

UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

APPROACHES TO SPATIALIZING QUALITATIVE DATA

A THESIS

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

Degree of

MASTER OF SCIENCE IN ENVIRONMENTAL SUSTAINABILITY

By

SAMANTHA JUNG

Norman, Oklahoma

2022

APPROACHES TO SPATIALIZING QUALITATIVE DATA

A THESIS APPROVED FOR THE
DEPARTMENT OF GEOGRAPHY AND
ENVIRONMENTAL SUSTAINABILITY

BY THE COMMITTEE CONSISTING OF

Dr. Travis Gliedt, Chair

Dr. Jennifer Koch

Dr. Jack Friedman

Abstract

This study investigates how researchers use technology to create geographic visualizations that provide spatial context for displaying and accessing qualitative data such as texts, photographs, videos, and/or audio recordings. I interviewed 21 individuals on their experiences with spatializing qualitative data, which I define as displaying and analyzing data that are not numerical or categorical (e.g., texts, images, videos, and audio recordings) in the spatial context of a geographic map. I conducted semistructured interviews with nineteen researchers in geography, social science, and humanities disciplines and two GIS professionals in the energy industry. I took an inductive approach to qualitatively analyzing these interviews, performing thematic coding and writing analytic memos. I identified themes of storytelling, data strategies, technological solutions, and collaboration, which are highlighted and discussed. The results of this study show that researchers across disciplines are not only interested in but are successfully finding ways to spatialize qualitative data. Additionally, shortcomings of off-the-shelf software applications, ethical implications of locational data privacy, and confusion surrounding terminology are identified as opportunities for future research.

Acknowledgements

The research performed for this thesis, including my research assistantship, was funded in part by support from the National Science Foundation under Grant No. OIA-1301789 (2013-2018, “Adapting Socio-Ecological Systems to Increased Climate Variability”), which I gratefully acknowledge.

This research would not have been possible without the interview participants who gave their time and shared their perspectives and experiences with me. Their contribution is sincerely appreciated.

I would like to express my profound gratitude to my thesis committee, consisting of Dr. Travis Gliedt, Dr. Jennifer Koch, and Dr. Jack Friedman, for their helpful feedback and advice as well as their patience and support as I navigated graduate school as a new parent. To Dr. Gliedt: Thank you for always expressing your enthusiastic support. Having a committee chair with such a positive, optimistic attitude alleviated many of my concerns. To Dr. Koch: Thank you for introducing me to Python and GIS. I so appreciate your willingness to share your knowledge with me and to assist me in my efforts. To Dr. Friedman: Thank you so much for investing in me, both as my research supervisor and as my thesis committee member. Your dedication to helping me stay connected to my research as a new parent was invaluable, as were your guidance and coaching throughout the interview, analysis, and writing processes.

Multiple people informed my thinking on GIS and spatializing qualitative data during my research assistantship, notably Dr. Lee Hachadoorian, Dr. Mike Stanton, and Evan Linde.

Within the Department of Geography and Environmental Sustainability, I extend my sincere appreciation to Dr. Mark Meo and Dr. Jad Ziolkowska, who contributed to my understanding of sustainability, and to the graduate college liaisons, Dr. Tom Neeson and

Dr. Laurel Smith, and the administrative coordinator, Emalee Lemke, who kindly provided me with assistance on many occasions.

I would also like to thank my family and friends for their support. To my husband, Don: I love you so much. I cannot begin to list all the ways you have loved and served me and our precious daughter, Nadia. Thank you. To my daughter, Nadia: Your hugs, smile, and laughter have brightened even the hardest days. I love you dearly and am so thankful for you. To my parents: Thank you for your constant prayers, love, and support. Mom, you have devoted so much time to helping me in so many practical ways. I could not have written this thesis without you. To my parents-in-law and sister-in-law: Thank you for consistently encouraging and praying for me. To my brothers and sister: The good times and laughter we have shared have helped me more than you know. To my friends Lindsey and Ashlee: I am so thankful for our friendship. Your prayers, encouragement, and support have made an extraordinary difference in my life. To my friends Dolly, Monica, and Jenny: I am so grateful to have experienced the highs and lows of graduate school with you. Your understanding, encouragement, and advice have helped me tremendously.

Finally, I would like to express my gratitude to God. He has blessed me abundantly, and I have done nothing apart from Him.

Table of Contents

Chapter 1	Introduction	1
Chapter 2	Literature Review	3
2.1	Qualitative GIS Background	3
2.2	Qualitative GIS Definition	3
2.3	Qualitative GIS Approaches.....	4
Chapter 3	Methods	7
3.1	Sampling Technique and Interview Process	7
3.1.1	Interviewee Backgrounds and Descriptions	8
3.2	Thematic Analysis of Interview Data.....	14
Chapter 4	Results	17
4.1	Why is Qualitative Data Spatialized?.....	17
4.1.1	Stories for a Public Audience.....	18
4.1.2	Stories Past and Present.....	22
4.1.3	Stories from Qualitative Data.....	22
4.1.4	Stories from Quantitative Data.....	24
4.1.5	Stories from Combining Quantitative and Qualitative Data	25
4.1.6	Stories and Mapping.....	28
4.1.7	Telling Others' Stories	31
4.1.8	Stories for Social & Environmental Justice	35

4.2	How is Qualitative Data Spatialized?.....	42
4.2.1	Data Strategies.....	42
4.2.2	Technology Strategies.....	59
4.2.3	Collaboration Strategies.....	66
Chapter 5	Discussion & Conclusion.....	82
5.1	The Map's Relation to Qualitative Data.....	83
5.2	Spatializing Qualitative Data as a Multidisciplinary Method.....	84
5.3	Effect of Researcher's Career Stage on Multidisciplinary Work.....	85
5.4	Ambiguity in Terminology.....	85
5.5	Ethical Implications.....	88
5.6	Key Findings.....	89
5.7	Limitations of This Work.....	90
References	91
Appendix A	Request for Participation in Thesis Research.....	99
Appendix B	Interview Protocol for Thesis Research.....	101

Chapter 1 Introduction

Harrison and Dourish define *space* as “the three-dimensional environment, in which objects and events occur, and in which they have relative position and direction” (1996, pp. 68–69). Tuan asserts *place* is “not only a fact to be explained in the broader frame of space, but it is also a reality to be clarified and understood from the perspectives of the people who have given it meaning” (1979, p. 387). This distinction between *space* and *place* has been compared to the difference between a *house* and a *home* (Harrison & Dourish, 1996, p. 69).

The analysis of space often deals with data that can be categorized and/or analyzed quantitatively. Geographic information systems (GIS) software is a standard tool for performing this type of analysis and working with these types of data. However, “quantitative data or methods seldom suffice to reveal what people perceive or experience in their everyday lives” (Kwan & Knigge, 2006, p. 2001). Qualitative social science methods can offer insight into the human experience of place, although as reported by Baur et al. (2014), performing spatial analysis in qualitative research has not been well studied as a methodology, and they recommended the use of GIS as a tool for integrating these methods. Despite the view of GIS as a primarily quantitative tool, Pavlovskaya contends that spatial analysis within GIS is mostly nonquantitative, based on “human reasoning” (2006, pp. 2011–2012; 2009, p. 20), and she extends this argument to visualization, which she ascribes to be the “most powerful and widely used function” in GIS (2006, pp. 2012–2013; 2009, pp. 23–24).

Scholars have recommended mixed methods research to address the limitations associated with using spatial analysis and qualitative research methods separately (Baur et al., 2014; Cope & Elwood, 2009; Fielding & Cisneros-Puebla, 2010), but there is a lack of resources to show researchers how to use GIS with qualitative data. This prompted the question, “How do

researchers spatialize qualitative data?” In this research, I aim to identify 1) researchers’ perspectives on the challenges and benefits of spatializing qualitative data and 2) strategies they employ to spatialize qualitative data. To address these aims, I invited researchers to participate in interviews to describe their experiences with spatializing qualitative data. For the purpose of this thesis, I define the term *spatializing qualitative data* as displaying and analyzing data that are not numerical or categorical (e.g., texts, images, videos, and audio recordings) in the spatial context of a geographic map.

In Chapter 1, I have introduced the concepts of space and place, which inform my research on spatializing qualitative data. In Chapter 2, I outline the qualitative GIS mixed methods framework for combining the spatial visualization capabilities of GIS with qualitative data as a useful approach for integrating the study of space and place. In Chapter 3, I describe my methods for conducting the research for this thesis, including recruitment and data collection efforts, relevant information about the interviewees who participated in this study, and how I analyzed the interview data. Chapter 4 is organized in two sections: in the first, I address interviewees’ purposes in spatializing qualitative data, and in the second, I address their techniques for spatializing qualitative data. In Chapter 5, I discuss key findings and conclusions from this research.

Chapter 2 Literature Review

2.1 *Qualitative GIS Background*

Critiques of GIS in the 1990s identified, among other things, the limitation of GIS in handling nonquantitative data (Pickles, 1995; Sheppard, 1995). As pointed out by Sheppard (1995, p. 13), the type of qualitative data that represents human experience is rarely collected in databases that are the usual sources for data analyzed in GIS:

A GIS is conventionally considered to be a way of processing standard socioeconomic and biophysical data of the kind collected by innumerable agencies. There is, however, an abundance of other information that is rarely collected in such databases: the variety of knowledge and wisdom possessed by diverse individuals and social groups and gathered in the course of their experiences.

The dominant perspective of GIS as a quantitative tool has not changed much since Sheppard published this observation in the mid-1990s (Pavlovskaya, 2009; Jung & Elwood, 2019). In the early 2000s, geographers and social scientists began developing qualitative GIS approaches to address this limitation (Elwood & Cope, 2009; Jung & Elwood, 2019; Pavlovskaya, 2009). Jung and Elwood (2010) credit Kwan (2002) as the first to advocate for qualitative GIS through combining the two disparate analysis technologies of GIS and computer-aided qualitative data analysis software (CAQDAS).

2.2 *Qualitative GIS Definition*

Cope and Elwood (2009) acknowledge multiple meanings of the term *qualitative GIS*, first defining GIS, then defining what constitutes *qualitative* in the context of qualitative GIS.

They assert that GIS comprises not only technology (i.e., software) but also methodology and social practice. *Qualitative* may refer to the data being analyzed (Elwood & Cope, 2009; Jung & Elwood, 2019), the insight provided by the data (Elwood & Cope, 2009), and/or the analysis performed on the data (Elwood & Cope, 2009; Jung & Elwood, 2019). Schuurman (2009) adds that the data about data (i.e., metadata) may also be qualitative even if the data they describe are not (e.g., metadata could qualitatively describe how quantitative data were collected and categorized). Jung and Elwood (2019) reiterate the term's applicability to the data analyzed, the understanding provided, and the analysis techniques as well as referring to a mixed methods framework.

2.3 *Qualitative GIS Approaches*

Research studies (Jung, 2007, 2009; Jung & Elwood, 2010, 2019) have elaborated on practical aspects of performing qualitative GIS, describing useful functionalities of computer-aided qualitative GIS (CAQ-GIS). These works situate CAQ-GIS as a mixed methods framework that supports qualitative GIS approaches by providing strategies to incorporate qualitative data into GIS and perform qualitative analysis on such data within or in conjunction with GIS. Jung and Elwood (2010, 2019) discuss four such strategies: converting qualitative data; hyperlinking qualitative data; harnessing GIS functionality to store, manage, and display qualitative data; and performing qualitative data analysis and spatial analysis in parallel (i.e., qualitative data analysis is not performed within GIS).

Data transformation refers to creating categories or quantitative measures of qualitative data to represent the data more easily in GIS using conventional techniques (e.g., symbols). Hyperlinking refers to inserting hyperlinks to externally stored qualitative data in the information associated with spatial objects in GIS: accessing the information for the spatial object shows the

hyperlink, which can be clicked to access the original qualitative data attributed to that location. The CAQ-GIS strategy of using the data storage and management functionality of GIS to handle qualitative data requires a greater familiarity with GIS software, with some researchers coding their own extensions to do so (Kwan & Ding, 2008; Matthews et al., 2005). One of the means of incorporating qualitative data is in the use of the “imagined grid,” in which photographs are assigned to cells in a raster grid layer that can be overlaid on the base map or other layer of interest, a technique developed by Jung (2007). Another technique is using relational databases in GIS to incorporate qualitative data, initially called a “social-relational database” (Jung, 2007) and later referred to as a “hybrid relational database” (Jung, 2009; Jung & Elwood, 2010). These relational databases allow the user to attribute multiple nongeographic data records, including qualitative data, to a single spatial reference. The CAQ-GIS strategy of performing qualitative data analysis in parallel with geographic spatial analysis affords the researcher benefits of each type of analysis, giving a more comprehensive look at the data without needing to possess the level of GIS expertise required for storing and managing qualitative data directly in GIS. One example of this strategy is the grounded visualization approach (Knigge & Cope, 2006, 2009), which advocates for the integration of grounded theory and geographic visualization analysis techniques to reveal insights that would not be evident from examining the data from either a qualitative analysis or spatial analysis alone.

The elements that constitute qualitative GIS/CAQ-GIS/CAQDAS-GIS are qualitative data (typically descriptive of human experience), location information to georeference the qualitative data, and GIS software to analyze and visualize the data. Qualitative data may be represented in GIS in a number of ways: quantitative characterization for conventional representation (e.g., symbols), hyperlinks to external files, or direct storage within a GIS

database. Qualitative data may also be analyzed using software designed expressly for that purpose, with spatial visualization performed alongside to give additional insight that would not be apparent from using either method alone.

Chapter 3 Methods

3.1 Sampling Technique and Interview Process

I recruited twenty-one individuals via email to participate in interviews using a combination of two nonprobability sampling techniques: expert sampling and snowball sampling (Bhattacharjee, 2012). The recruitment material and method were approved by the University of Oklahoma Institutional Review Board (IRB); this material is included in Appendix A. Recruitment communication occurred between September and December 2018. I emailed a request for interview volunteers to email subscribers of the Section on Environmental Sociology (ENVIROSOC listserv) as well as the International Environmental Modelling and Software Society (iEMSs listserv); three volunteers from the ENVIROSOC listserv responded to the request. The remaining respondents were recruited by direct request through email: nine were either recommended by committee members or were authors of relevant published works, and nine were recruited by snowball sampling from other interviewees' recommendations. All communication preceding and following interviews was conducted over email. I conducted all interviews as audio-only phone calls, except for one that was conducted as a video call. All interviews included an IRB-approved verbal statement of consent and were audio-recorded using handheld digital voice recorders. Two recorders were used to protect against data loss in the event that an unexpected technical problem occurred with one of the devices. Interview length ranged from 15 minutes to 70 minutes, with an average length of 45 minutes. All interviews were conducted between October 2018 and January 2019.

The semistructured interviews followed an IRB-approved protocol (Appendix B) and covered topics of each interviewee's spatial research projects, collaboration experiences,

educational and GIS background, and the technological tools and software solutions employed in their work. The semistructured format provided flexibility with the protocol script, allowing interviewees to talk about their work in whatever way was natural for them (Rowley, 2012; Trier-Bieniek, 2012). For many of them, this was done by describing and commenting on specific projects with which they had been involved, whether as the initiator/principal investigator, a collaborator, or a student/research assistant.

3.1.1 Interviewee Backgrounds and Descriptions

The following quotation from Interviewee 19 is representative of the type of participant who was sought for this research:

I am connecting spatial data with quantitative and qualitative data, and my research revolves around those types of questions about water access and water justice, and also . . . trying to be a part of the conversation about social science ethics.

She described connecting spatial data with qualitative as well as quantitative data, with topics of study centered on environmental issues combined with a social science aspect. Of course, not all interviewees had backgrounds and perspectives identical to that of Interviewee 19, and the diversity represented added to the insight gained from this research.

Nineteen interviewees were in academia and two were in industry. The latter two worked at renewable energy companies as GIS professionals, with one holding a vice president position in his company and the other holding a data analyst position. Among the interviewees in academia, five academic disciplines and seven career stages were represented, with academic discipline correlated to career stage in Table 1.

Table 1. Distribution of Career Stages across Academic Departments

Career Stage	History	Environmental Science/ Sustainability	Geography	Sociology	Digital Humanities	Total
Professor	3	1	3			7
Associate Professor	3	1				4
Assistant Professor		3	1			4
Postdoctoral Researcher		1		1		2
University Lab Director					1	1
GIS Professional					1	1
Total	6	6	4	1	2	19

3.1.1.1 Interviewee 1

Interviewee 1, an assistant professor in sustainability at a university in the United States, holds research interests in participatory modeling to integrate social, economic, and ecological factors.

3.1.1.2 Interviewee 2

Interviewee 2, an associate professor in sustainability at a university in the United States, holds research interests in participatory modeling to integrate social, economic, and ecological factors.

3.1.1.3 Interviewee 3

Interviewee 3, a professor in sustainability at a university in the United States, holds research interests in renewable energy siting in relation to public perception and local acceptance.

3.1.1.4 Interviewee 4

Interviewee 4, a professor in history at a university in the United States, discussed two projects with which he has been involved: a three-dimensional reconstruction of historic buildings in multiple districts of his city and a map linking combined audio, video, and text descriptions of various sites in his city.

3.1.1.5 Interviewee 5

Interviewee 5, a postdoctoral researcher in sustainability at a university in Canada, stated that his work had primarily dealt with quantitative spatial data, including demographics such as education and political affiliation, but that he was interested in the idea of analyzing interviews in a geographically representative way.

3.1.1.6 Interviewee 6

Interviewee 6, a professor in geography at a university in the United States, discussed his experience gathering qualitative data in the form of audio interviews that were captured while moving through space, referred to as geo-narratives, and videos of landscape change taken while moving through space, referred to as spatial videos.

3.1.1.7 Interviewee 7

Interviewee 7, a vice president at a renewable energy company in the United States, had a strong background in GIS and discussed the potential utility and benefit of spatializing qualitative data such as interviews for analysis of renewable energy siting in relation to public perception and local acceptance.

3.1.1.8 Interviewee 8

Interviewee 8, a professor in history at a university in the United States, discussed his work on digital humanities projects that spatialize qualitative data, which included creating a mobile device platform designed to help others tell location-based stories.

3.1.1.9 Interviewee 9

Interviewee 9, an assistant professor in environmental science at a university in the United States, holds research interests in the effect of place-based factors in public perception and local acceptance of renewable energy.

3.1.1.10 Interviewee 10

Interviewee 10, an associate professor in history at a university in the United States, discussed her project combining contemporary and historic stories tied to specific locations.

3.1.1.11 Interviewee 11

Interviewee 11, a data analyst for a renewable energy company in the United States, worked with GIS in the context of energy efficiency research. Her experience was mostly with

analyzing quantitative data using GIS, although she also had experience working with interview data.

3.1.1.12 Interviewee 12

Interviewee 12, a recent PhD graduate in sociology at a university in the United States, investigated the inclusion of spatial data in qualitative social science research. She described herself as a primarily qualitative researcher who does spatial-related work. Although her education was in sociology and her research interests were focused on topics of race/ethnicity, culture, and inequality, she noted that she was often the person performing spatial analysis in her collaborative work with others in social science research.

3.1.1.13 Interviewee 13

Interviewee 13, an associate professor in history at a university in the United States, discussed various aspects of his projects that spatialized qualitative data, including a collaborative relationship to advance the projects in areas outside his expertise.

3.1.1.14 Interviewee 14

Interviewee 14, a professor in geography at a university in the United States, holds research interests in public perception and local acceptance of renewable energy as a social issue.

3.1.1.15 Interviewee 15

Interviewee 15, an assistant professor in geography at a university in Canada, served in editorial capacities for geography and data journals. He discussed his experience researching

digital humanitarianism efforts in emergency response situations and reflected on how people's experience of place differs from address- or coordinate-based notions of space.

3.1.1.16 Interviewee 16

Interviewee 16, a professor in history at a university in the United States, discussed his experience with digital humanities, including digitization of analog data, and shared his perspective on the interconnectedness of geography and history.

3.1.1.17 Interviewee 17

Interviewee 17, a professor in geography, has held leadership positions in geography and GIS/GIScience organizations and served in editorial capacities for geography and public health journals. He discussed how people's experience of place differs from address- or coordinate-based notions of space.

3.1.1.18 Interviewee 18

Interviewee 18, a GIS analyst at a university in the United States, discussed his experience combining spatial, quantitative, and qualitative data. He spoke about the importance of humanizing data and the difficulty in doing so.

3.1.1.19 Interviewee 19

Interviewee 19, an assistant professor in environmental science, discussed gathering information using surveys and interviews in specific geographic areas, and she also spoke about collaboration experiences she has had.

3.1.1.20 Interviewee 20

Interviewee 20, a university lab director and instructor in digital humanities at a university in the United States, discussed his experience combining spatial, quantitative, and qualitative data and spoke about the importance of humanizing data and the difficulty in doing so.

3.1.1.21 Interviewee 21

Interviewee 21, an associate professor in history at a university in the United States, discussed her experience creating a mapping tool that incorporated data from various sources, which was intended to be used by policy makers to help them make more informed decisions regarding housing needs in the community.

3.2 Thematic Analysis of Interview Data

I conducted all interviews over the phone, audio-recording them using handheld digital voice recorders and taking handwritten notes. To analyze the interview data, I used the thematic analysis method (Braun & Clarke, 2006). I evaluated statements from interviewees at a semantic level (i.e., at face value) to identify themes present across the entire dataset (Braun & Clarke, 2006). Most interviewees described a project or two with which they had been involved that they considered to have spatialized qualitative data. They typically described their thoughts and feelings about their experiences working on those projects, covering areas including motivations, benefits, challenges, and software tools.

After all interviews had been completed, I listened to the recording of each interview and transcribed it using Express Scribe Transcription Software in conjunction with Microsoft Word. While reviewing the interview data during transcription, I took analytic memos (Saldaña, 2013)

and coded themes in the data (Braun & Clarke, 2006; Saldaña, 2013) using the built-in comments feature of Microsoft Word. One purpose of analytic memo writing is “to document and reflect on . . . the emergent patterns, categories and subcategories, themes, and concepts in [the] data” (Saldaña, 2013, p. 41). I took an inductive approach to this analysis (Braun & Clarke, 2006), generating thematic codes based on the content of the data rather than using predetermined codes. These memos helped me to discover themes in an iterative process and allowed me to adjust my view of the topic and my expectations for this research. After completing all transcriptions, coded excerpts along with corresponding analytic memos were organized in Microsoft Excel, structured such that each interview excerpt corresponded to a row with columns for interviewee identifier, interviewee consent, analytic memo (if applicable), and thematic code(s). From there, patterns were identified across interviews to develop themes that I construed to be illustrative of the interviewees’ efforts to spatialize qualitative data. There were 17 initial codes that I identified and used (Table 2). These codes were reviewed, refined, and consolidated so that they fell under two overarching themes that encompassed why interviewees were spatializing qualitative data and how they went about it.

Table 2. Thematic Codes with Descriptions

Collaboration	The collaboration code included interviewees’ discussions of working with other people who have different expertise and skills to their own, whether they did such work or not.
Data	The data code included interviewees’ mentions of the types of data used in their projects along with descriptions of how they analyzed, stored, or otherwise treated the data.
Discipline-specific thinking/training/silos	The discipline-specific thinking/training/silos code included interviewees’ mentions of disciplinary silos, discipline-specific thinking, working with others in different disciplines, and working as part of a team comprising multiple disciplines.

Educational/GIS background	The educational/GIS background code included interviewees' statements describing or referencing their educational backgrounds and/or experiences working with or receiving training or instruction in GIS.
Human experience	The human experience code included interviewees' mentions of human experience as an element of their work.
Innovate software/technology gap	The innovate software/technology gap code included interviewees' mentions of developing custom technological solutions for their research and mentions of limitations of existing technology to meet their needs.
Other	The other code was used to capture miscellaneous interesting comments from interviewees that did not fall under any of the other codes.
Public Audience	The public audience code included references to creating content for public use or even simply public (i.e., nonrestricted) access.
Quantitative vs qualitative	The quantitative vs qualitative code included interviewees' discussions of the differences between working with quantitative and qualitative data.
Reference	The reference code was used to capture interviewees' mentions of their own or others' work.
Resource constraints/institutional funding	The resource constraints/institutional funding code included interviewees' mentions of funding or other factors that affected or may have affected their access to resources, including technology, and their ability to perform their research.
Social justice	The social justice code included interviewees' mentions of social justice as an element of their projects.
Software	The software code was used to capture interviewees' mentions of specific software packages, whether they used such software or not.
Space vs place	The space vs place code included interviewees' discussions of how space as a geographic location differed from place as lived experience of the location.
Student involvement/exposure	The student involvement/exposure code included interviewees' mentions of student involvement in their projects as well as interviewees' mentions of sharing knowledge with students in the classroom.
Views on GIS	The views on GIS code included interviewees' comments on the strengths and weaknesses of GIS for various purposes.
Visualization	The visualization code included interviewees' comments on the visual aspect of spatializing qualitative data.

Chapter 4 Results

4.1 *Why is Qualitative Data Spatialized?*

Sharing stories of human experience was a primary goal for many interviewees working with spatialized qualitative data. Interviewee 16, who spent much of his career as a historian intertwining qualitative data and storytelling with geography, was straightforward in connecting storytelling to the work that defines his field:

Our technique is all narrative. We don't do things like, say, findings, methods, all those sorts of things like geographers do. We tell stories.

One commonality shared among many of the interviewees was that projects were intended to be shared with the general public. Multiple interviewees focused on telling stories from the past. One interviewee focused on telling present-day stories, and she collected those stories directly from living subjects as spoken narratives on location where the story took place. Interviewee 8 collected what he called “place-based stories,” describing them as involving various media forms, such as text, map coordinates, historical photos, oral history clips, and mini video documentaries. Some interviewees were working from primarily quantitative data, some from primarily qualitative data, but most, if not all, sought to combine these different types of data in an accessible way that could be navigated using an intuitive visual interface, typically incorporating a map.

Mapping added a critical dimension to these stories. These efforts to tell others' stories revealed challenges and shortcomings inherent in taking on such an endeavor. A central component to most of these efforts was a desire to increase public awareness of and education in

an area of injustice or inequality, and some interviewees expressed a desire to humanize their data but found it difficult to do so.

4.1.1 Stories for a Public Audience

Interviewees often worked on projects intended for a public audience. This directed not only the type of data they collected, but also how they collected, analyzed, stored, and presented their data. When asked about the reasoning behind his projects, Interviewee 8, whose work included linking descriptions to historic buildings as well as spatializing oral histories, communicated that his interest in public history influenced his motivation for choosing to pursue projects that shared stories with the general public:

It comes out of my interest in public history. So, it really is mainly about sharing with the public. . . My goal was always that this is for the public.

Interviewee 4 described working on a project that linked qualitative data to historic buildings as well, and he also worked on a project concerning the history of landscape change in designated neighborhoods. He specified that not only were his projects designed for the public but that the priority for targeting that audience was more important than furthering scholarly research:

All these projects were designed as public projects. They're not academic—the overarching goal was not to further academic research but to provide research tools for [the] general public.

Interviewee 16 shared the goal of directing some of his work toward the general public rather than for other researchers. Interviewee 16 has a career as a professor and author of history and digital humanities, and he related his desire to share his knowledge as an expert in his field with members of the general public:

I decided that I would just see if I couldn't share that expert knowledge with nonexpert learners.

Interviewee 13 described how his work on a project that spatialized qualitative, textual data in addition to quantitative data contributed to the creation of a digital archive that was designed to be useful for both the general public as well as academic researchers:

My work . . . contributed to, or helped with, this collaborative group [to] create a set of digital resources that basically makes all of these maps and the underlying data behind them available to the public and to scholars and so forth. So that's what [the project] is. It creates this publicly oriented, digital archive of these resources.

Interviewee 14, whose research covers energy as a social issue and public acceptance of renewable energy technology, also described viewing his work as being intended for both types of audiences, public and academic:

My job, I saw, was to alert the rest of the community—and I think of the community in the broadest sense, the academy but certainly the lay people as well as the sophisticated experimental types. So, my job was really to bring this up, to formulate it in a certain way, to make it attractive in terms of the way it was presented and where it was published.

His comments on presenting his research in an “attractive way” points to the difference in imperatives of projects having both the general public as well as academics as the intended audience. Interviewee 18 also commented on the influence that designing for a public audience makes on the presentation of a project's content:

They like pretty maps, they like aesthetically pleasing maps, so I think that's your first kind of pull into the project, but then once you get them in there, you have to quickly tell

them something and be prepared that that might be the only story they get, a quick minute or couple-minute interaction.

When the end product is intended for the general public, there is a different expectation for how to present the data and how the user will interact with it (Dransch, 2000; Martin, 2014). The preceding quotation from Interviewee 18 indicates that there is also pressure to present it in such a way that a user will be interested enough to engage further. While Interviewee 18 revealed his strategy was to design maps that could quickly engage the audience and draw them in further to explore more of the data available through the map, Interviewee 8 stated that his response was to move away from, though not abandon, mapping due to the challenges presented in conveying a large amount of information through a map interface:

We know that with that many stories and with a map that's as cluttered as ours is, a better way to engage people when they go to either the website or the app is to show them some content.

One of the aspects of visualizing spatial data is that locations are typically denoted by pins (or other symbols) on a map. As Interviewee 8 points out, this becomes problematic when there are many points, especially when they are close together—the map becomes cluttered. In cases where the public is the intended audience, a cluttered map could cause the project to fail to engage the intended audience.

Interviewee 10 discussed how she employed multiple modes of presentation with her project to engage the public, both through in situ public interaction as well as online access to a map-based visualization:

[The project]'s not just a website. It's also in location, so on the streets of [the city] are signs that have the [project] logo on the telephone number, and then when you call that number you hear a story of the spot that you're standing in.

Interviewee 10 had designed her project based on a similar project that had been done in a different city. Before beginning her project, she had in mind that the qualitative data of personal experiences would be shared as audio stories in various physical locations around her city, with the point being to make site-specific history available to the public in an engaging way. The project also invited participation from the general public, which was accomplished by providing a phone number for listeners to call to share their own site-specific stories, whether for the same site or for a different site in the city. Not only was this qualitative data made available to the local public through audio recordings in physical locations, but it was also made available digitally to the global public through a website:

We decided to do the website because we thought it would give more people more access to it.

This digital access included providing the stories as text to increase accessibility:

For the listener, if they're hard of hearing, that's why we have the transcript up.

Public interaction via story submittal was also available through the website. Along with the onsite signage and online map, the stories have also been made available as walking tours. In addition to the multiple modes of presentation for the public, Interviewee 10 also planned to author a book describing how to recreate such a project to share her experiences developing this place-based project with other researchers.

Interviewee 21 described how a tool her team had developed was intended for use by local policy makers, but they were surprised to find that other groups, including journalists, a

state-level agency, and a research institution, were also using it. Granting public access to this tool resulted in others finding a broader range of application for their data and research.

4.1.2 Stories Past and Present

Some projects included accounts from the past and others from the present. At least one interviewee (Interviewee 10) described a project that shared contemporary stories, while multiple other interviewees, especially those in history, described projects that shared stories from years past. Whether the original storytellers were from the past or present, interviewees were driven to share these stories of human experience. Interviewees who spoke with living individuals generally worked with qualitative data, as their data were collected via verbal first-person narratives that were audio-recorded and typically transcribed. Interviewees who were focused on telling stories from the past used various types of data, such as reports, maps, shipping logs, newspaper articles, and diary entries. While some of these data were qualitative, much of them were quantitative. Telling stories from quantitative data was a considerably different experience from sharing stories that were already in narrative form.

4.1.3 Stories from Qualitative Data

Interviewee 20, whose projects have included multiple digital maps used to communicate stories, communicated that including qualitative data is an important factor in his team's mapping projects. He referred to "original evidence" in the form of qualitative text, which he implied held great value for his team's projects. He stated that their strategy for storytelling through digital maps emphasizes inclusion of as much of those data as possible:

One thing we do is we just show the original evidence in a number of cases . . . a big strategy is to include as much of that qualitative text as we can.

Interviewee 4 worked with volunteers to gather their views surrounding historical landscape change in their neighborhoods. After being presented with information “to encourage them to think about the place in the context of changes in the built and natural environments,” these volunteers took photos of places they felt held significance in their communities and recorded short narratives explaining why they chose those places, which were referred to as “photonarratives.” This technique of combining audio descriptions with visual depictions provides an increased level of sensory input, conveying more information about the sense of place (Barriage & Hicks, 2020; Bost & Wingenbach, 2018; Lewinson, 2015; Nykiforuk et al., 2011). This combination of qualitative data was the main vehicle for storytelling in that project.

Interviewee 10 also worked with volunteers to gather stories to represent the contemporary human experience of people of various demographics in her community, especially those in marginalized populations. She describes recording firsthand accounts from the original storytellers for her project:

We would take the person to the spot that they were talking about, they would talk about it there, and they would describe what they see. . . . You're hearing a story really, literally from that person, and you're standing in that exact same spot that they stood.

It is likely that being in the place where the story originally occurred evoked a stronger or more detailed recollection from the participants, which may have helped the data collector to better understand the unspoken as well as spoken aspects of the story by having a more immersive experience.

Interviewee 20 described his feelings about including qualitative data in a particular project focused on sharing experiences of enslaved people who had been forced to move from

one place to another. His comments demonstrate the importance that firsthand accounts hold when sharing stories of human experience:

We thought of the qualitative experience of people who experienced forced migration, who were bought and traded and sold in the American slave trade, that that's not something we could not have on the map and feel like it was remotely a success.

4.1.4 Stories from Quantitative Data

For interviewees who had large amounts of quantitative data, storytelling emerged as a preferred technique for engaging the public with their data. This technique was employed with the intention of making quantitative data on topics such as gerrymandering and redlining more impactful and meaningful.

Interviewee 16, a historian, was familiar with working with qualitative data as both the input and output of his research endeavors. His comment on the challenge of creating qualitative output from quantitative input demonstrates the difficulty inherent in telling the stories embedded in quantitative data:

The big challenge for me is to turn [quantitative] data into qualitative information. . . . That's what I'm working on, is trying to find ways to see complex patterns in space, and then translate them back into words.

Interviewee 13 was another historian whose work made use of both qualitative and quantitative data. He indicated that his purpose in working with quantitative data (via a relational database) was to allow him to use the information contained within it to tell stories:

I don't know how to develop a relational database, for example, that can store a bunch of information, but then also allow you to extract information to be able to tell stories.

Although he acknowledged lacking the skills to create such a database, Interviewee 13 sought out others who were able to fill in such gaps through collaboration.

Interviewee 21 discussed working on a primarily quantitative project to create an online mapping tool. She related that the tool was intended to be used by policy makers to make more informed decisions regarding housing needs in the community. Although she did not emphasize a personal goal of storytelling for the project, she found that there were others, such as journalists, who were writing stories from the quantitative data that was made more accessible through the tool she and her team created, indicating that quantitative data do contain stories, but it takes intentional effort to find and tell those stories:

The tool was intended to be used by elected officials, so they understand the community housing needs within their districts . . . then we found that there are other users that we hadn't necessarily anticipated who have used the tool. So local journalists, for example, have used the tool, just in writing about stories about equity and community development.

While most interviewees did work with quantitative data in some manner, not all of them were directly attempting to draw stories from them. A common goal among interviewees was the need to combine quantitative and qualitative data in a harmonious way to give a clearer presentation of the story being told.

4.1.5 Stories from Combining Quantitative and Qualitative Data

Few projects were exclusively quantitative or qualitative—a key issue was in combining these two types of data to tell a cohesive story. Some interviewees had more quantitative or GIS-focused backgrounds, while others had more qualitative backgrounds in the humanities and social sciences. Interviewees with quantitative backgrounds noted that without the appropriate qualitative information, they would have an incomplete picture.

Interviewees who attempted to use quantitative data to tell stories experienced some difficulty in doing so. They expressed that there is value to be gained in having qualitative data to supplement their quantitative data. Interviewee 18, who works as a GIS project manager and analyst for a digital humanities lab, explained that combining qualitative data with quantitative data in a spatial context is driven by the desire to tell stories. While it is common for those with similar backgrounds in fields such as GIS to be more comfortable or familiar with handling quantitative data, Interviewee 18 felt that using quantitative data alone was insufficient to tell a full story. He stated that their goal is to represent people and their experiences and to try to avoid reducing them down to numbers, and his team has chosen to combine qualitative and quantitative data as a method to achieve that goal:

Presenting qualitative and quantitative data is a huge part of what we do, and we try to combine both of those into each atlas map, because it's a big part of telling the full story.

People aren't just numbers; they actually have stories and more deep narratives to tell.

Interviewee 15, whose background is in geography and GIS, echoed this sentiment when he suggested that simply using quantitative data alone was insufficient when seeking a deeper understanding of human experience:

There are richer ways of understanding the human experience . . . than just quantitative information.

He elaborated on this opinion when describing his graduate studies:

My master's thesis was largely driven by the idea that geocomputational approaches towards visualization, really [what you] might call geovisualization, largely relied on quantitative data to understand issues of place and place belonging and place

experience, and I found that to be kind of problematic because of the very personal way that people experience place and interact with their environments.

After completing his master's thesis, Interviewee 15 observed such a problem firsthand while gathering data for a project as a PhD student. He found himself being met with personal stories of how subjects' lives were affected by their environments during the process of collecting geographic information from middle school students in underprivileged areas concerning their daily journeys. He recounted how his team was emotionally affected by hearing the story of one of these students consistently taking a detour on her route to school to avoid passing by the location of a drug dealer. He illustrated that stories can be embedded in geographic data, stating such quantitative data can be imbued with qualitative data (MacEachren, 1995), which is not evident when the information is only presented as coordinates on a map without additional context:

It does speak to the positionalities and the subjectivities and all this stuff that can go into a web map that you don't even think about. It was a very quantitative exercise, just mapping a journey, x and y coordinates, but it's imbued with all this subjective and personal information.

Interviewee 20 spoke about a project with which he was involved that used mostly quantitative information but also included some qualitative data. A primary source of data was quantitative surveys that had qualitative data associated with them in the form of area descriptions, where surveyors entered their comments and descriptions of the areas that were being evaluated. He stated that these qualitative data reveal insight that might be overlooked when focusing on the quantitative data:

[The area description] gets under the surface of what's not, might not, be evident in the quantitative data that they collected alone.

These comments on using both types of data give the impression that quantitative data can be useful for building a framework on which qualitative data can be added to fill in gaps to tell a more complete story.

Although all interviewees worked with qualitative data, most, if not all, also worked with quantitative data. Determining how to combine qualitative and quantitative data most effectively to tell a story was a major element of their work, but they also faced the challenge of how best to incorporate the spatial aspect of these stories. As Interviewee 13 stated, all three components must be combined in the end product:

That's what [this project] is. . . . It puts the geospatial data together with the quantitative data and the qualitative textual comments.

4.1.6 Stories and Mapping

Interviewee 20, whose work was in digital scholarship, noted that because of the technological abilities available with digital mapping, qualitative data such as text can be linked to the map in ways that are not possible in print form:

One thing that's really nice about digital maps, as opposed to print maps, is that we have a lot more opportunity to include text within them than you could do in a print map.

Often, the data being used to communicate a story, whether quantitative or qualitative, would be linked to points on a map. Interviewee 20 described using the technique of linking data to points on a map to present the stories in a spatial context:

We then georeferenced those, trying to place those experiences as best we could in space, and placed simple points where you can click on them, either on a timeline or on the map, and read those experiences.

Some interviewees were able to find ways of combining different types of qualitative data, such as audio, visual, and textual, in such a way as to be represented by a single point. Interviewee 4, whose project used “photonarratives” or “photonarrations” (as described in Section 4.1.3), disclosed that he employed this technique of linking audio files and photographs to points on the map:

People can access most photonarrations by map markers, so that they can click on those and then the MP4 file will pop up, and they can play those, listen to those.

However, regardless of the amount or type of data represented by a point, there were still some challenges with having a large number of points on the map itself (see comments from Interviewee 8 in Section 4.1.1). Both Interviewee 4 and Interviewee 20 experienced challenges associated with linking qualitative data to points on a map, as did many interviewees, and Interviewee 17 succinctly pointed out this inherent difficulty:

If you're gathering location information about people that way [qualitatively], you definitely have a challenge in translating that into actual points on a map.

Interviewee 18 mentioned that there are some publications doing storytelling work through mapping, and though these publications are not scholarly sources, the quality and innovation seen in their work influences how he and his team approach their own projects in a university setting:

There are some great digital mapping projects, places like The New York Times and The Washington Post and National Geographic. I would say they're paving the way for

mapping and graphics, as far as storytelling, in my opinion. We constantly admire their work and draw inspiration from that.

Interviewee 8 conveyed his thoughts on combining stories with a map after working on a project that involved collecting location information from human subjects. The data gathered from participants in that project revealed that their perception of space was based on their familiarity with routes they frequently took between places of personal importance, such as from home to work or school. He stated that although mapping still plays an important role, they have found it is not critical to sharing the stories in a way that effectively engages a public audience. He stated that while the map is still a key part of the project, due to the cluttered visual presentation that results from having large numbers of points in a small area, they have deemphasized the map:

How important is mapping to sharing place-based narratives? It's not necessarily critical. So, what our project has ended up doing is decentering and deemphasizing the map, though it's still a key part of the project.

It is interesting that Interviewee 8 concludes that mapping is “not necessarily critical” for sharing stories linked to specific locations. When describing events or experiences tied to particular places, one expectation would be that a map would add clarity and context. However, this is not always the case.

Interviewee 13 indicated that one reason mapping is not so simple is that there is a subjective, qualitative aspect to the thought process that goes into mapping (Kitchin & Dodge, 2007). Although he is describing others' processes of mapping, not his own, his comment indicates that mapping is a subjective process and that maps are products of the mapmakers'

opinions and judgements about a place; there is more to mapping than simply presenting data about a space:

Essentially, what we did was illustrated that this is not merely a process of mapping. It's also a process of evaluating, creating judgements, creating qualitative judgements.

As interviewees were not sharing their own stories but rather those of others, creating qualitative judgements came into play.

4.1.7 Telling Others' Stories

The task of sharing others' stories required interviewees to make decisions that would affect the way the stories were viewed and understood. Some interviewees were able to hear stories from the people who experienced them firsthand, sometimes even in the locations where the stories took place, while others were using data from the past and were therefore unable to speak with the people whose stories they were telling. Those working with living subjects may have been better situated to preserve the voices of the original storytellers, as those working with written accounts or even quantitative data from the past were endeavoring to create a narrative without the ability to consult a particular story owner. Interviewee 10 recorded the voices of the original storytellers in the location where the stories took place and used those audio files to share the stories with the public, while Interviewee 13 was working with mostly quantitative data to try to weave together a story showing the effects of unjust practices in the housing industry that had taken place over several years in the past. These two interviewees highlight the difference in researchers' ability to consult story owners depending on the age and nature of their data. Choosing how to present the stories plays a large part in how they are received by the audience.

Interviewee 20 implies that storytelling is accomplished through the researcher's involvement in presenting the information, as opposed to creating an archival project. He explained that his team intentionally decides which part of the results are displayed first according to their understanding of what is most important or relevant, a process he referred to as "curating":

This is the difference between a project that's straight up archival and what we try and do, because we curate the results.

This implication is also evident in comments from Interviewee 10. Although her project is based on sharing stories, she did not discuss the concept of storytelling directly. However, she did indicate that she is aware of the power she holds in shaping how stories are viewed in her role as a teller of others' stories, by directing the presentation of those stories to emphasize certain voices:

I wanted to foreground the Black experience, but also the Black narrator, who gets subsumed always in the historical retellings.

The way that the researcher presents the story can have the effect of changing the story as originally told; it, in essence, becomes a new story. Interviewee 10 describes a strategy of seeking underrepresented and minority voices to tell stories of injustice in her city (further discussed in Section 4.1.8). Her intent is to emphasize these voices to help them be heard, and she described an experience when she was working on publishing an article in this manner. An editor questioned why the names of some people in the story were deemphasized (only referred to in footnotes) as opposed to the main narrator of the story, whose name was featured in the main text. Her reply reinforced her stance of choosing to use her position to amplify certain voices and ultimately to influence the way the audience sees the story:

The White people that were trying to get me to take down the signs are named in the footnotes, . . . and so they said, “Why isn’t this in the publication itself? It’s pretty obvious that people can find that person.” And I was like, “It’s because I don’t want them to be the main speaker of the story; I want the Black narrator to be the main speaker.”

Her story alludes to the fact that a single event can be experienced by multiple people, and each person would tell the story in their own way. Each person’s experience of the same event would be affected by their own past, culture, opinions, and life, and this personal perspective will color their understanding and perception of what transpired during the event. Not only is a story influenced by the perspective of the individual who experienced it but also by the secondhand storyteller, the researcher. Interviewee 8 recognized this happening in his own project while acknowledging that the original storytellers (locals in the city of Kisumu, Kenya) would not have expressed their experiences in the manner in which his project presented them:

The concept of doing place-based history is admittedly something that is being imposed on this project based on our interest, and it would not necessarily be the first way that a Kenyan would conceive of history.

While a given project may not fully represent the point of view or way of thinking of its participants or the full context of the stories, doing so may not be the purpose of the project. Regardless, this is a possible effect when telling others’ stories, as evidenced in further comments from Interviewee 8 on this subject:

History is not necessarily about where something is, but how it connects to a people’s shared experience, and so they would view it through an ethnic lens, and how it connects

maybe to families or religion, perhaps. It's not necessarily the way that people traditionally would have conceived of history.

His description suggests that the culture of his research participants could influence them to view their history more collectively, as a shared experience rather than just individually. It also suggests that certain research approaches, such as forcing space into stories, can diminish important facets of human experience. This may be a likely possibility when working with spatialized qualitative data, as Interviewee 20 remarked that maps hold appeal for showing the experiences of large groups of people. He explained that they are capable of presenting a “linear narrative” to represent the experiences of many people:

Maps are really attractive because they can represent something of the experiences of huge number of people in a linear narrative.

While the creation of a linear narrative can be an effective and useful way to share stories of human experience through storytelling, it may also run the risk of giving an incomplete or even inaccurate understanding of the experiences of the specific communities or people groups it purports to represent.

While all of these interviewees were using data to share stories of human experience, they were not sharing their own stories, but rather the stories of others. As described in Section 4.1.2, some of these stories were from the past and others were from living participants. Especially for those working with contemporary accounts, interviewees whose data included personal stories had the benefit of having events recounted by those who experienced them, but that did not guarantee that those stories would always be perfectly relayed. When telling others' stories, researchers curate the presentation of the data to tell a story of their own, which may not be quite the same story that their participants told, which could either be intentional or

unintentional. Nevertheless, interviewees stressed the importance of telling these stories, as they were often motivated by the desire to effect positive change through education on social or environmental issues of injustice or inequality.

4.1.8 Stories for Social & Environmental Justice

Many interviewees talked about using their data to share stories of human experience. These stories were often shared with the intention of bringing attention to instances and systems of injustice. Interviewees used the words “inequality” and “justice” (social and environmental) when talking about these types of projects. *Social justice* in this thesis can be understood to have the meaning described by Kathleen Maas Weigert in the International Encyclopedia of the Social & Behavioral Sciences (2015, p. 397):

Social justice is seen as a unique type of justice characterized by a focus on the ‘common good’ and the individual’s obligation and right to make a contribution to that (hence, sometimes called ‘contributive’ justice) while acknowledging the role of the state and civil society to remove barriers that prevent individuals from so doing.

Interviewee 19 described her research as being focused on environmental justice as it relates to questions of access to natural resources, especially water:

That research question was if there were environmental injustices or inequities in access to natural resources such as recreational areas. That is one of the most explicit ways where I’ve looked at space and place, in terms of environmental justice. . . . My research revolves around those types of questions about water access and water justice.

Interviewee 21 spearheaded an effort to create a mapping tool centered on housing needs in her local area. She stated that one of the goals of her project was to provide information that would assist in benefitting under-resourced neighborhoods:

One of our goals in using the mapping tool is to think about various strategies for building affordable housing but also maintaining community character, specifically for under-resourced neighborhoods that are under development pressure and gentrification pressure.

Interviewee 20 described how his team designed their project to draw attention to the portion of their data that most clearly showed issues of race and class: the area descriptions from redlining surveys. He indicated that this kind of information is the most important not just to the researchers but also to the audience:

We put [area descriptions] first and foremost, because that's often the area that will give you the most insights into the thought process of the assessor and particularly along issues of race and class that would be really explicit about these things, and so we put that up front, because we think that's the most important. . . . I think it's the first thing most people look at.

Interviewee 10 spoke about social justice at greater length than other interviewees. Throughout her interview, she disclosed that she felt a strong motivation to share the stories and experiences of people who have been marginalized in some way by society, and she revealed that her project was intended to contribute to social justice:

For me there's this very, very strong social justice aspect to [the project].

She explained that intentionally including stories from underrepresented voices was very important to her personally. While those were not the only experiences included in her project, as the overall goal was to share stories connected to specific locations in the downtown area of her city, she did stipulate a minimum requirement for inclusion of these voices because they are so integral to the purpose of her project:

Another thing that's really important to me is the social justice part, so I ask for one-third of the stories to be pulled from historically underrepresented people. . . . I just really want stories from people who don't usually get heard to be included in the project.

When giving an example of how her project includes such stories, Interviewee 10 explained that she endeavored to effect meaningful change in her city by educating the majority population (White, born in the United States) about the value that a particular minority of the population (non-White, immigrant) adds to their community and to help them see what it is like to be part of that minority. As mentioned in Section 4.1.1, one of the ways she did this was by offering walking tours of the city, both as self-guided tours and led by a tour guide, that describe the experiences of different immigrant groups. She shared that her project has a message, which she indicated was based on her personal feelings and beliefs surrounding the difficult experiences of historically underrepresented people:

One of the tours that we're doing is about Hmong immigration, and the other one is about three waves of immigration to [this city]. Because I am who I am, the message of both of these [is] about thinking about immigrants and what they're coming into and what they can bring to a community that is predominantly White.

When asked how her work contributes to effecting social justice, Interviewee 10 reinforced the impression that spreading awareness was her main goal. She described her willingness to take any opportunity to discuss the project:

I just take any opportunity to speak about it. . . . If somebody asks me to do something for [the project], I say yes.

Although she stated social justice was important to her and a strong motivator behind the work she did for the project, she also mentioned that she does not typically use the term “social justice” when she is given the opportunity to speak about her work:

Sometimes when I'm giving a talk, I'll often speak about the fact that there's a social justice bent to it. I don't use those words when I'm giving a talk generally.

While she did not elaborate on her reasons for not using those words, it seems to suggest that the phrase “social justice” may not resonate with her audience as she would intend. She did not define the phrase herself, but Weigert (2015) noted that social justice can be confused with *distributive justice*, which typically refers to Rawls's (1971) theory advocating for a more equal distribution of “social goods” (including wealth), as opposed to a view of social justice as *contributive justice*, as defined at the beginning of this section.

Interviewee 18 discussed working on multiple projects that addressed injustice, mostly from the past. He gave an example from a project that addressed the forced migration of enslaved people, describing how his team used stories in addition to the quantitative and spatial data to help humanize their data:

We do show immigrations and outmigrations of people being sold and bought in the continental slave trade. So, what we do, we provide some narratives in those places, actual letters and people telling their stories of being sold, and where they were moved to.

Other interviewees have also taken this approach of making personal stories available alongside the quantitative and spatial data to create an opportunity for the audience to connect with the feelings expressed in those stories. Interviewee 20 described some of the feelings associated with personal accounts of injustice that he and his team strove to convey in one of their projects:

We needed that qualitative experience because the spatial dimension tells you something about where people were purchased and where they were bought or moved to, but it doesn't tell you anything about the terror of being up on the auction block, or the pain of being, the trauma of being separated from friends and family. So, we needed that to be a part of this map.

These comments from both Interviewee 18 and Interviewee 20 demonstrate a desire to communicate not just the stories but the emotion behind them such that the audience can feel the pain of the injustice and suffering themselves. Interviewee 18, whose work employed large amounts of quantitative data, noted that humanizing data is particularly difficult when addressing subjects of injustice and inequality, but his comments demonstrate that it is an important motivator in this kind of work:

I think it's a challenge with each new project, and I don't know if we've necessarily cracked the vault on humanizing people in our projects. I think it's very tough, especially when you talk about hard things like redlining and inequality and slavery. And you are presenting quantitative data to make an argument. I don't think we've figured that out. I don't think anybody has quite figured that out. It's really hard to [put the] human [experience] back into that, and not just show people as numbers and as symbols on a page.

His statements also address the fact that this challenge is one that has not been completely resolved, an observation that other interviewees have made as well, but they have nevertheless been working to accomplish this goal.

By telling stories of injustice, especially through communicating the feelings embodied in those stories, interviewees endeavor to effect positive social change. In discussing this topic, an

interesting distinction came up concerning the idea of structural systems of injustice versus individual stories of injustice.

4.1.8.1 Structural vs. Individual Stories

Integrating maps into the process of telling stories of injustice helps draw attention to the fact that the stories are not just isolated experiences, although those are very important; they are part of a pattern of injustice, connected to places of importance in local communities, and can reveal structural or systemic issues. Providing a visual representation of the frequency of such occurrences can help the audience to see these patterns of injustice. Showing these patterns spatially could also help ground the story to make it more impactful to the audience.

Interviewee 10 commented that stories can be seen as “one-off” and explained that by using GIS, individual stories that show issues of gentrification could be expanded to reveal larger patterns of inequality by showing the data in a spatial context:

You can see gentrification through the stories, but it's just one-off, and you can intuit gentrification. But if we did this larger study, then we could see that this is just a person that's experiencing something in a larger pattern, and that's how we would use GIS, to show the larger patterns of gentrification in this neighborhood.

These comments also hint at the perception of GIS as a specifically quantitative tool, but regardless of whether GIS is used, maps are conducive for presenting both quantitative and qualitative data together in a spatial context.

Interviewee 18 described how even though their projects attempt to humanize data on topics of inequality and injustice by sharing individual accounts of those who experienced injustice, they also attempt to “extrapolate” that to represent the experiences of much larger numbers of people who were also affected by the same system of injustice:

We tried to add in a person-by-person example and say, kind of, extrapolate that by thousands of people. I think we still grapple with if we did that successfully, and I think we try to figure out how do we do that with every project.

Interviewee 20 emphasized the importance of personal experiences, saying, “It always comes back to people to me,” but he also pointed out the difference between individual and structural perspectives, stating that his projects and the field of history in general have been more aligned with sharing the structural perspective:

The work that we’ve been doing is in keeping with much of the work, or at least the directions I see within the field of history, which is a movement towards thinking more about historical change from a structural perspective and less of a focus on kind of individual cultural history.

Most interviewees, including Interviewee 20, have expressed the importance of individual narratives in storytelling. However, this statement suggests that highlighting the structural perspective of injustice is preferable to simply presenting the individual perspectives.

As described in Section 4.1.8, many interviewees were sharing stories for social justice purposes; therefore, they may find that informing audiences about structural injustice is useful because structures can be changed while individual experiences that have already occurred cannot be changed. However, as interviewees have made clear, individual stories are still very important and effective for communicating feeling and affect, which can elicit a stronger connection from the audience, demonstrating that it is beneficial to present both the structural context and individual experiences. It seems that structural issues are generally identified as such when patterns of injustice are observed, indicating that large amounts of data are necessary to establish them. Large amounts of data are typically quantitative, whereas qualitative data,

including the personal accounts and stories that are so valuable, tend to be associated with the individual perspective of injustice. Utilizing a spatial visualization such as a map provides a way to present the qualitative with the quantitative and display the structural and individual perspectives of injustice simultaneously.

4.2 How is Qualitative Data Spatialized?

4.2.1 Data Strategies

Interviewees employed many strategies for working with their data. This section will discuss interviewees' experiences 1) working with location data, 2) addressing the obstacle of qualitative data in analog form, and 3) converting qualitative data into quantitative data.

4.2.1.1 Location Data (Geographic Coordinates)

All interviewees worked with data that were tied to location in some way. The connection to location varied across interviewees and projects, with some interviewees' projects dealing with location in such a way that latitude and longitude coordinates were not required. However, many interviewees worked on projects where latitude and longitude coordinates were collected.

4.2.1.1.1 General Location Assignment

Interviewees 1 and 2 were directly requested to participate in interviews based on their work in participatory modeling. However, they explained that the models they created were not spatially explicit; therefore, they did not work with coordinates. Interviewee 2 explained that her work was location-based but not spatially disaggregated:

System dynamics is not a spatially disaggregated modeling technique. . . . It's not like agent-based modeling or spatial types of modeling where you can represent a different value for each point on the landscape. So, you cannot do that using system dynamics modeling. However, it is entirely possible to build a system dynamics model depicting a specific spatial location. . . . You could very well build a model of Long Beach, California, a specific location, but it wouldn't be spatially disaggregated, per se.

Interviewee 1 explained that his research team would create a model of the system dynamics within a given space, as opposed to mapping or spatializing the dynamics of a system in a particular area:

We give them the space and we ask them to model, and it really is qualitatively done, what's happening in that space. . . . Rarely, or in fact, never, have we gone the other way where then we take that model and then try to make it spatialized.

Although Interviewees 1 and 2 did not typically work with spatial data, Interviewee 2 did have experience doing so. Her experience led her to conclude that there were instances where spatializing would not make sense based on the question that is being asked, especially because of the time and effort involved in such an endeavor:

Building a spatially explicit model is a huge effort. . . . It's really something that should only be done if it's really necessary to answer the question that you're asking. If you can get an answer to your problem with a simpler approach, something that's not as time and resource intensive, it's usually better to do that.

Interviewee 9 performed similar work for her dissertation, which evaluated data from two separate projects. After working on a project that used survey data that were associated with

various locations, she was inspired to collect qualitative interview data in multiple areas and evaluate the data for each area separately:

I analyzed each site separately, and then I looked for patterns across all three sites.

While this type of location analysis was similar to that described by Interviewees 1 and 2, the survey project had location data in the form of geographic coordinates, and although Interviewee 9 was not involved in the data collection portion of that project, she shared that she did spatial analysis using that data:

The survey data includes respondents' latitude and longitude, and I used a program to use that data to figure out what county they were in. And I basically did a county-level analysis.

She also considered how the topology of the space affected whether residents would actually see wind turbines, observing that her participants' opinions on renewable energy were connected more to the visibility of the wind turbines than to the proximity of the turbines.

Interviewee 14, a professor of geography and researcher in renewable energy landscapes, also discussed the visibility of renewable energy sources as compared to that of conventional energy production facilities. He described the spatial aspect of his work as being related to the site-specificity of wind turbines and differences in perception of wind energy compared to other sources of energy based on how visible they were to the public.

4.2.1.1.2 Spatial Data from Published Sources

Interviewee 3, who was directly requested to participate in an interview based on his work with public acceptance of renewable energy in offshore locations, explained that his work does not seek to spatialize qualitative data per se but that qualitative data and quantitative spatial data are evaluated alongside each other. He related that data connected to specific locations were

quantitative and gathered from databases. Qualitative data were gathered from interviews without tying these data to specific locations, although, as in the work described by Interviewees 1 and 2, they were associated with a location:

We occasionally map something, but most of the coordinates, all the coordinates are generally being pulled from various databases and then we statistically analyze different datasets together. I haven't really mapped out qualitative data.

Interviewee 5 expressed interest in spatializing qualitative data but clarified that he himself had not done so. He stated that, like Interviewee 3, he relied on databases for spatial data, which were quantitative in nature:

I haven't been doing qualitative. What I have done is I've looked at census data and other spatial data, like the car registry [and] voting registry.

Interviewee 11, a GIS analyst for a renewable energy company, commented that most of the spatial data with which she has worked was primarily drawn from similar sources, particularly census data; however, she also mentioned that original qualitative data were also collected from interviews. She explained that data from interviews were typically analyzed using software that helped quantify the results, which is discussed further in Section 4.2.1.3.

Interviewee 12, a recent graduate with a doctoral degree in sociology and a background in GIS, described a project she had recently begun: an analysis of news media documentation about two specific neighborhoods in the same city. She stated that she was using census data for the project, explaining that she was seeking to identify how spatial patterns contributed to media representation of the neighborhoods:

I am grounding my analysis about how race is discussed in the context of gentrification in a spatial analysis of the demographic changes that both of the neighborhoods had

experienced in the recent past and the larger context of what was happening in the city, and so using those spatial patterns to understand then how the two neighborhoods were being represented and why we see differences in how the two were being presented.

Interviewee 21 developed an online tool to help policymakers in her local area make more informed decisions regarding affordable housing. Her tool also relied primarily on published sources of data:

We've identified the kinds of datapoints that we wanted to include. We then identified the sources for where to get that data. We've been fortunate to have very good open data-sharing arrangements with a number of different entities, so we can continually update that data.

4.2.1.1.3 Manual Assignment of Location Data

Interviewee 17 described talking with survey participants to gather location information that would enable them to map the locations digitally:

We've just asked them where they were, and then we got their address, an address that way, or some landmark, and then we would just map it manually. Not manually, but using software. But each one, a person had to sit there and be like, "Now, where is this place?" to create the digital data from it that way.

He went on to say that they would be able to collect such data more directly from the participants in an upcoming project:

We basically have someone interact with a tablet or a laptop computer, show them maps, and they can point to locations and we can capture their location data that way.

He also worked on a project to visualize narrative data, geolocating locations that were described by participants:

People would tell us the important places they go throughout their daily lives, and we would map them.

Interviewee 10 obtained location information in a similar manner. She spatialized qualitative data in the form of location-based stories collected from both face-to-face interactions and preexisting oral history records. She described traveling to the location in which a story took place to record a story (as discussed in Section 4.1.3), and for records from an oral history archive, stories were selected based on whether they identified locations that could be georeferenced:

The first iteration of interviews, we literally did them on location. . . . We also have stories in this project that are from the oral history program. . . . We went through transcripts and found stories that had locations. Then we took those stories out of the oral histories, and then put them on location. So that's a different method.

Like many other interviewees, she relied upon students to input the locations for the digital map, which in her case, was a modified Google Map.

Interviewee 19 described working with survey data that were associated with residential addresses as well as parcel numbers. Because the surveys were mailed out, the location data were collected prior to receiving the survey data. However, she described those addresses as having to be mapped manually rather than being imported from published sources:

I worked on a project where they had collected survey data, household survey data, that included the addresses and parcel numbers of the households who had participated in the survey. . . . I worked with some collaborators who mapped how physically far away that those households were from their nearest waterway, plotted those on a map.

She went on to say that she had worked with follow up results from a shorter survey, which allowed her to compare responses from laypeople and elected officials. She explained that she used zip codes to analyze those responses spatially but did not map them:

I ordered them by zip code, and so I was matching space-to-space.

Interviewee 8 worked on two different projects that spatialized qualitative data. He referred to “pins on a map” for each project. For the first project, he mentioned collecting addresses, and for the second project, he described finding locations on a satellite map to determine their coordinates. The first project, which utilized addresses, was based in the United States, in the same region where Interviewee 8 lived. The second project, which relied upon the research team (usually students) to perform geolocation using a satellite map, was based in Kenya. According to Interviewee 8, the area in which project data were collected lacked street addresses. While location information was collected, it was not in a format that was conducive to digital spatialization:

For establishing where something is, you have to kind of know, you have to be able to identify it, usually by looking at a map. Usually a satellite map, and you have to zoom down to where you can identify where it is in relation in other places that you know. . . . Sometimes it's been, actually, students and even myself and my colleague, who've actually dropped the pin on the map, based on our knowledge of where these places are; even students over in Kenya have not recorded that for us.

While location information was collected, it seems that the way Kenyans conceptualize and communicate where something is differs from the way that many Americans do. Interviewee 8 went on to explain that although his projects were spatial, he did not see them as requiring the level of spatial analysis afforded by GIS.

Interviewee 4 worked on a project that determined location data similarly. His project combined photo and audio qualitative data that were collected through an app called Pixstori, which did not collect location data. Spatial data were assigned manually by the research team, who used Google Maps to look up the location described by the participants to find the associated latitude and longitude of the location. The coordinates were then attributed to the qualitative data via a web-based form:

We had to do that by hand once the MP4 was produced by Pixstori. We had to associate each photo narrative with latitude and longitude. We just used a map; we just used Google Maps to find the place on the map and then that would bring up the latitude and longitude. . . . Every photo narration had a form that was filled out and was then linked to the MP4 file itself.

Interviewee 15, an assistant professor in geography, described his experience combining videos and text with a map interface both to share and collect qualitative data for his master's research:

I took a video of every single neighborhood in the entire city, put it on the map, made it available for anyone to watch, and as the video was playing, just had a little textbox, and asked people to describe the neighborhood they were seeing.

He went on to say that since working on that project, he has focused more on studying how other people are spatializing different kinds of data rather than working with spatial data directly:

Most of my research after that took GIS and its practices as my object of inquiry, so I wasn't actually doing the mapping myself. I was looking at how other people were mapping qualitative data.

He described his doctoral research on that subject, primarily in the area of geospatial information gathered from social media by humanitarian organizations to aid in relief efforts. He found that some data were geotagged automatically, while some location information was determined manually from descriptions or photographs:

Three percent of tweets [posts made via the social media platform Twitter] are geotagged, in the latest numbers that I've seen, but that's still an enormous amount of data. . . . But then there's other ways that people were doing it. Very, very manual, surprisingly manual, people going through and see the names of street corners and then going into the map to find the coordinates for that place.

Interviewee 16 worked on many digital history projects throughout his career, including one that mapped the movements of troops in the 1990s using Adobe Flash software to create the animations. He described the work of another researcher's that was similar to his own—identifying locations in historical records, digitizing the associated information, and mapping that information using geospatial technology:

[A colleague] had gone through all the descriptions of place names in those 127 volumes and turned them into geospatial coordinates, then [another colleague] took those coordinates and mapped them, which students went through and mapped everywhere that the United States Army came into contact with African Americans.

Interviewee 18 described a similar effort:

This atlas was published in 1932, I think, so fairly old. What we did is we cut the binding of the book. We high-resolution scanned every map and visualization in there. We then georeferenced them, and then provided supplemental data behind that.

He indicated that projects developed by his team draw on existing historical sources of data, which are then presented in modernized ways that utilize digital technology:

We try to think of new ways of seeing old data.

Interviewee 20 described another project that obtained location data in the same way, in this case, diary entries:

We've been working for months, maybe longer than that, to georeference and transcribe these particular diaries and we actually did a ton more. I think we did hundreds of them.

Interviewee 13, an urban historian, described the process of finding and spatializing data for a project on redlining. The redlining data consisted of papers as well as maps created from survey results:

The Home Owners' Loan Corporation, the federal agency . . . sent survey information out to scores of cities, more than 200 cities. . . . They combined these survey results, or this kind of data, into both kind of like a paper database and created a series of maps.

He explained that these data were primarily analog and had to be digitized before they could be spatialized, a hurdle he faced for his other projects as well, which is discussed further in Section 4.2.1.2. Digitizing the maps and spatial data was done by creating GIS shapefiles:

We scanned and then we digitized, creating ArcGIS shapefiles, polygon shapefiles of the maps, and then also created these textual and data forms that represented the survey information that these local real estate leaders had created for all of these cities.

These projects described by Interviewees 13, 16, 18, and 20 all involved digitization as part of the overall spatialization effort.

Interviewee 7, a GIS professional involved in selecting potential sites for wind turbines, shared that qualitative data in the forms of legal regulations and newspaper articles were gathered and linked to specific counties, which were then mapped using GIS software:

We monitor trade magazines and social media and any published article on whether or not existing developments are receiving pushback. . . . Then we'll see that certain counties have indicated that they're supportive of wind energy, and we'll map that by county.

He went on to explain that such data were typically categorized, for example, as supportive or not supportive of wind energy development. While in some scenarios, this approach is logical and appropriate, in other scenarios, it may not be an ideal treatment of data.

4.2.1.1.4 Automatic Assignment of Location Data

Interviewee 17, a professor in a department of geography and certified GIS professional, collaborated with other researchers in health behavior analysis. For their work, they sent brief surveys to participants via their mobile phones, which allowed them to capture location data automatically:

With the most recent project, we basically grabbed their location using the GPS embedded in their phones when they answered the survey.

Interviewee 6 described collecting qualitative data as videos using equipment that automatically captured location information:

[My colleague] had developed a technique for taking a camera . . . that would be mounted to a car, but it could be mounted to anything, and it records video, but also coordinate data, where you can offload the video, and you can see a little map of where

you went. . . . We took the audio recording of the interviews and synced them up so you could essentially tie a word to a coordinate.

He went on to clarify that the audio was captured via a separate recorder, so that the audio timestamp had to be correlated with the video timestamp. This was accomplished through the use of a tool developed by another researcher collaborating with them:

[The collaborator] had developed a web interface, where you could match up the timestamp on the [camera] with the timestamp on the recording, and there was an offset. And run this through this web-enabled software and get your coordinates and import them.

Although there were multiple data collection devices, which required data to be synchronized, the effort was eased by a technological resource developed by a collaborative partner.

4.2.1.2 Digitizing Analog Data

Interviewees 13 and 16, who have done extensive work in the area of digital history, spoke about a data challenge common in their field, that of large amounts of analog data. These two interviewees described digitizing analog data to have more flexibility and efficiency when working with such data. Interviewee 16 has been working on digitization efforts for many years, launching a website for a large-scale digitization effort less than a year after the World Wide Web was released to the public in 1993. A few of his comments describing his experience as a historian using computer technology in the 1980s and 1990s are included here:

There was an interesting program, made out at the University of Maryland in the '80s called The Great American History Machine, and . . . it offered maps that you could see on Unix workstations, which were a pain, since I had to go to the engineering school to see what those looked like, and then you could actually map something like the railroad

network, and you could see that. So, back in the very early '90s, I would make these maps remarkably painfully.

As a researcher in the field of history at that time, using a computer was particularly uncommon. Despite the efforts of digital pioneers in the field of history and other humanities, the data sources for historical research remain prevailingly analog, at least according to one historian,

Interviewee 13:

One of the challenges for a historian is this analog to digital conversion. We've got plenty of data, but it's all in paper version.

He mentioned at one point finding a large source of data that was of interest to him, but it was in analog form:

I found a dataset of 130 years' worth of Chicago election results, and it exists basically in analog form.

He went on to describe how the lack of standardized terms and names in that analog dataset limited a researcher's ability to extract data. Digitizing and standardizing that data would give the researcher a more accurate and complete view of the data, and at the time of the interview, Interviewee 13 had just begun a project to do so. He also described how another topic of interest to him, redlining, had been a subject of study for many years in his field, but the previous work had been mostly, if not completely, based on analog data sources. He explained that he and his collaborators took on the task not only of digitizing the analog data but also digitally spatializing the location-based data:

[Redlining] was not something that I had discovered; this has actually been a central topic to the work of urban historians for the last 25, 30 years. It had been done textually

and qualitatively. . . . We digitized, creating ArcGIS shapefiles, polygon shapefiles of the maps, and then also created textual and data forms.

Interviewee 20, the director of a university lab, shared that they freely give data away, and that the data from a redlining project (“HOLC stuff”) has been in high demand because it is a topic of great interest:

We give anything anybody wants away. And the HOLC stuff by far has been the most, would be the biggest demand, [be]cause everybody’s interested in that.

These comments suggest that their digitization efforts were unique and significant contributions to making data on such topics more available, accessible, and analyzable. However, Interviewee 13 also pointed out that it is not typical for researchers in history to have the training and skills necessary for taking advantage of the digitized and spatialized data. Not only that, but the ubiquity of analog data seems to create an environment where thinking about analysis from a computational perspective is unlikely. He remarks that potential exposure to spatial thinking and technology through formal GIS training would not necessarily change that; he considers it to require a different skillset altogether:

That’s a separate set of skills that you’re not going to get in GIS class of how to even recognize an analog dataset that could become a digital dataset.

Interviewee 20 reinforced this idea, communicating that while his team makes their data freely available to anyone who wants it, those that do contact them to request the data already know how to use it—they are not receiving requests from researchers who want to be able to use the data but lack the skills to do so:

If somebody’s capable of using spatial data, we can get it into a format that they can make use of it. I mean, that’s the hard part, right . . . I’d say, particularly, a number of

historians don't have skills, usually, in spatial data, and manipulating it themselves, and that's going to be the problem, not whether they can get it in this format or that format. That's the least of the challenges.

This tendency for historians not to have the necessary skills for working with spatial data is something that Interviewee 13 hoped to alleviate, as he conveyed his desire to share his knowledge of working with digital and spatial data with his colleagues and students.

Interviewee 16, who has seen firsthand how much technology has advanced in making spatialization faster and easier over the last 20+ years, expressed his optimism that working with digitized and spatialized data would become more common among historians as time goes on:

The PDF files do exist, and a lot of this stuff has become so commercialized and inexpensive, and the fact that we all spatialize our lives every time we look at our phone on Google Maps, I think maybe people will see it more.

As discussed in this section, Interviewee 13 was especially aware of the obstacle that analog data created for historians working to spatialize qualitative data, as the analog data must first be digitized to be integrated into any software program, and Interviewees 16 and 20 shared experiences that reinforced this idea. However, for many interviewees, a more common challenge for spatializing qualitative data was in determining how to incorporate qualitative data into a program or application that was designed for quantitative data, which is discussed in Section 4.2.1.3.

4.2.1.3 Converting Qualitative Data to Quantitative Data

It was common for some interviewees to perceive a need to reduce or convert qualitative data into a form of quantitative data to perform analysis on it. Interviewee 16, an early adopter of

digitization and computerization in his work as a historian (discussed in Section 4.2.1.2), said that multiple transformations had to take place with his data for him to accomplish his goals:

Basically all our evidence is qualitative. Then we have to turn it into quantitative. Then we have to map it into analog form, spatialized, and then we have to turn it back into analog language.

Interviewee 2, whose work involves participatory modeling, described her work as interpreting the stories that others tell her so that she can create quantitative representations of those stories, which is in contrast to interviewees who interpreted quantitative data to tell stories (discussed in Section 4.1.4). She presented an example of storytelling in reverse—rather than crafting stories from quantitative data, she analyzed narratives to create quantitative data:

What I end up doing is interpreting people's stories about the system into quantitative relationships that I can then simulate with the model.

Interviewee 1, who also used participatory modeling in his work, described using a similar technique:

We have people think of a place or we give them a picture of the place. We have them model the dynamics that are happening within that place, and we use their qualitative descriptions of what's happening into semiquantitative models called fuzzy cognitive maps.

These comments from Interviewees 1 and 2 indicate that as researchers, they play an interpretive role in translating qualitative data into quantitative or semiquantitative data.

Interviewee 11, a data analyst who uses GIS in her work for a renewable energy company, used a software program to aid in this process. She described how using the software

allowed her to quantitatively analyze qualitative data, indicating that treating the data this way made extracting insights easier:

[The software] really takes all of your qualitative data and makes it quantifiable and kind of easier to digest rather than just a block of text.

Interviewee 14, a professor in a geography department who has studied social acceptance of renewable energy, reported that interviews were gathered as qualitative data for some of his projects, but they were graded using a 5-point scale to perform quantitative analysis:

For some of the studies we've done, we've gone out and we've done interviews with people. And then those interviews were just scaled on a Likert scale, 5-point scale, and we then did our analysis quantitatively on those data.

Interviewee 12, a sociology graduate, described working with a large corpus of articles for her dissertation. She explained that she uses both qualitative and quantitative analysis, as she finds the two methods of analysis to be complementary rather than competing. Although she did perform qualitative analysis, she remarked that “it’s really hard” when there is a large amount of data. She indicated that performing quantitative analysis in tandem with qualitative analysis helps reveal patterns and trends that are not as readily recognizable when working with large amounts of textual data:

Even though I'd been doing qualitative data analysis with those articles, it's really hard to analyze qualitatively, because there's so much data. So I use visuals and also just quantification, to see what's happening with the data.

Interviewee 17, a geography professor who collaborates with other researchers to study how people’s environments influence their health behaviors, commented that he tends to reduce qualitative data such as information from short-response interview questions down to

quantitative data as well, indicating that like Interviewees 11 and 12, he found that quantifying the data made analysis easier:

What we usually end up doing is kind of reducing the qualitative information to some kind of quantitative variable and then analyzing it that way.

However, both he and several other interviewees recognized that qualitative data provided more information than could necessarily be reflected by quantitative data. Although he described himself as a “quantitative researcher,” he found that treating data in this manner did not always communicate the depth of information contained in the original qualitative data:

I'm more of a quantitative researcher. I got into this because I thought, there's so much rich qualitative data here, and the statistics aren't really as useful for analyzing these kinds of data. That's the big challenge, if you want to create a statistical model for these kinds of data, you have to really reduce the qualitative data into some more simplistic numeric form and then apply statistics to it, and that's not always very satisfying.

The comments from these interviewees reveal that creating quantitative representations of qualitative data was one strategy used when spatializing qualitative data. While this strategy may at times be well suited for the researcher's aims, valuable information can be lost when treating data in this way, as acknowledged by multiple interviewees (see Section 4.1.5). Other strategies were also employed by interviewees to better preserve the original format of their qualitative data, often through technological solutions.

4.2.2 Technology Strategies

One of the strategies used by interviewees was leveraging technology to spatialize qualitative data. Three interviewees held positions in GIS (one in academia, Interviewee 18, and two in industry, Interviewees 7 and 11), and other interviewees had experience using GIS,

including Interviewees 6, 9, 15, and 17. Although the original research questions presented to interviewees assumed GIS software would be used for spatialization, many interviewees did not use GIS software but rather custom solutions that often relied upon a web-based mapping technology (e.g., Google Maps), and many interviewees were not the ones performing spatialization tasks. Interviewee 20, who is the director of a university lab that creates custom technological solutions for digital history projects, shared that his team is open to using multiple strategies to accomplish their goal of bringing stories of human experience to the surface in their projects and, as further discussed in Section 4.2.2.1, there is no preexisting solution for addressing each project's individual requirements:

We try any number of techniques to visualize the evidence we have to surface a story that we want to tell and communicate information, an interpretation we want to communicate to our audience. Whether it's qualitative information or quantitative data, in both cases, there's no ready solution.

Interviewee 18, a GIS specialist, expressed the need for creativity when addressing these challenges to successfully tell a coherent story when fusing quantitative, qualitative, and spatial data:

I think you have to be creative in ways that allow your users to follow along with the story, get the quantitative data along with backing that up with narrative and qualitative data, such as journal entries or letters or, for instance, like in the redlining project we did, actual descriptions of neighborhoods, how you pair that along with actual spatial data to give that narrative and give that type of data spatial reference.

Interviewee 17 reported that there was no software solution for analyzing spatialized quantitative and qualitative data at the same time:

There's just no standardization of how to analyze georeferenced qualitative data. There's a lot of standardized ways of analyzing quantitative data with statistics, [and] there's a lot of standardized ways of analyzing text data and interview data, but there's not really any standardized way of doing both at the same time now, as far as I know.

He went on to say that such a functionality was desirable for himself and other researchers. Most interviewees who desired to incorporate these different types of data pursued a custom software solution. This strategy is discussed in Section 4.2.2.1.

4.2.2.1 Custom Software

Many interviewees reported that they needed custom web development for their projects, indicating that there were no off-the-shelf software solutions that would allow them to create the digital, spatialized content that they envisioned. For interviewees with humanities and social science backgrounds, who are not trained in GIS or other spatializing software, outsourcing this element of the project is expected, and because many of the projects were intended to engage a public audience, each project had specific requirements for an interface suitable for a nonexpert audience. Even interviewees trained in GIS turned to customized solutions that would address their unique requirements, as their projects were also typically intended for a public audience and not data analysis alone. Although some interviewees did use GIS software, many used web-based solutions such as Google Maps.

Interviewee 16, who was instrumental in the creation of a digital lab dedicated to digital humanities projects at his university, conveyed that for the many different projects they have done, they have not used preexisting software in a standard way but have had to “adapt” not only software but also spatial thinking to support their goals:

I guess I would say that we've not just adopted geographic or spatialized ways of thinking; we've tried to adapt them. . . . We didn't just adopt them, we've adapted them. We haven't just bought programs out the box and applied them to history, we've had to put them to our uses.

Interviewee 21, an urban historian, sought the expertise of computer science and GIS colleagues at her institution for guidance in developing an online mapping tool. From these conversations as well as exploring similar mapping projects from other institutions, they concluded that standard GIS technology was not suitable for their needs:

We looked at all these different examples and then tried to figure out if there was a way for us to use standard, open-source technology like ArcGIS and ultimately determined that we couldn't do everything we wanted to do with that platform.

Interviewee 15 holds a master's degree in Geographic Information Science, but he found it was not designed to cater to his particular research interests concerning social aspects of space and place. However, driven by his interests and armed with his knowledge of GIS, he developed creative ways of using the software to suit his purposes:

I was like, this technology is far too limited, let me see if I can beat it into saying something or doing something different than what it was meant to do.

Interviewee 18, who holds a master's degree with a focus in Geographical Information Systems and Technologies, recounted a similar experience while in graduate school. He said that he felt his use of GIS was atypical, explaining that he would begin an effort by determining the desired output and then working backward to attain it:

I feel like I used the software in unconventional ways, and thought about data and the software as a tool, and not just clicking a button, but figuring out what would I want the

output to be, and what I want to do before I went through, and then I would figure out how to do that.

He went on to say that his experience using GIS in that way was very well suited for the work he does now with spatialized digital humanities projects. He noted that all of his team's projects are customized:

We custom write all of our projects. . . . So, each project is, I wouldn't say from scratch, but we don't design a project based on a tool; we use a tool based on a project we want to create. . . . Esri's great, I mean, QGIS, CARTO, these are all great, great [GIS] tools, but we like to have the flexibility to create what we envision.

Interviewee 4, a professor in a history department, was involved in a large research initiative that provided him with access to an information technology (IT) team to support his project. He described that while Google Earth was selected as the best software option for the project interface, it still needed to be customized to properly display the project data:

We used Google Earth for our display interface. And so, we wrote our own code so that the data would appear properly in Google Earth display.

Interviewee 13 explained that for his spatialized qualitative data project, GIS is used throughout the workflow but not used for the display interface, which is customized:

I and many of the other collaborators used Esri and ArcGIS for creating the resources. However, we didn't use that for the interface. There was a CARTO database, which runs the [project] site and the geospatial interface. It's customized and offers a little bit more flexibility.

Interviewee 17, a professor of geography and trained GIS professional, communicated that his team chose to custom-build an interface for one of their projects. This particular project used GIS software, but, as stated, it required a customized interface for the visualization:

We built a software interface to visualize this kind of narrative data. . . . It's basically like a custom set of tools for visualizing this kind of narrative activity space data.

Although he is an expert in GIS and, as described in the previous comment, has customized it to suit his purposes of visualizing qualitative data in a spatial context, he acknowledges that GIS is not well suited for that purpose, and therefore, people are “making stuff up” to address this limitation:

What do we do about this, given GIS is the main way of handling and analyzing spatial information, but it doesn't handle qualitative data very well? People are just kind of making stuff up.

Before taking a position as an associate professor in a history department, Interviewee 10 had seen a project sharing location-based stories in another city that inspired her to replicate it. She described contacting the owner of the project and asking to expand it to include her current location, but the owner informed her that it was being closed and she would have to recreate it from scratch. She explained that even though her project has a different name, it looks the same to the end user. However, she took a different approach to the process of geolocating the stories, as the original project was done using “drawn maps,” whereas she incorporated the use of digital mapping technology (Google Maps):

So, in fact, what he did and what I do, even though it looks exactly the same, it's actually different, because the backend is really different. He geolocated on maps, like drawn maps, and I geolocate on a Google Map on my website. His website was like drawn

maps, with pinpoints of the spots that had stories, so he was working with an artist. And I work with a graphic artist that changes the physical map of the Google Maps of [this city].

Her statement that she worked with a graphic artist to customize the map display illustrates her collaboration with an expert in a different discipline. While they did rely on Google Maps, it was still necessary to customize the display. This comment suggests that the use of an application programming interface (API) may offer a greater level of flexibility and customization for displaying spatialized qualitative data than GIS; however, it may be that as her project, as well as many other interviewees' projects, is intended to be published online for use by a public audience, an API may be a more suitable solution than GIS for creating web-based maps.

Interviewee 21 worked to create an online mapping tool serving the policymakers in her area, which was designed to help them make more informed decisions about affordable housing. She revealed that much, but not all, of the data were quantitative in nature; even so, conversations with GIS experts led to the conclusion that GIS software was not well-suited for her purposes and that a custom software solution would be necessary:

So that's when we, after a series of conversations with faculty in our computer science department and in our GIS program, basically determined that we really needed a custom-designed platform, and that's when we went to the [university's computational science center] to design it.

She revealed that to meet her project's technological needs, she turned to resources within her university for expertise outside her field of study: computer/computational science and GIS. The necessity of collaboration and sources of collaborative knowledge-sharing and partnerships are further discussed in Section 4.2.3.

4.2.3 Collaboration Strategies

Collaboration was a topic that arose in at least 10 out of the 21 interviews. This section includes interviewees' discussions of working with other people who have different expertise and skills to their own, whether they did such work or not. The experiences of at least three interviewees (13, 18, 19) indicated that collaboration is an essential factor in creating technological solutions of the scope involved in the participants' projects. Those collaborators, along with two others (Interviewees 9 and 16), also stated that they relied on collaborators to provide supplemental skills when their analysis required a level of expertise beyond their own. Five interviewees (9, 10, 12, 13, 16) spoke positively about collaboration in general, with three of them (9, 13, 16) also recounting specific experiences with collaboration. Four interviewees (10, 17, 19, 20) described collaboration challenges they encountered. At least three interviewees (13, 16, 21) discussed the roles that personal connections and institutional resources played in their collaboration efforts.

4.2.3.1 Essential Collaboration

Many interviewees described working on innovative research projects that would not have been possible without the help of collaborators in other disciplines. This type of collaboration has been termed *essential collaboration* for discussion in this thesis.

Interviewee 19 made a point to state that she intentionally collaborates for all her research. She has a background in sociology with a research focus on water management decision-making. She also discussed her experience with an autoethnography project that is separate from her water management research. These research efforts have benefitted from coordination with other researchers who have different areas of expertise to her own as well as with policymakers and stakeholders. Her statements indicate that she views herself as a bridge

builder, strategically choosing degrees, career opportunities, and research projects that allowed her to foster understanding and knowledge-sharing across disciplines. Because she places such a high importance on this type of work, she not only recognizes the effort required to accomplish it, but is also willing to put forth that effort, taking steps to promote individual ownership among team members and measuring against qualitative research validity criteria for evaluating the effectiveness of her collaborations:

The benefits [to collaborating] are exponential. I don't do full-authored research or individual research at all. I only collaborate. And when I do, I use qualitative, evaluative criteria of authenticity, transparency, and transferability. . . . My goal, in my collaborations, is that maybe I come up with the idea and I organize people, but over time . . . the scientists have come to take ownership over the project, and it was my proposal, but now it's our research, and that is my goal with all of my collaborations.

Interviewee 19 additionally relayed that her collaborators come from many different backgrounds and disciplinary fields, as her commitment to multidisciplinary research has motivated her to seek out these collaborations.

They're almost all interdisciplinary and transdisciplinary. The Australia group is a soil scientist, a plant biologist, a plant physiologist, a microbiologist, a geologist, and I'm the only social scientist, and then there's a conservation scientist. The Utah group that I was telling you about were all city managers, as well as a team of about 20 researchers from engineering, hydrology, social science, geography, ecology, all kinds of different disciplines. So that's intentional for me.

She also conducted autoethnography research with a diverse group of scientists wherein she sought to bring understanding of social science to non-social scientists, revealing not simply

benefits to collaboration, but the value and necessity of including atypical perspectives, such as how affect and emotion can influence typically quantitative, hard science research:

[For] this particular study, my objective was to get non-social scientists to consider affect, so emotions and the five senses . . . and also not just understand, to intimately understand through experience, how social science can contribute to their work.

For Interviewee 13, collaboration has been essential in two large research projects: one on redlining and one on elections. When asked if he was able to create an interface for one of his projects on his own, Interviewee 13 replied that he relied on his collaborators to develop it. It was only after establishing a collaborative relationship with a technical resource for his research that Interviewee 13 was able to pursue his second project:

I started thinking about or trying to develop collaborations to pursue those. The redlining project came out in 2016, and I had been working on the elections project since 2013. I was working on them side by side, but then [the redlining project] took precedence. And then I turned to the elections project. And that was when I worked much more solo, much more individually on that, until maybe the last year and a half or so, maybe the last year, when we really started collaborating.

He noted that even though he has already expanded his skills outside of what is traditional in his field by learning to use GIS, he lacked the skills that his collaborators possess, which are needed for his projects:

I wish I could do stuff that's half as good as them, but it's enough to be a historian and I kind of go the extra mile doing the GIS stuff.

Interviewee 18 described his experience as part of a transdisciplinary team that was set up to assist in collaboration efforts for projects that aimed to spatialize qualitative data, and he

specifically talked about collaboration in terms of being part of a three-person team in which each team member has a unique role. He portrayed each role as necessary to produce the type of project that entails simplifying complex datasets and relationships into an easily understood and navigated medium to promote public engagement:

There's only three of us . . . , but I feel like we each have that three legs of a stool kind of component. We have the data, the mapping side; we have [the] programming, historian side; and then we have a visual, graphic designer person. It's kind of this cycle in a project, [we] keep going around and around between all of us until we get something where we're all happy.

This team worked with researchers from other institutions in addition to their own, offering multidisciplinary collaboration to researchers who may not have such resources through their own institutions.

Interviewee 17, a professor of geography trained in GIS, shared that he participates in multidisciplinary collaboration with a colleague who has a degree in counseling and no experience with GIS. He found that collaboration to be productive due to each individual's interest and involvement in the research efforts and their communication throughout the process:

The reason that that collaboration has been fruitful is, I think, because we share a lot of the interest in solving the problems and talk a lot about both the substantive challenges, in terms of the research question around substance use and place, and also the computational spatial challenges.

4.2.3.2 *Supplemental Collaboration*

Some interviewees discussed reaching out to others when they needed a more advanced level of expertise than they possessed to accomplish certain parts of their analysis. This type of collaboration has been termed *supplemental collaboration* for discussion in this thesis.

Interviewee 9 communicated that although she is able to utilize GIS, she does not consider herself an expert, and she endeavors to pursue personal collaboration with others who have more experience in GIS:

I have a pretty basic level of GIS, but I am really into collaborating with people who are really good at GIS.

Interviewee 13 had begun work on a project linking qualitative and spatial data, and although he does have spatial analysis skills, he recognized that he lacked the advanced GIS skills and web development skills necessary to achieve his vision for the project. It was not until after he established a collaborative relationship that provided ample technical resources through partnerships with experts in other areas that he was able to complete the project:

One of the things that [collaboration] illustrated was that I had to learn [that] even though I've got a handle on geodatabases and shapefiles, I don't have a handle on managing large, interlocking datasets. I don't know how to develop a relational database, for example.

Interviewee 19 has a working knowledge of GIS but requires the help of an expert in GIS to perform certain calculations and detailed analysis:

I don't know where I was first exposed to ArcGIS, but I've also used the application in my dissertation work. But in terms of spatial analysis—and when I mean analysis, I mean doing the calculations—that's where I get a collaborator on to make sure that I am

considering auto collinearity and those kinds of considerations. When it starts getting, what I feel is, kind of in the weeds. Like really detailed.

When Interviewee 16 lacked sufficient knowledge to perform necessary tasks for his projects, he sought out others who were willing and able to teach him the skills he needed to accomplish his research goals. This method of collaboration relies on knowledge transfer from an expert to a nonexpert. This is in contrast to collaboration that relies on an expert to contribute their time and skill as a project team member, which Interviewee 16 referred to as “partnerships” and indicated was a preferable method of collaboration:

I would go to people and say, “I’m trying to do this, can you help me figure out how to write this SPSS [syntax]?” or whatever, and they would help me. . . . I think that my answer is, in many ways, I did learn a lot of all of those, but generally, partnerships with people who already know it is the best way to go.

4.2.3.3 General Collaboration

Multiple interviewees spoke about collaboration in a general sense, some of whom had not actually performed the collaboration being discussed, while others related positive feelings about collaboration experiences. This type of collaboration has been termed *general collaboration* for discussion in this thesis.

Interviewee 9 was new in her career, but she did have experience working with colleagues who had different areas of expertise and training from her own, and she stated her general support for collaboration while still acknowledging personal responsibility for broadening one’s own knowledge. Her viewpoint differs only slightly from that shared by Interviewee 16 (see Section 4.2.3.2) concerning collaboration via both knowledge sharing and partnerships:

I think the key is, we need to be independent learners, and we also need to rely on our colleagues and collaborate with our colleagues who have training and who have expertise in spatial analysis.

Interviewee 10 indirectly commented on collaboration when she remarked that she would be interested in using spatial techniques to glean new findings in her work and noted that she had spoken with a colleague skilled in GIS about the possibility of working together to achieve that:

I do have a friend that works in GIS, works with GIS in the university that I work at, and we have spoken about doing some, basically, mega data . . . it would be interesting to chart gentrification.

Interviewee 12 has worked on multidisciplinary teams involving qualitative data and spatial analysis before, often as the person performing the spatial analysis aspect of a project, even though her background is in sociology. Her perspective leads her to believe that facilitating collaboration is the route to achieving greater application of spatial analysis techniques in qualitative research:

Maybe the route to getting more of this integrated is helping people network between folks who are interested in spatial data analysis and folks who are working with qualitative data, to coordinate more and do more collaborative projects. To integrate spatial data analysis into the qualitative work.

Interviewee 16 communicated his belief that historians and geographers/environmental scientists have things in common that would foster productive collaboration efforts:

My hope is that historians will have things to contribute back to geographers and environmental scientists. . . . What would be great is if environmental scientists, who, in my experience, think a lot like historians. . . . in terms of the ecology of connections of

things that don't seem to be connected and of consequences of acts that don't seem to have immediate consequence; that's kind of what history is, too. I think that it would be great if non-historians reached out to us to see what we might be able to help provide.

It is interesting that in this comment, while Interviewee 16 shares that he would like to see historians and non-historians collaborate, he phrases it in such a way that indicates others are initiating the collaboration. This may be connected to the work of the digital lab he instituted, which freely provides data and is a resource for collaboration. This and other resources for collaboration are further discussed in Section 4.2.3.4.

4.2.3.4 Resources for Collaboration

For discussion in this thesis, *resources for collaboration* refer to the places that interviewees were able to find collaborators after having already established an interest in doing so. Interviewees would seek the necessary knowledge and skills through personal connections with colleagues and through knowledge centers such as other academic departments or units (e.g., library, lab, or institute). These connections and knowledge centers were found within as well as outside interviewees' own institutions. Some interviewees also hired professionals in private industry, often for web development aspects of their projects. Interviewees may have looked to more than one of these places to attain the knowledge and skills they needed to fulfil their projects' objectives.

As mentioned in Section 4.2.3.2, the experiences of Interviewee 16, an innovator in digital and spatialized history, led him to believe that partnerships are the preferred method of collaborating. Working with collaborators who already possess the knowledge and skills to execute and oversee a given aspect of a project cuts out the time required for nonexperts to attain the necessary skills that will enable them to accomplish the task(s) required for their projects.

Interviewee 13, an associate professor in a history department, described his experience discovering other scholars outside of his own institution who shared not only his research topic but also his vision for digitizing material in a field where doing so is not the norm. They eventually transitioned to a collaborative relationship based on their common interest and goals. As described by Interviewee 17 in Section 4.2.3.44.2.3.5, there are challenges associated with collaborating across disciplines; it is not clear whether the other scholars with whom Interviewee 13 collaborated were in different disciplines from his own, but he does specifically mention that the group worked well together:

When I was starting on this project, I was working solo on redlining, but I found there were a couple of other scholars who were also working on redlining and had this idea of digitizing the material. And so, at some point we decided, wouldn't it be better if we collaborated? And the group got along pretty well together. So, it was something I found outside of my university. It was not an intra-university collaboration.

Interviewee 21, an associate professor in a history department, described that while her university has developed library resources that benefit her work through collaborative knowledge sharing, those resources were not available when she began her work. However, she was able to establish collaboration through personal connections:

I would say it started with the personal connections and then, simultaneous to us developing the program, these other initiatives were taking shape. So now there's a more, kind of, robust network of people doing interdisciplinary work around mapping and spatialization and digital humanities, but that wasn't necessarily the case when we started.

She went on to say that her university has developed a computational science resource, which she has been able to rely on for collaborative partnerships in developing technological solutions in her work.

Interviewee 4 related that as part of a larger research initiative, he was provided with access to a team of professionals who possessed the skills necessary to meet the technological development requirements of his project:

[My] project is part of a much larger research initiative. . . . We had the benefit of an IT team that managed all the software and data, so that I didn't have to get very much involved in that, except to describe what I wanted the end product to look like, and then the IT team would develop both input software and end user software.

Some interviewees hired outside help for their projects. Interviewee 10, whose project was based on collecting and sharing stories that had occurred at locations in the downtown area of her city, stated that a media agency was hired to design the map and website for her project:

We hired a media agency called [name] to do the website, to design the website. They're the ones that designed the map, and then from the back, my students are the ones that put in the locations on the map.

Interviewee 18, a GIS analyst, explained that while his team created custom applications for all of their projects, they did hire an outside company to help develop a toolkit that they have used for several projects:

We custom write all of our projects. They were first based on the [project] toolkit, which was in conjunction with [company name] out of San Francisco, and then from there, they kind of laid the groundwork of our custom applications.

4.2.3.5 Challenges of Collaboration

One challenge that arose for Interviewee 10 was incompatibility in purpose with potential collaborators. Other researchers have contacted her for guidance on creating projects similar to hers, but if their purposes were not aligned with that of her project framework, she opted out of pursuing a collaborative relationship. In other circumstances, this incompatibility was not initially apparent and did not show up until after investing time together to evaluate compatibility:

It's an oral history project. So, it's first-person narrative. So sometimes I'll be talking to people where I'll be just explaining that. "If that's the work that you want to do, this isn't the project that supports that work." . . . They want it to be more of a jingle—a promotional thing. I talk to people probably once a month, and sometimes it goes pretty far, like I become a consultant, and then sometimes it falls apart. Mostly it's just curiosity at first. And then they go away, and sometimes it'll take a couple of years. And sometimes even after a couple of years and things actually being set up, it'll still fall apart.

While not every person who contacts her may be a good fit for a collaborative effort, Interviewee 10 is writing a book to share her knowledge from working on her project, as mentioned in Section 4.1.1.

Interviewee 20 discussed collaboration from the perspective of sharing knowledge and information with others in his discipline. As described in Section 4.2.1.2, he recognized a lack of experience with spatial technology as an obstacle to sharing spatial data within his discipline of history. He went on to say that he freely shares spatial data from his projects, but the challenge for him is that there is not much interest or demand for it from other historians, since training in, or even exposure to, spatializing technology is not standard or common for the field. In his

experience, technical challenges are minor in comparison, since anyone who requests such data already knows how to use it.

While technical collaboration challenges were relatively trivial for Interviewee 20, this was in contrast to the experience of Interviewee 19, who identified file sharing as her biggest challenge in collaboration. Her collaborators were at different institutions, each of which had its own system for email, cloud storage, etc. Identifying a system that will function well for everyone in the group and be convenient enough not to discourage user engagement created an obstacle to facilitating productive participation in some of her collaborative efforts. It appeared that it was not a lack of functionality inherent in any particular system that created this challenge, but, rather, it was finding a single system that provided sufficient availability and usability for each collaborator:

It seems like every institution has their own thing, and every time you transfer, you have to move between systems. And then if you're collaborating with people who have other systems, it sounds like a great idea, with share folders and data and things like that, but it gets really complicated and people get frustrated and end up not using the systems at all. I just experienced this in Australia last week—I have an ongoing collaboration with women, and every single person's at a different institution, and some people want to work over email, and some people want to work through Google Drive, and some want to work through Dropbox, and that is my biggest technical challenge.

Interviewee 17, a professor in a geography department, identified the fundamental challenge of communication when working with people from different disciplines, from terminology to methodology and research approaches. He acknowledged not only the need for domain experts from other disciplines to understand him and the technological constraints faced

in his role as a GIS expert, but he also recognized his need to understand a project from the perspectives of the researchers from other disciplines that are involved, which would allow him to direct his own efforts to ensure his contribution to the project is part of a cohesive whole. The recognition of this challenge highlights the difficulty experienced by anyone working with people of different backgrounds, illustrating that many of the hurdles present in multidisciplinary work are related to siloed thinking within academic disciplines. Interviewee 17 advised having an open mind to provide some mitigation of these challenges, suggesting that while differences in language and methodology may be unavoidable, the solution to such a challenge is not necessarily broadening the scope of academic disciplines to avoid silos but rather approaching multidisciplinary work with a willingness to listen, learn, and adjust one's expectations accordingly to achieve a common goal, realizing and accepting that doing so will require time:

I love working with other people, and it's challenging to work with people from other disciplines a lot of times. You have to have an open mind, and there's a lot of challenges around jargon and language and things like that, but people are interested in making progress, understanding new things. The collaborative environment can be pretty challenging sometimes, just because it usually takes a really long time in the beginning just to figure out language and stuff like that. Honestly, the challenge goes both ways. It's like, for a GIS person, you [have to] figure out what the domain questions are and understand how to translate them into a GIS context, but a lot of times, it's also that the domain expert person needs to understand the issue of representation in the software, which has its own theoretical and methodological set of issues, which are interesting and important. I think it's important in the collaboration for everyone to appreciate the other person's background.

Interviewee 19, an assistant professor in environmental science, also recognized that disciplinary silos can be a barrier to communication. With an aim to be part of a multidisciplinary team, she diverged from her primary field of sociology to get degrees in other disciplines so that she could “speak the language,” and she sought out a position outside of her field of education so that she could be a more effective collaborator:

My bachelor's and first master's were in sociology, but I intentionally also got a master's in urban planning and then a PhD in ecology so that I can speak the language. And instead of staying within sociology, I deliberately looked for and got a job in environmental sciences so I can be embedded in a group where it's not intuitive or it's taken for granted that humans and society have an impact on the environment, so I can be there to talk about human behavior and societal behavior in places where . . . people just kind of guess what humans are going to do, and then it's kind of brushed to the side, because they don't feel like it's their expertise.

Interviewee 19 also brought up a concern that those not trained in the social sciences might not be aware of how some of their methods and practices could create social risks unless they collaborate with others who are trained to look for it:

Not only within the social sciences and how we use our methods, but also in interdisciplinary and transdisciplinary projects, where engineers and ecologists, for example, might use those geography systems in a particular way and not understand the social risks.

Interviewee 16, who began using technology to spatialize his research in history during the 1980s, was proactive in searching for opportunities to pursue his goals, finding resources outside of his own academic department to help him achieve his vision, whether collaboration

was via equipment (e.g., a computer), knowledge sharing, or partnerships. He discussed his endeavors to make use of digital and technological resources before they became the ubiquitous tools that are easily accessible in American universities now. His innovative approach to conducting research in the field of history led to a position of collaboration and knowledge-sharing on a computing committee at his institution at a point when he was an associate professor:

I was the only humanist who was using a computer at [my institution] in 1990, so they put me on a university committee to do with computing.

Gaining access to these resources and accomplishing his vision with the available resources was inconvenient and laborious, and he acknowledged that even with the vast improvements in computing power and technology since then, the field of history has not yet embraced this form of transdisciplinarity:

I've been saying for 25 years, "Hey, folks! This is the profound social change of our time, the rise of the digital, and freely sharing information around the world and visualizing complex patterns, wouldn't that be cool?" Some people have liked it, but in general, the profession does not.

Although interviewees did identify challenges in collaborating with others, especially with others in different disciplines from their own, it was clear that collaboration was a necessary component in projects that spatialized qualitative data. This took the forms of expanding one's own knowledge and skills by learning from a mentor or tutor, partnerships with experts, multidisciplinary research teams, and outsourcing technical tasks such as web development and mapping. Interviewees found resources for collaboration from their own personal contacts, other

departments or centers at their own institutions, departments or centers at other institutions, and professionals in private industry.

Chapter 5 Discussion & Conclusion

In this research, I sought to explore why and how researchers spatialize qualitative data, finding that many researchers do so to share stories of human experience, relying on collaboration to develop custom technological solutions that incorporate geolocated data in various ways. I conducted interviews with researchers who had experience spatializing qualitative data to contribute to knowledge on this subject. I developed the interview protocol from an expectation that GIS would be used as the primary geovisualization tool employed by interviewed researchers, but this was not the case, although some interviewees did make use of GIS in their geovisualization efforts. The difficulty of protecting personally identifiable information associated with geolocated qualitative data was expected to be a relevant topic of concern and discussion for interviewed researchers, but it was not. While some interviewees did deal with sensitive information, they typically did not express any difficulty in protecting the privacy of the data during the course of their research. While not an intended focus of the interviews, the theme of storytelling as the motivation for spatializing qualitative data was repeatedly brought up during the interviews. An unanticipated issue that arose in recruitment and interviews was the lack of a clear definition of the terms *spatializing* and *qualitative data*. These terms have respectively been defined to mean “viewing in the spatial context of a geographic map” and “data that are not numerical or categorical (e.g., texts, images, videos, and audio recordings)” in this thesis, but confusion stemming from their initial use during data collection highlights the need for standardized terminology relating to spatial visualization of qualitative data, particularly for outsiders to the field seeking entry. Many interviewees reported that preexisting software packages, including GIS, did not offer the flexibility necessary to achieve their research goals. Conversations surrounding the innovation of technological solutions for

interviewees' desired research outputs included opinions and experiences with GIS software that revealed limitations in its ability to meet their needs, driving most to create custom technological solutions for their projects. The main point of consensus among interviewees was the need for collaboration, emphasizing that geovisualizing qualitative data is a multidisciplinary challenge.

5.1 The Map's Relation to Qualitative Data

Many of the interviewees were in academic fields or had educational backgrounds in which working with location-based projects was common or expected, while others' backgrounds were more focused on qualitative research. Regardless, all interviewees found themselves at the intersection of combining qualitative data with spatial visualization. However, the descriptions of projects provided by interviewees of disparate backgrounds revealed that there seems to be a difference between *adding qualitative data to a map* and *adding a map to qualitative data*. The goals and execution of a project affect whether the map is itself the primary object of interest or if it is supplementing the primary object of interest.

For example, *adding qualitative data to a map* could look like an analyst beginning with a map, potentially in GIS, and importing qualitative data to be displayed and analyzed in the context of their geographic locations. This concept seems to align with the definition of geonarratives as defined by Yuan (2020). *Adding qualitative data to a map* supports the analysis phase of research and seems more common among GIS users to identify and study spatial factors in qualitative data. Converting qualitative data into a form of quantitative data was a typical data strategy for this, but this strategy loses much of the detail provided by qualitative data in their original forms. Qualitative GIS techniques (e.g., hyperlinking) seek to address this limitation (Jung & Elwood, 2019).

Alternatively, *adding a map to qualitative data* aligns more closely with the work of Interviewee 10, whose comments indicated that a map was added to stories to provide geographical context rather than to perform spatial analysis. This view seems to align with the concept of spatial narratives as defined by Yuan (2020). *Adding a map to qualitative data* supports the presentation of information to an audience external to the researcher(s) and seems more common among qualitative researchers presenting place-based stories. Collaboration with web developers was one strategy for interviewees pursuing such projects. The use of Esri StoryMaps (which, according to the genres defined by Roth [2020], could be described as a dynamic slideshow) is another option that would support this framework.

5.2 Spatializing Qualitative Data as a Multidisciplinary Method

While qualitative GIS is becoming well established as a research methodology, there is no one-size-fits-all technological solution for geovisualization of qualitative data, especially in projects intended for public education and interaction. Researchers using GIS with qualitative data in the analysis stage of research are publishing works on qualitative GIS as a mixed methods research approach (Cope & Elwood, 2009; Jung, 2009; Jung & Elwood, 2010, 2019). However, academics using web-based mapping technology as an informative tool for public education and/or policy making (i.e., geovisualization as an output rather than an element of analysis) are not publishing works on their methods. While qualitative GIS has emerged as a valid research method, which an individual researcher could potentially employ more or less independently, geovisualization of qualitative data for public-facing, web-based maps requires a multidisciplinary collaborative effort, and there has been little contributed to scholarly literature on this specific combination of end user (general public), content/input (qualitative data), method (multidisciplinary collaboration incorporating expertise from social sciences and humanities,

web development, and GIS), and output (web-based interactive map). Literature on geovisualization does address some of these factors but does not go into detail on how to incorporate qualitative data, although the subject is occasionally touched upon when addressing multimedia in geovisualization (Dykes et al., 2005; Koua et al., 2006; Kraak & MacEachren, 2005; MacEachren et al., 2004; MacEachren & Brewer, 2004; MacEachren & Kraak, 2001).

5.3 Effect of Career Stage on Multidisciplinary Research

Most of the projects discussed in these interviews were multidisciplinary efforts (see Section 4.2.3), and tenured professors are more likely to have the opportunity to pursue multidisciplinary projects (Arnold et al., 2021; Sobey et al., 2013). This is partly due to the pressures and resource constraints on lower-level positions in academia, which were reflected in two interviews. Interviewee 15 mentioned that “our own pressures, trying to graduate with our PhDs or get tenure” placed time and resource constraints on himself and other academics early in their careers. Similarly, Interviewee 13 indicated that getting a tenure-track position had an effect on his ability to pursue a project that combined his interests and studies in the seemingly disparate areas of history and GIS:

Once I got a tenure-track faculty job at [university name], I was in a decent position to be able to take on a project like this.

The career stage of researchers affects their ability to initiate or contribute to multidisciplinary projects.

5.4 Ambiguity in Terminology

The phrase *spatializing qualitative data* was used in the research design and recruitment materials for this study, which were developed in 2018. Prior to this, a Google Scholar search for

that exact phrase returned only one result, a PhD dissertation (Bergeron, 2011), although a more recent search returned an article that has been published since then (Norton, 2020). The term *spatializing* does not seem to have a standard definition or to be widely used in any area of scholarship, although two definitions of *spatialization* were identified, one within geographic literature and one in music technology:

1. Spatialization refers to “extend[ing] geographic principles and cartographic techniques to the visualization of non-geographic information.” (Skupin & Fabrikant, 2003, p. 99)
2. “Spatialization, the synthesis of spaces and spatial properties of sounds for a listener, is a growing field of interest for researchers, sound engineers, composers, and audiophiles.” (Peters et al., 2011, p. 10)

Both these definitions use the term *spatialization* to refer to two- or three-dimensional representations of space rather than geographic, locational space. That is, they deal with relations between things (whether concrete, such as features of a room, or abstract, such as ideas) apart from geographic location (i.e., latitude and longitude coordinates). The term *mapping* is more common in usage, especially for those outside the discipline of geography, but it also refers to a cognitive exercise (e.g., concept mapping) and obfuscates searches for information on the cartographic meaning of the word. According to MacEachren and Kraak, the term *geovisualization* refers to “theory, methods, and tools for visual exploration, analysis, synthesis, and presentation of geospatial data (with data having geospatial referencing)” (MacEachren & Kraak, 2001). *Geovisualization* may offer the best fit for the defined meaning of spatialization in this thesis, but as is the case with *spatializing qualitative data*, *qualitative geovisualization* is not an established term in scholarship nor is it in common usage.

Even for terms that have been well established in literature, disciplinary silos may prevent researchers from other fields from being made aware of the terminology. For example, qualitative GIS is an established term in the discipline of geography (as discussed in Chapter 2), but researchers from other disciplines may be unfamiliar with the term and therefore fail to use it in their work, even if they practice the method: “When pursuing qualitative GIS, they [social scientists and humanities scholars] often do not use the term or trace connections to these important literatures” (Pavlovskaya, 2017, pp. 5432–5433). This disparity between disciplines contributes to silos and further inconsistency in terminology.

Norton (2020) recognized that there is still not a singular term addressing the concept of spatializing qualitative data; rather, multiple areas of research stemming from various disciplines have coined their own labels. In fact, the research presented in Norton’s article (2020), which revolved around using GIS to map plantations from qualitative descriptions of their locations recorded in the early 1700s, illuminates an area of ambiguity concerning qualitative data even within the working definition used in this thesis: some data that are not numerical or categorical (e.g., texts, images, videos, and audio recordings) may be intended to describe *where* a location exists in space (termed *qualitative locations* by Yao & Jiang [2005]) rather than to capture nonnumerical and noncategorical information *pertaining to* a location.

Yuan (2020) addresses a similar concept, outlining the difference between geo-narratives and spatial narratives. She defines geo-narratives as “oral histories, life histories, and biographies” that are geolocated, having digital latitude and longitude data attributed to the qualitative narrative data. In contrast, a spatial narrative has an overarching linear story about a geographic location over time; events of this story can come from multiple authors and sources (Yuan, 2020).

This definition of spatial narrative is reflected in Roth's (2020) categorization of visual storytelling genres in cartographic design. He delineates seven genres for visual storytelling employing a map, whether as a central or supporting element. The classification of each genre establishes a clear terminology, except "storytelling" is constrained to the telling of a single, overarching linear narrative rather than the presentation of many distinct narratives that form a collective "story" representative of an underlying theme or issue, as was common among interviewees. This differing view of the "story" is significant in this context because the genres are defined by the techniques used to enforce linearity of the narrative (Roth, 2020).

5.5 Ethical Implications

The interview protocol included questions about privacy requirements for the protection of the identities of interviewees' project participants. The responses and experiences of the interviewees did not suggest that they encountered difficulty in protecting personally identifiable information when spatially visualizing qualitative data and had little to say concerning restrictions and limitations on tools for that purpose. This may be due to factors such as the data themselves, options for accessing and analyzing the data, or an interviewee's feelings on the subject. Some interviewees described working with data that had no privacy restrictions, having been collected with the intention of public access. Others had access to a local, downloaded copy of GIS software on a personal computer, eliminating risks from digital transmission of data associated with using web-based tools. Another possibility is that interviewees may have felt that their comments on the subject could be viewed as incriminating.

The growing amount of geolocated data collected automatically from electronic devices raises questions of personal privacy and ethics. Researchers have found that locations frequented by an individual, particularly home and work, can be estimated with reasonable accuracy from

large datasets of anonymized cell phone call records (Zang & Bolot, 2011). Decision-making frameworks for balancing personal privacy with the societal and economic benefits of collecting location data have been proposed (Kedron & Trgovac, 2021; Power et al., 2021), but the tension between legal treatment and ethical treatment of personal data remains, especially in light of the “privacy paradox”: the fact that many people legally consent to the collection of their data even though they say that they value the privacy of their personal information (Brown, 2001; Norberg et al., 2007).

5.6 Key Findings

In this thesis, I sought to answer the question, “How do researchers spatialize qualitative data?” The findings from this research show that researchers across disciplines are not only interested in but are successfully finding ways to spatialize qualitative data, frequently relying upon collaboration to develop custom technological solutions that meet their research goals. However, the findings from this research also raise questions about where such multidisciplinary efforts “fit” and where researchers pursuing these efforts can find resources to assist them in their efforts. A standardized terminology may prove useful in directing interested researchers to such resources as well as in creating space for development of such resources. Another contributing factor to the strategies used by researchers was the lack of standard, off-the-shelf technology solutions that could meet researchers’ needs for geovisualizing qualitative data, and one interviewee indicated that merging qualitative data analysis functionality with quantitative analysis in a geovisual context was desirable. Development of such technology may be beneficial for many researchers. This study also found that collaboration was strongly relied upon by researchers and was viewed favorably by those who discussed it, but this strategy is highly

variable in effectiveness and accessibility as it depends on the network and institutional resources available to the individual or team.

5.7 Limitations of This Work

Because I used nonprobability sampling techniques (expert sampling and snowball sampling) for recruiting interview participants, the data gathered from these interviews cannot be generalized. Many interviewees related that what constitutes qualitative data is not well defined; neither is the term *spatialize* well defined. The ambiguity surrounding these terms may have affected researchers' interest and feelings of eligibility for participation in this study. Many interviewees described projects intended for public access. One of the ways I performed expert sampling was by searching for papers on spatialized qualitative data—this would not seem to create a bias toward public access projects. However, many interviewees were recruited through snowball sampling, which may have had this effect. Additionally, researchers whose work was for the public may have had a greater interest in spreading awareness of their projects and therefore have been more willing to participate in this study.

References

- Arnold, A., Cafer, A., Green, J., Haines, S., Mann, G., & Rosenthal, M. (2021). Perspective: Promoting and fostering multidisciplinary research in universities. *Research Policy*, *50*(9), Article 104334. <https://doi.org/10.1016/J.RESPOL.2021.104334>
- Barriage, S. C., & Hicks, A. (2020). Mobile apps for visual research: Affordances and challenges for participant-generated photography. *Library and Information Science Research*, *43*(2), Article 101033. <https://doi.org/10.1016/j.lisr.2020.101033>
- Baur, N., Hering, L., Raschke, A. L., & Thierbach, C. (2014). Theory and methods in spatial analysis: Towards integrating qualitative, quantitative and cartographic approaches in the social sciences and humanities. *Historical Social Research*, *39*(2), 7–50. <https://doi.org/10.12759/hsr.39.2014.2.7-50>
- Bergeron, S. J. (2011). *Engaging the virtual landscape: Toward an experiential approach to exploring place through a spatial experience engine* [Doctoral dissertation, West Virginia University Libraries]. <https://doi.org/10.33915/etd.4696>
- Bhattacharjee, A. (2012). *Social science research: Principles, methods, and practices* (2nd ed.). University of South Florida Tampa Library Open Access Textbooks Collection at Scholar Commons.
- Bost, E., & Wingenbach, G. (2018). The photo narrative process: Students' intercultural learning in agriculture. *Journal of International Agricultural and Extension Education*, *25*(4), 83–98. <https://doi.org/10.5191/JIAEE.2018.25407>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Brown, B. (2001). *Studying the internet experience*. HP Laboratories technical report HPL-2001-

49. HP Laboratories Bristol.

Cope, M., & Elwood, S. (Eds.). (2009). *Qualitative GIS: A mixed methods approach*. SAGE Publications Ltd. <https://doi.org/10.4135/9780857024541>

Dransch, D. (2000). The use of different media in visualizing spatial data. *Computers & Geosciences*, 26(1), 5–9. [https://doi.org/10.1016/S0098-3004\(99\)00039-4](https://doi.org/10.1016/S0098-3004(99)00039-4)

Dykes, J., MacEachren, A. M., & Kraak, M.-J. (Eds.). (2005). *Exploring geovisualization*. Elsevier Ltd. <https://doi.org/10.1002/arp.274>

Elwood, S., & Cope, M. (2009). Qualitative GIS: Forging mixed methods through representations, analytical innovations, and conceptual engagements. In M. Cope & S. Elwood (Eds.), *Qualitative GIS: A mixed methods approach* (pp. 1–12). SAGE Publications Ltd. <https://doi.org/10.4135/9780857024541.N1>

Fielding, N., & Cisneros-Puebla, C. A. (2010). CAQDAS-GIS convergence: Toward a new integrated mixed method research practice? *Journal of Mixed Methods Research*, 3(4), 349–370. <https://doi.org/10.1177/1558689809344973>

Harrison, S., & Dourish, P. (1996). Re-place-ing space: The roles of place and space in collaborative systems. *Proceedings of the 1996 ACM Conference on Computer Supported Cooperative Work*, 67–76. <https://doi.org/10.1145/240080.240193>

Jung, J.-K. (2007). *Computer-aided qualitative GIS (CAQ-GIS) for critical researchers: An integration of quantitative and qualitative research in the geography of communities*. (Publication No. 3261991) [Doctoral dissertation, State University of New York at Buffalo]. ProQuest Dissertations Publishing.

Jung, J.-K. (2009). Computer-aided qualitative GIS: A software-level integration of qualitative research and GIS. In M. Cope & S. Elwood (Eds.), *Qualitative GIS: A mixed methods*

approach (pp. 115–136). SAGE Publications Ltd.

<https://doi.org/10.4135/9780857024541.N7>

Jung, J.-K., & Elwood, S. (2010). Extending the qualitative capabilities of GIS: Computer-aided qualitative GIS. *Transactions in GIS*, 14(1), 63–87. <https://doi.org/10.1111/j.1467-9671.2009.01182.x>

Jung, J.-K., & Elwood, S. (2019). Qualitative GIS and spatial research. In P. Atkinson, S. Delamont, A. Cernat, J. W. Sakshaug, & R. A. Williams (Eds.), *SAGE research methods foundations*. SAGE Publications Ltd. <https://doi.org/10.4135/9781526421036818834>

Kedron, P., & Trgovac, A. (2021). Assessing connections and tradeoffs between geospatial data ethics, privacy, and the effectiveness of digital contact tracing technologies. In S.-L. Shaw & D. Sui (Eds.), *Mapping COVID-19 in space and time: Understanding the spatial and temporal dynamics of a global pandemic. Human dynamics in smart cities* (pp. 115–136). Springer, Cham. https://doi.org/10.1007/978-3-030-72808-3_7

Kitchin, R., & Dodge, M. (2007). Rethinking maps. *Progress in Human Geography*, 31(3), 331–344. <https://doi.org/10.1177/0309132507077082>

Knigge, L., & Cope, M. (2006). Grounded visualization: Integrating the analysis of qualitative and quantitative data through grounded theory and visualization. *Environment and Planning A*, 38. <https://doi.org/10.1068/a37327>

Knigge, L., & Cope, M. (2009). Grounded visualization and scale: A recursive analysis of community spaces. In M. Cope & S. Elwood (Eds.), *Qualitative GIS: A mixed methods approach* (pp. 95–114). SAGE Publications Ltd.

<https://doi.org/10.4135/9780857024541.D11>

Koua, E. L., MacEachren, A., & Kraak, M. J. (2006). Evaluating the usability of visualization

- methods in an exploratory geovisualization environment. *International Journal of Geographical Information Science*, 20(4), 425–448.
<https://doi.org/10.1080/13658810600607550>
- Kraak, M.-J., & MacEachren, A. M. (2005). Geovisualization and GIScience. *Cartography and Geographic Information Science*, 32(2), 67–68. <https://doi.org/10.1559/1523040053722123>
- Kwan, M.-P. (2002). Feminist visualization: Re-envisioning GIS as a method in feminist geographic research. *Annals of the Association of American Geographers*, 92(4), 645–661.
<https://doi.org/10.1111/1467-8306.00309>
- Kwan, M.-P., & Ding, G. (2008). Geo-narrative: Extending geographic information systems for narrative analysis in qualitative and mixed-method research. *The Professional Geographer*, 60(4), 443–465. <https://doi.org/10.1080/00330120802211752>
- Kwan, M.-P., & Knigge, L. (2006). Doing qualitative research using GIS: An oxymoronic endeavor? *Environment and Planning A: Economy and Space*, 38(11), 1999–2002.
<https://doi.org/10.1068/a38462>
- Lewinson, T. (2015). Co-constructing home with photovoice: Older residents of an assisted living facility build a Photonarrative. *Qualitative Social Work*, 14(5), 702–720.
<https://doi.org/10.1177/1473325014561139>
- MacEachren, A. M. (1995). *How maps work: Representation, visualization, and design*. Guilford Press.
- MacEachren, A. M., & Brewer, I. (2004). Developing a conceptual framework for visually-enabled geocollaboration. *International Journal of Geographical Information Science*, 18(1), 1–34. <https://doi.org/10.1080/13658810310001596094>
- MacEachren, A. M., Gahegan, M., Pike, W., Brewer, I., Cai, G., Lengerich, E., & Hardisty, F.

- (2004). Geovisualization for knowledge construction and decision support. *IEEE Computer Graphics and Applications*, 24(1), 13–17. <https://doi.org/10.1109/MCG.2004.1255801>
- MacEachren, A. M., & Kraak, M.-J. (2001). Research challenges in geovisualization. *Cartography and Geographic Information Science*, 28(1), 3–12. <https://doi.org/10.1559/152304001782173970>
- Martin, S. (2014). Interactive visual media for geomorphological heritage interpretation. Theoretical approach and examples. *Geoheritage*, 6(2), 149–157. <https://doi.org/10.1007/S12371-014-0107-Y>
- Matthews, S. A., Detwiler, J. E., & Burton, L. M. (2005). Geo-ethnography: Coupling geographic information analysis techniques with ethnographic methods in urban research. *Cartographica: The International Journal for Geographic Information and Geovisualization*, 40(4), 75–90. <https://doi.org/10.3138/2288-1450-W061-R664>
- Norberg, P. A., Horne, D. R., & Horne, D. A. (2007). The privacy paradox: Personal information disclosure intentions versus behaviors. *The Journal of Consumer Affairs*, 41(1), 100–126. <https://doi.org/10.1111/J.1745-6606.2006.00070.X>
- Norton, H. K. (2020). Finding the spaces betwixt and between: GIS of the 1733 St. Jan Slave Rebellion. *International Journal of Historical Archaeology*, 24, 803–822. <https://doi.org/10.1007/s10761-019-00526-7>
- Nykiforuk, C. I. J., Vallianatos, H., & Nieuwendyk, L. M. (2011). Photovoice as a method for revealing community perceptions of the built and social environment. *International Journal of Qualitative Methods*, 10(2), 103–124. <https://doi.org/10.1177/160940691101000201>
- Pavlovskaya, M. (2006). Theorizing with GIS: A tool for critical geographies? *Environment and Planning A*, 38(11), 2003–2020. <https://doi.org/10.1068/A37326>

- Pavlovskaya, M. (2009). Non-quantitative GIS. In S. Elwood & M. Cope (Eds.), *Qualitative GIS: A mixed methods approach* (pp. 13–37). SAGE Publications Ltd.
<https://doi.org/10.4135/9780857024541.n2>
- Pavlovskaya, M. (2017). Qualitative GIS. In D. Richardson, N. Castree, M. F. Goodchild, A. Kobayashi, W. Liu, & R. A. Marston (Eds.), *International encyclopedia of geography: People, the earth, environment and technology* (pp. 5432–5441). John Wiley & Sons, Ltd.
<https://doi.org/10.1002/9781118786352.wbieg1156>
- Peters, N., Marentakis, G., & McAdams, S. (2011). Current technologies and compositional practices for spatialization: A qualitative and quantitative analysis. *Computer Music Journal*, 35(1), 10–27. https://doi.org/10.1162/COMJ_a_00037
- Pickles, J. (Ed.). (1995). *Ground truth: The social implications of geographic information systems*. The Guilford Press.
- Power, D. J., Heavin, C., & O'Connor, Y. (2021). Balancing privacy rights and surveillance analytics: A decision process guide. *Journal of Business Analytics*, 4(2), 155–170.
<https://doi.org/10.1080/2573234X.2021.1920856>
- Rawls, J. (1971). *A theory of justice*. The Belknap Press of Harvard University Press.
- Roth, R. E. (2020). Cartographic design as visual storytelling: Synthesis and review of map-based narratives, genres, and tropes. *The Cartographic Journal*, 58(1), 83–114.
<https://doi.org/10.1080/00087041.2019.1633103>
- Rowley, J. (2012). Conducting research interviews. *Management Research Review*, 35(3/4), 260–271. <https://doi.org/10.1108/01409171211210154>
- Saldaña, J. (2013). *The coding manual for qualitative researchers* (2nd ed.). SAGE Publications Ltd.

- Schuurman, N. (2009). Metadata as a site for imbuing GIS with qualitative information. In M. Cope & S. Elwood (Eds.), *Qualitative GIS: A mixed methods approach* (pp. 41–56). SAGE Publications Ltd.
- Sheppard, E. (1995). GIS and society: Towards a research agenda. *Cartography and Geographic Information Systems*, 22(1), 5–16. <https://doi.org/10.1559/152304095782540555>
- Skupin, A., & Fabrikant, S. I. (2003). Spatialization methods: A cartographic research agenda for non-geographic information visualization. *Cartography and Geographic Information Science*, 30(2), 99–119. <https://doi.org/10.1559/152304003100011081>
- Sobey, A. J., Townsend, N. C., Metcalf, C. D., Bruce, K. D., & Fazi, F. M. (2013). Incorporation of Early Career Researchers within multidisciplinary research at academic institutions. *Research Evaluation*, 22, 169–178. <https://doi.org/10.1093/reseval/rvt004>
- Trier-Bieniek, A. (2012). Framing the telephone interview as a participant-centred tool for qualitative research: A methodological discussion. *Qualitative Research*, 12(6), 630–644. <https://doi.org/10.1177/1468794112439005>
- Tuan, Y.-F. (1979). Space and place: Humanistic perspective. In S. Gale & G. Olsson (Eds.), *Philosophy in geography* (pp. 387–427). Springer. https://doi.org/10.1007/978-94-009-9394-5_19
- Weigert, K. M. (2015). Social justice: Historical and theoretical considerations. In J. D. Wright (Ed.), *International encyclopedia of the social & behavioral sciences: Second edition* (Second, pp. 397–400). Elsevier. <https://doi.org/10.1016/B978-0-08-097086-8.32081-5>
- Yao, X., & Jiang, B. (2005). Visualization of qualitative locations in geographic information systems. *Cartography and Geographic Information Science*, 32(4), 219–229. <https://doi.org/10.1559/152304005775194683>

- Yuan, M. (2020). Geographical enrichment of historical landscapes: Spatial integration, geonarrative, spatial narrative, and deep mapping. In C. Travis, F. Ludlow, & F. Gyuris (Eds.), *Historical geography, GIScience and textual analysis* (pp. 259–272). Springer.
https://doi.org/10.1007/978-3-030-37569-0_16
- Zang, H., & Bolot, J. (2011). Anonymization of location data does not work. *Proceedings of the 17th Annual International Conference on Mobile Computing and Networking - MobiCom '11*, 145. <https://doi.org/10.1145/2030613.2030630>

Appendix A

Request for Participation in Thesis Research

A.1 IRB-Approved Email Recruitment

Hello, <name of potential participant>,

My name is Samantha Jung, and I am a graduate student at the University of Oklahoma. / I saw your article <title> in <journal>/ OR /I was referred to you by <name>/, and I would love to ask you a few questions related to your work. As part of my research for my master's thesis, I am interviewing researchers to gain an understanding of the abilities and limitations of technology in spatializing qualitative data. The interview would take about an hour over the phone, and it would be recorded. If you decide to participate but change your mind later, you have the freedom to stop participating at any time, for any reason. I would be happy to send you a digital copy of my thesis after it is finished. Please reply to let me know if you are interested in participating!

Sincerely,

Samantha Jung

M.S. Candidate, Environmental Sustainability

University of Oklahoma

Norman, OK

The University of Oklahoma is an equal opportunity institution.

A.2 IRB-Approved Phone Recruitment

Hi, <name of potential participant>, my name is Samantha Jung, and I'm a graduate student at the University of Oklahoma. /I saw your article in <journal>/ OR /I was referred to you by <name>/, and as part of my research for my master's thesis, I'm interviewing researchers to gain an understanding of the abilities and limitations of technology in spatializing qualitative data. The interview would take about an hour over the phone, and it would be recorded. Would you be interested in participating? We can do it right now (**if verbal consent is approved by IRB**) or schedule it for another time, if that would be better for you. <Potential follow-up question if s/he declines to participate: Is there someone else you can recommend to do the interview?>

Appendix B

Interview Protocol for Thesis Research

B.1 Opening Script

The goal of the opening script is to give the interviewee the context of the interview as well as an idea of what to expect.

Hi, thank you so much for taking the time to speak with me today. First of all, I'd like to give you an idea of what I'd like to talk with you about. As you may recall, I contacted you because /I was interested in your article(s), <title(s)>/ OR /<name> referred me to you/. The focus of my research is to understand how other researchers are currently using technology to analyze qualitative data that has a connection to a specific location, so I'd like to ask you some questions about the technical side of your research.

B.2 Experience

B.2.1 Research Project(s)

The professional background and experience of most participants will be known beforehand from the publication of the interviewee's research, but this section gives the interviewee the opportunity to describe it verbally and to fill in any gaps.

/I've reviewed your article(s), <title(s)>/ OR /<Name> referred me to you because of your work in <area>/. Can you tell me a bit about your research—particularly research where you have analyzed qualitative data spatially? About how many projects have you worked on like this, where specific locations were attributes of your qualitative data?

B.2.2 Data & Technology

The purpose of this section is to understand the technical attributes and constraints of the research project(s). This will inform me of whether the process I developed over the past year has relevance and utility for other researchers and projects.

What were the primary types of data you collected for your project(s)? (e.g., written observations, surveys, interviews, photographs, etc.)

- What type(s) of spatial data were collected? (e.g., raster vs. vector data, if vector data: point, line, polygon)

Could you describe the process of how you managed your data, from collecting the raw data to getting it into a form where you could work with it more easily?

How did you keep track of the location of each data point?

What were the different technological tools you used to manage and analyze your data? (e.g., computer programs, mobile apps, or websites)

- Were any of these tools already being utilized in your department?
 - Did you have experience using them before?
 - [if so] Was your previous experience useful for this project's needs?
 - [if not] How did you figure out how to use them to best meet your needs?
 - [if not] How did you find out about them, and what influenced your decision to try them?
 - What resources did you use to learn how to use these tools?

- Were there other options that you considered but ultimately didn't use?
 - [if so] Was lack of training or previous experience a factor in that decision?
 - [if so] Was cost a factor? Why or why not?

Were your efforts to spatialize qualitative data influenced by the work of other scholars?

- [if so] How did their work impact yours?
- [if not yet addressed] Could you give me their names or the titles of their works?

[if not yet addressed] Why did/didn't you consider using GIS to spatialize your qualitative data?

- How did you become familiar with using GIS tools?

Can you describe what your desired or expected output was from using these tools?

What were the challenges you remember from this analysis process?

- Was confidentiality of your data a concern? What were some of the difficulties in spatializing data that you experienced due to privacy restrictions?
- Did you experience any difficulties from using computers with different operating systems, such as Windows and Mac?
- Were there any other shortcomings with the software or process?

How would you describe the ideal way of viewing or working with your spatial data?

B.3 Value of Analysis

OK, that answers most of my questions, but I would like to get your perspective on the value of doing this kind of analysis. Can you summarize your opinion on why this approach to analyzing data is important in your field?

How do you think this type of analysis could benefit other fields or disciplines?

B.4 Follow-Up

The purpose of this section is to ask the interviewee for resources to find additional potential participants (snowball sampling).

Can you recommend anyone else I should contact about this topic (e.g., someone you have been on a conference panel with)?

B.5 Safety Net Questions

These questions are included to give the interviewee an opportunity to discuss any points that were not covered earlier that s/he finds pertinent. Such points could prove valuable in providing additional information not directly addressed by the interview questions.

Is there anything else that you wanted to talk about that we didn't get to?

Is there anything else you would like to add?

B.6 Closing

OK, thank you again for taking the time to speak with me today. Feel free to contact me any time with any questions or concerns you might have about our interview or my research.