills, as well as satisfy what are often vague, non-specific guidelines for using data and graphics in historical writing.[26] In the sections that follow, I discuss major takeaways from this study, alignment (or misalignment) with the *C3 Framework* and other world history standards, and implications for world history instruction.

Data visualizations are important modes of information in world history

This study confirms that world historians view data visualizations, especially tables, maps, and graphs, as important sources of information in their discipline. Nearly a quarter of the peer-reviewed world history articles in *JWH* and *JGH* contained data visualizations, and in some articles, there were well over a dozen data visualizations. These data visualizations were not merely decorative or superfluous. In almost every article where data visualizations were present, historians called attention to the data visualizations in the written text, inviting readers to view or study them.

These results indicate that encouraging students to pay attention to data visualizations in historical writing is an important first step in building multimodal disciplinary literacy skills. While this may seem obvious, research indicates that many teachers neglect to provide explicit instruction around data visualizations, sometimes doing little more than point to data visualizations in texts or lecture slides, and that students tend to ignore data visualizations in texts when they are trying to address historical questions.[27] Unfortunately, school textbooks hardly ever call readers' attention to data visualizations in the same way that world historians do in their scholarly articles, and state standards rarely require students to learn that data visualizations are important sources of information in a text. Furthermore, there is little acknowledgement within state standards that making meaning of data visualizations can be challenging and requires intentional instruction.[28] The more teachers call students' attention to data visualizations as sources of information that require analysis and interpretation, the more students will see them as information worthy of readers' attention. This will provide students with a foundation for using data visualizations in their own historical writing about world history topics.

Data visualizations help provide necessary context for historical arguments

World historians often used data visualizations to provide historical and spatial context, such as using maps to show the location or conditions of a place they were discussing, or a graph to show global changes as context for a study of a particular region over the same period. Establishing temporal or spatial context is a critical aspect of historical reasoning. Contextualization provides insight into facts and conditions surrounding, leading up to, or happening concurrently with a particular historical event or phenomena, establishes a sense of difference between time periods or places, and makes a topic and its chronological sequencing more intelligible.[29] However, the information required to establish historical context can be extensive.[30] For world historians, data visualizations seemed to serve as a relatively efficient way to contextualize their arguments.

The *C3 Framework* is explicit in their recommendations that students consider and evaluate historical context, recommending that by the end of high school, for example, students "evaluate how historical events and developments were shaped by

unique circumstances of time and place as well as broader historical contexts."[31] However, there is less in the document to recommend that students provide context in their historical arguments, let alone through use of data visualizations. And several studies indicate that contextualization can be difficult for students in their historical writing, but that explicit instruction such as using a cognitive apprenticeship model can have positive effects.[32] Though more research is needed, it is possible that using data visualizations as a source for contextual background knowledge with students, and then modeling the integration of data visualizations for context in historical writing, may be an effective way to support students' multimodal disciplinary literacy.

Data visualizations can engage readers with important historical meta-concepts

World historians often used data visualizations to convey information about important historical meta-concepts such as change and continuity over time, similarities and differences, and relative impact or significance. Continuity and change, which is at the heart of the discipline of history, was the most prevalent concept that data visualizations displayed. In fact, over half of tables and over 90% of graphs showed change over time. These data visualizations are useful for historical reasoning because they show not only chronology, the necessary "scaffolding for organizing historical thought," but also duration, turning points, and the patterned connections between a variable or variables in time—all necessary for historical reasoning and the basis for understanding other concepts like cause and consequence.[33]

Comparison was the second most common function of data visualizations in the world history articles and is also a concept important for historical thinking, particularly in world history where trans-regional and -national comparisons are core to the field.[34] While some historians used maps and graphs to draw readers' attention to similarities and differences between places or phenomena, tables were the data visualization of choice for comparisons. Tables allowed the historians to compare multiple points in one display and provided precise quantities useful for the readers' own calculations.

The *C3 Framework* encourages students to "analyze change and continuity" and to "compare developments that happened at the same time."[35] But neither the *C3 Framework* nor state standards specify that students should analyze or use data visualizations using historical thinking concepts like change over time or comparison.[36] Indeed, these documents do little to encourage analysis of data visualizations at all, let alone in a way that is related to historical thinking. However, students need to learn how graphical conventions communicate concepts like change and continuity over time and how to compare data points or trends for similarities and differences.[37] This requires explicit instruction in analysis of existing data visualizations, and, better yet, opportunities for students to create their own data visualizations from data they have collected or that is available in datasets. Students taking an *Advanced Placement World History: Modern* course may receive such instruction, as the College Board's course

description recommends that students "create tables, graphs, or other infographics to interpret text or data."[38] These types of exercises allow students to tell stories about change over time or similarities and differences through data visualizations, which they can then learn to integrate with verbal text. But research indicates that state standards guiding instruction for non-AP world history courses largely fail to provide recommendations for explicit instruction in both analyzing and creating data visualizations, despite exhortations from experts that making sense of data visualizations is challenging, requires instruction, and that creating your own data visualizations is useful for helping students better understand the kinds of stories data can tell.[39]

Data visualizations have evidentiary value in world history

World historical claims and arguments often center around periodization in world history, spatial schemes, or units of analysis, interregional or global connections, cultural contacts and exchanges, cultural comparisons, interregional patterns, or historiographical issues. World historians connect localized cases to global patterns and phenomena, uncover previously unknown interactions and exchange networks, or problematize western-centric economic, social, or cultural assumptions.[40] This study has shown that for all these types of claims and arguments, world historians find evidentiary value in multiples kinds of data visualizations. As archivist Trevor Owens has argued, through the analysis and interpretation of data, scholars can "uncover information, facts, figures, perspectives, meanings, and traces of thoughts and ideas… which can in turn be deployed as evidence to support all manner of claims and arguments."[41] Indeed, 78% of the data visualizations in the world history articles I reviewed were used as evidence for claims and arguments. Graphs that showed change over time were used to support arguments about periodization or global and regional trends, tables were used to highlight comparisons between seemingly disparate cities, regions, or nation-states, and maps that showed movement and interregional connections were used to make arguments about spatial units of analysis or relatively unexplored trading patterns.

However, the ways that world historians used data visualizations as evidence matters. Specifically, while they viewed data as a species of artifact, they also clearly recognized that the data were constructed or processed for a particular purpose at a particular moment in time. They represented the idea that there is no such thing as "raw data," seeing instead that data have been gathered for a particular reason and have been filed into datasets by human actors. When representing their data in data visualizations, they made it clear that data had been further manipulated to tell a unique story or support a specific argument. They viewed them like other forms of text—authored works that have been interpreted and can be interpreted by others. Yet, like other artifacts of the past, data held evidentiary value for the world historians using them.[42]

So common was the use of data visualizations as evidence in world history articles that it seems clear that students should also learn to employ them as evidence in their historical writing. But asking students to include data visualizations as a source of evidence is not enough—how students view data visualizations and employ them as evidence also matters. Too often, data and data visualizations are seen as objective and factual, and as a result, students may be tempted to present them as such in their historical arguments or explanations. However, students will be well served, for the sake of both disciplinary literacy and their roles as citizens, to learn that from generation and collection, through representation and visualization, data are never neutral or objective, are often incomplete, and that their interpretation is dependent upon one's positionality and biases.[43] It is for this reason that proponents of using data in history also call for transparency in methodology,[44] and that several of the articles I reviewed were indeed transparent in their methodology, or used others' claims about data as the basis for their counterargument. It is also why all the historians who used data visualizations included extensive footnotes, and sometimes explained potential flaws in their data. In short, the use of data visualizations as evidence in history should reflect an epistemic stance that recognizes the interpretive nature of the discipline, and the interpretive nature of data visualizations within the discipline.

To be sure, the epistemic stance of world historians may explain the prevalence of tables as sources of evidence. As data storytelling expert and author Cole Nussbaumer Knaflic has written:

> *Tables, with their rows and columns of data, interact primarily with our verbal system. We read tables…Tables are great when you have an audience who wants to do just that. Or if you have a diverse audience, where each wants to look at their own piece: a table can meet this need.[45]*

If historians work with a keen understanding of the interpretive nature of their discipline, and the interpretive nature of data visualizations themselves, they may be inclined to present a visualization that is more precise and open to interpretation than a graph, which is better at interacting with our visual system and conveying patterns and trends.

Unfortunately, while curriculum standards, including the *C3 Framework*, often encourage "data" or "graphics" as evidence, they do not necessarily promote a critical approach to data or data visualizations. In fact, standards encouraging critical analysis of data visualizations are rare. Again, recent research shows that only 12 states require that students learn how to critically evaluate data visualizations in history or their other social studies classes.[46] This means that many students across the United States may go through school with little to no instruction on how to critically evaluate data visualizations, and may overestimate their weight as evidence, in both their own and others' arguments.

In this digital age, when historians are increasingly accessing digital datasets, visualizing data, and using data and data visualizations as part of historical inquiry, it is crucial that educators acknowledge and teach these new forms of historical communication and writing. World historians regularly use data visualizations to communicate information about the past, and they integrate them into their historical arguments as sources of evidence. Yet this aspect of discipline-specific communication is not fully represented in curriculum standards, nor in the *C3 Framework*. This places the onus on world history teachers and curriculum writers to encourage analysis of data visualizations, and to help students meaningfully weave tables, maps, and graphs into their writing as sources of information and evidence.

Tamara L. Shreiner is Associate Professor of History and Social Studies Education at Grand Valley State University in Allendale, Michigan. Prior to her work at Grand Valley, Shreiner was a world history and big history teacher in Ann Arbor, Michigan. Her scholarship over the last several years has focused on the teaching and learning of data literacy in history and social studies.

Notes

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[1] See Jack Schneider and Sivan Zakai, "A Rigorous Dialectic: Writing and Thinking in History," *Teachers College Record* 118, no. 1 (2016): 1-36 and Chauncey Monte-Sano, "Disciplinary Literacy in History: An Exploration of the Historical Nature of Adolescents' Writing," *Journal of Learning Sciences* 19 (2010): 539-568.

[2] For one recent exception, see Jeffery D. Nokes, "Building an Argument with Historical Numbers," *Defining Historical Literacies What and How Do Historians Read and Write?* (New York: Routledge, 2022), 256-275.

[3] See Lauren Fingeret, "Graphics in Children's Informational Texts: A Content Analysis," Doctoral dissertation ID no. 3524408, Michigan State University, 2012; Carrie E Finholm and Tamara L Shreiner, "A Lesson in Missed Opportunities: Examining the Use of Data Visualizations in Online History Lessons," *Social Studies Research and Practice* (2022): 155-166; Tamara L. Shreiner, "Data Literacy for Social Studies: Examining the Role of Data Visualizations in K-12 Textbooks," *Theory & Research in Social Education* 46 (2018): 194-231; Tamara L. Shreiner, "Building a Data-Literate Citizenry: How U.S. State Standards Address Data and Data Visualizations in Social Studies," *Information and Learning Sciences* 121, no. 11/12 (2020): 909-931.

4   National Council for the Social Studies, *The College, Career, and Civic Life (C3) Framework for Social Studies State Standards: Guidance for Enhancing the Rigor of K-12 Civics, Economics, Geography, and History* (Silver Spring, MD: National Council for the Social Studies, 2013), 60.

5 Common Core State Standards Initiative, "Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects," (Washington, D.C.: National Governors Association, 2011), 42.

6 See Shreiner, "Building a Data-Literate Citizenry," 909-931.

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