Feminist Data Visualization

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Abstract—In this paper, we begin to outline how feminist theory may be productively applied to information visualization research and practice. Other technology- and design-oriented fields such as Science and Technology Studies, Human-Computer Interaction, Digital Humanities, and Geography/GIS have begun to incorporate feminist principles into their research. Feminism is not (just) about women, but rather draws our attention to questions of epistemology – who is included in dominant ways of producing and communicating knowledge and whose perspectives are marginalized. We describe potential applications of feminist theory to influence the information design process as well as to shape the outputs from that process.

Index Terms—Visualization, inclusion, digital humanities, critical perspectives, feminism.

✦

1 INTRODUCTION

When exploring the intersection of data visualization and the digital humanities, one must consider not only how the domain of digital humanities – and of the humanities more generally – can provide new opportunities for the design and application of visualization tools and techniques, but also how theories from the humanities can themselves inform visualization design. Research in the field of data visualization is often framed in terms of how it helps to "reveal" knowledge [15], support narrative storytelling [70], or otherwise facilitate pathways to "insight" [12]. These same keywords are often employed – and challenged – in humanistic theories that explore how knowledge is produced, transmitted, and perceived. Among the earliest and the most enduring of these theoretical schools is what is known as *feminist theory*. A body of work that owes its emergence to the women's suffrage movements of the nineteenth century, feminist theory evolved through several "waves" over the course of the twentieth century, and now encompasses a range of ideas about how identity is constructed, how power is assigned, and how knowledge is generated, as well as how a range of *intersectional* forces [19] such as race, class, and ability, combine to influence the experience of being in the world.

In this paper, we outline a feminist approach to visualization, drawing upon a set of canonical and contemporary theories from the humanities in order to show how visualization research can be adapted to emphasize the situated nature of knowledge and its perception. Our goal is to encourage the development of a range of alternative visualization practices that better emphasize the design decisions associated with data and its visual display. We are particularly interested in exposing the assumptions involved in choices about data type, categorization schema, visual typology, interaction mode, and intended audience; as well as those associated with the qualitative aspects of visualization design and its reception, such as the composition and structure of the design team, the identification and involvement of user communities, the contextual and affective factors that influence both the design and reception of visualizations, and the many forms of labor that contribute to a successful visualization design. By identifying these assumptions and associating them with the core principals of what we term *feminist data visualization*, we hope to expand the conversation about what visualization for – and with – the humanities could become.

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2 RELATED WORK

Feminism is "not (just) a women's issue," as Johanna Drucker reminds us, nor does feminist theory help to inform issues of gender alone [25]. As the binary distinction between male and female, as well as the hierarchical relation that posits male above female, have been abstracted to serve as models for a range of structures and systems, feminist theory has been marshaled in order to challenge the validity of a variety of binaristic and hierarchical configurations. By the same token, expansions of feminist theory – crucially, intersectional feminism – have been employed to overturn systems of oppression that cannot be reduced to a single structure or source. We lead with this theoretical lens so as to frame the four related fields of inquiry that have contributed to our formulation of feminist data visualization: feminist science and technology studies, feminist human-computer interaction, feminist digital humanities, and critical cartography & GIS. In the following sections, we summarize the main contributions of each field in more detail.

2.1 Feminist Science and Technology Studies

Science and Technology Studies (STS) is an interdisciplinary field that emerged in the 1960s and 70s. STS examines the social, cultural, and historical aspects of science and technology. Feminist theory and analysis has played a key role in this field, leading to the development of original theoretical frameworks [4, 6, 34, 39] as well as the sustained challenge to dominant epistemological perspectives [37, 47, 56, 80]. One of the key contributions of STS has been to challenge the idea that science and/or technology is objective and neutral by demonstrating how scientific thought is situated in particular cultural, historical, economic, and social systems [77]. Feminist STS, both implicitly and explicitly, looks to the perspectives of those marginalized by current power configurations (including and especially those marginalized because of gender, sexuality, race, and/or ethnicity) as a way of exposing how their perspectives are not included in what is considered "objective" truth [74]. Challenging neutrality, objectivity, and universality does not mean that feminist STS retreats to a position of relativism or solipsism, however. The field rejects neither the scientific process nor quantitative ways of knowing the world. Rather, feminist STS allows us to see how all knowledge is situated, how certain perspectives are excluded from the current knowledge regime, and how multiple true objectivities are possible.

2.2 Feminist Human Computer Interaction

In the field of human-computer interaction (HCI), there is an emerging conversation about how to draw from feminist theory and other critical perspectives for the design of interactive and computational systems. Lucy Suchman's work has long explored the implications of feminist theory for technology production and use [75, 76]. More recently, Shaowen Bardzell has asserted that feminism can be deployed throughout the design process to produce a "generative contribution" [5]. Feminist HCI design work has included foci on female

makers and hackerspaces [32], motherhood as a life phase [3], post-partum technologies [22], and talking back to street harassment [23]. While historically, HCI aspired to "universal" usability, the early 2000s saw a proliferation of work that challenged that idea through design practice [24, 60]. Feminist HCI builds on that work and draws on feminist standpoint theory [39] to explicitly valorize marginal perspectives so as to "expose the unexamined assumptions of dominant epistemological paradigms" [5]. In relation to visualization in particular, Peter Hall coined the term *critical visualization* in 2008 to describe practices that counteract "the technological view" of visualization, a view which emphasizes technique and efficiency while eliding historical, social and rhetorical concerns [35]. Marian Dörk et al. built on this concept to elucidate design principles for working with data [26]. In both feminist HCI and critical information visualization, researchers have introduced design principles that attempt to draw attention to how knowledge resides in specific bodies (*disclosure/self-disclosure*, *embodiment*), how power is distributed throughout the design process (*empowerment*, *advocacy*, *ecology*) and how to include more voices and alternative perspectives in the design process, as well as the experience of the resulting artifact (*participation*, *pluralism*, *plurality*).

2.3 Feminist Digital Humanities

Since the field's inception, digital humanities (DH) has entailed a sustained attention to certain feminist concerns. The Orlando Project [10] and the Women Writers Project [31] are early and enduring examples of how DH has emphasized the recovery of female literary and cultural contributions. In recent years, the fields of DH and STS have begun to converge, resulting in a range of projects that incorporate feminist theoretical perspectives into their digital work. Key work in this area has included wearable representations of Twitter activity related to reproductive health [50] and embodied enactments of historical health data [67], as well as content management platforms [58], social media collectives [9], scholarly networks [30], and educational opportunities [78]. In terms of visualization work, gender – especially as it relates to issues of authorship and style – has long served as a subject of DH research, e.g. [46]. However, the visualizations that accompany such analyses almost always employ standard representational techniques [45]. Recently, Miriam Posner [65] identified the development of new visual strategies for the representation of non-binary gender as one of the most pressing challenges of DH today. Other work that seeks to incorporate embodied and affective modes of perception into new visualization forms, e.g. [49, 79], promises to extend feminist digital humanities visualization work in exciting ways. To date, however, this work has been conducted in isolation from the visualization community. Additional partnerships between DH scholars and visualization researchers, along the lines of interdisciplinary projects to visualize the sonic aspects of poetry [57] or the ambiguities of temporal data [59], constitute a rich site for future inquiry.

2.4 Critical Cartography & GIS

In the late 1980s and early 1990s, geographers challenged conventional academic cartography by linking maps and other visual representations of geographic knowledge explicitly to power using the critical theories of Michel Foucault [17, 18]. Cartographers such as JB Harley challenged the perceived neutrality of the map and introduced notions of ideology and bias [40, 41]. While he did not explicitly draw on feminist theory, Harley argued for the situatedness of maps as historically and culturally contingent documents. During the same period, Denis Wood connected maps explicitly to the rise of the nation-state and showed how maps serve political interests [82]. Other scholars linked Geographic Information Systems (GIS) to an impoverished techno-positivism [64] and militarism [71]. Subsequent scholarship theorized the map more as rhetorical proposition than depiction of "fact" [81]. The declassification of GIS technology and the introduction of locative functions into everyday devices like mobile phones has led to a flourishing of artistic and critical mapping practices [20] like Laura Kurgan's work that intentionally introduces social and political questions through visualization [51]. Relatedly, there has also been an expansion of participatory design strategies for democratizing geographic information collection

and visualization [27] for those who have been excluded from dominant mapping practices, such as indigenous populations [16]. Since 2000, scholars have articulated explicitly feminist approaches to mapping and GIS [28, 42, 62] including nuanced considerations of gender and mapping with new technologies [73]. Mei-Po Kwan used the term *feminist visualization* to describe how GIS could be used in ways that are compatible with feminist epistemologies and politics [52]. Her design principles include grounding mapping practices in women's everyday lives and political struggles, as well as incorporating qualitative and narrative components into spatial representations.

3 PRINCIPLES OF FEMINIST DATA VISUALIZATION

In what follows, we introduce six core principles of feminist data visualization. As our intention is to directly impact the design of future visualizations, we follow our explanation of each principle with a set of questions relating to design process and design output. We should note, also, that while our primary focus is on visualization design and the related issues of interaction and display, our feminist approach requires that we expand the design frame so as to account for the range of social forces and material conditions that influence the design process. In other words, a feminist approach to data visualization, while centered on design, insists that data, design, and community of use, are inextricably intertwined.

3.1 Rethink Binaries

Central to feminist theory is the disavowal of binary distinctions– not only between the categories of male and female, but also between nature and culture [37], subject and object [43], reason and emotion [54], and body and world [4], among many others. A feminist approach to data visualization should therefore emphasize representational strategies premised on multiplicity rather than binaries, and acknowledge the limits of any binaristic view [53]. This approach is exemplified by (if not limited to) the representation of gender; typically recorded as binary and discrete variables – e.g. either male or female – gender might be better represented as continuous and multidimensional [29]. Not only a challenge for the visualization phase of research, rethinking the representation of gender, among other binaristic categories, challenges us to inquire how the processes associated with data collection and classification, as well as their visual display, might be made to better account for a range of multiple and fluid categories.

Design Process Questions: Is our data the right type? What categories have we taken for granted? How can we register responses that do not fit into the categories we have provided, even and especially if they are "edge cases" and "outliers"?

Design Output Questions: How do we communicate the limits of our categories in the final representation? How can we allow the user to refactor the categories we have presented for view?

3.2 Embrace Pluralism

Feminist theory seeks to challenge claims of objectivity, neutrality and universalism, emphasizing instead how knowledge is always constructed within the context of a specific subject position [8, 38, 39, 54]. In the context of data visualization, a focus on the designer's own subject position can help to expose the decisions, both implicit and explicit, that contribute to the creation of any particular visual display. Both Bardzell and Dörk et al. have framed this quality around "self-disclosure" [5, 26]. We believe that self-disclosure, and an embrace of pluralism more generally, can do more; it can help to encourage alternatives to the single "view from nowhere" so often favored in visualization design [21]. Ideally, a focus on pluralism would help visualization research move away from its current emphasis on "objective" presentation in favor of designs that facilitate pathways to multiple truths.

Design Process Questions: Whose voices are not represented on the design team but might be important for the conceptualization of the project? Who is being envisioned as the ideal user? How could additional perspectives be accommodated, even those considered marginal? Whose perspectives have been excluded from the

categorization schema? For example, collecting gender in female/male buckets excludes transgender, gender-fluid and two-spirit people.

Design Output Questions: Can the artifact communicate the subject positions of the researcher(s) and designer(s) in a transparent way? Whose view of the world does the visualization represent? Can the visualization communicate whose voices are missing? Could perspective-taking be a useful strategy to consider for multiple views on the data?

3.3 Examine Power and Aspire to Empowerment

Historically, women and other marginalized groups have experienced the negative effects of hierarchical structures of power. Feminist approaches seek to overturn these hierarchies by promoting horizontal systems of knowledge transmission. Such systems insist on a two-way relation between subject and object of knowledge [36, 39]. A feminist approach to data visualization therefore acknowledges the user as a source of knowledge in the design as well as the reception of any visual interface. The creation of knowledge is, after all, always a shared endeavor.

Following from this point is a related principle: that users are bound to the communities that shape them. Aspiring to empowerment, then, may involve designing for and evaluating the success of a visualization at the scale of the community rather than the individual user. This reorientation can help us to acknowledge the communities who provide us with our design challenges, while also ensuring that the outcomes of our design research connect back to the communities that first made them possible. It can also help us to listen to community concerns and co-design visualizations to advance their goals, while building capacity to achieve them within the community.

Design Process Questions: How is power distributed across the design team? Whose voice matters more and why? How can end users' voices be more fully integrated into the design process? Can we build capacity in user communities, or enlarge our internal perspectives, by employing a more participatory design process?

Design Output Questions: Can the visualization empower the end user and/or her community, group, or organization? When do values often assumed to be a social good, such as "choice," "openness," or "access," result in disempowerment instead?

3.4 Consider Context

A central premise of feminist theory is that all knowledge is *situated* [36], where "situated" refers to the particular social, cultural, and material context in which that knowledge is produced [33]. A feminist approach to data visualization must therefore consider how diverse contexts can influence the production of a visualization, and think through the various ways in which any particular visualization output might be received. In the context of an Enlightenment model of knowledge production, in which additional information leads to increased understanding, a model that allows for the user to "drill down" to more information might be the logical solution for the display of an information system; but this is not the most appropriate choice for more horizontal knowledge frameworks, or those premised on exchange. As another example, consider standard practices of data cleaning. As designers, we often require "clean" data to construct our visualizations. Loukissas argues that local context is lost when we homogenize data [55]. An awareness of what we can learn from local context may yield richer and more informative visualization designs.

Design Process Questions: How can we leverage human-centered design [14] and participatory design [72] methods to learn about and with our end users, including learning more about their culture, history, circumstances, and worldviews? How can we let these insights shape our design practice and change our notions about what constitutes "good" information design?

Design Output Questions: What kinds of terminology, symbols, and cultural artifacts have meaning to end users, and how can we incorporate those into our designs? What might we learn if we were to visualize "messy" data [68]? How do we take context into account in the assessment of visualizations?

3.5 Legitimize Embodiment and Affect

Feminist theory recognizes embodied and affective experiences – that is, experiences that derive from sensation and emotion – as ways of knowing on par with more quantitative methods of knowing and experiencing the world [13]. By definition, visualization rests on the production and assimilation of visual knowledge. But even the most efficiency-oriented and task-driven visualizations have embodied and affective impact, if only to communicate their utility, economy, and purposefulness by way of the visual domain. With the rise of popular forms of visualization such as *data journalism*, designers have begun to intentionally leverage affect in order to create an emotional bond with a story or issue [11], or to engage and impress readers with beauty and complexity [61]. These affective dimensions of visualization have been under-explored in traditional visualization research. Acknowledging the importance of embodiment and affect also has implications for how we evaluate visualizations. Not simply about accomplishing a particular task, could we include measures of embodied and affective responses to visualizations as indicators of their effectiveness?

Design Process Questions: How can we leverage embodied and affective experience to enhance visualization design and engage users? What kinds of expertise might we need on our design team in order to do that? (e.g. fine art, graphic design, animation, or communication specialists)

Design Output Questions: What kinds of embodied and affective experience has meaning to end users? Should we consider tactile, experiential, or social ways of accessing the data visualization? Can we consider visualization outputs in an expanded field, such as data murals [7], data sculptures [1], public walks [2], quilts [48] and installations [63]?

3.6 Make Labor Visible

Information design processes often start with data, but a feminist approach would insist that they begin by working backwards to surface the actors (both individual and institutional) that have labored to generate a particular dataset. Starting with questions of data provenance helps to credit the bodies that make visualization possible – the bodies that collect the data, that digitize them, that clean them, and that maintain them. However, most data provenance research focuses on technical rather than human points of origination and integration [66]. With its emphasis on under-valued forms of labor, a feminist approach to visualization can help to render visible the bodies that shape and care for data at every stage of the process. This relates to the concept of *provenance rhetoric* [44] in which authors of narrative visualizations cite data sources and methods which may help build credibility with the audience. Making labor visible also has implications for fair attribution and credit for the resulting artifact, especially in light of the fact that women and other underrepresented groups have been notoriously excluded from sharing in credit for scientific work [69].

Design Process Questions: Can the team work backwards from the given data to document their provenance and talk to their caregivers? Has the team discussed roles, responsibilities, and credit in advance of publication?

Design Output Questions: Is it feasible to provide a metadata visualization that shows the provenance of the data and their stakeholders (caregivers) at each step? Have we properly attributed work on the project?

4 CONCLUSION AND NEXT STEPS

In this paper, we have outlined six principles for feminist data visualization: *Rethink Binaries*, *Embrace Pluralism*, *Examine Power and Aspire to Empowerment*, *Consider Context*, *Legitimize Embodiment and Affect*

and *Make Labor Visible*. These are preliminary and offered for the purposes of beginning a dialogue about how the digital humanities and information visualization communities can productively exchange theories, concepts, and methods. Applying humanistic theories to design processes and artifacts may be new territory for many humanists, just as grappling with questions of subjectivity, power, and oppression may be new territory for many visualization researchers. As data visualization becomes a mainstream technique for making meaning and creating stories about the world [70], questions of inclusion, authorship, framing [44], reception, and social impact will become increasingly important. In this regard, the humanities and specifically feminist theory have much to offer.

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