MATTHEW BREHMER

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CONTACT

mb@mattbrehmer.ca

+1-206-665-9232

mattbrehmer.ca

@mattbrehmer

matthewbrehmer

matthewbrehmer

mattbrehmer

Note: Throughout this research statement, I refer to my papers using the abbreviations provided in the right column of my publication list (e.g., TVCG-17); these abbreviations also link to corresponding author copies or pre-prints of these papers.

I am a visualization and human-computer interaction (HCI) researcher, specializing in creative expression with data for communication and presentation, the visualization of time-oriented data, and interacting with data beyond the desktop.

IMPACT

To date, my research contributions include **24** peer-reviewed journal and conference papers. I was the primary author on **11** of these papers, and of these, **9** appeared in top publication venues for visualization and human-computer interaction (HCI) research: *IEEE Transactions on Visualization and Computer Graphics* (TVCG, which includes proceedings from the *IEEE VIS* / *InfoVis* conference) and the *ACM Conference on Human Factors in Computing Systems (CHI)*.

Three of my first-author papers (TVCG-13, TVCG-17, and TVCG-14) have more than 100 citations each, with TVCG-13 being the most cited IEEE VIS / InfoVis paper since 2013, having over 550 citations as of the time of writing. TVCG-13 introduced a new approach to hierarchical and sequential task analysis for visualization, one that was central to my doctoral research. This approach has since provided a foundation for many visualization design and evaluation projects, and it has been extended by others in the research community to address specific application domains and forms of data.

In the discussion of my research below, I focus predominantly on my first-author papers appearing in *IEEE TVCG* since 2017: work performed as a postdoctoral researcher at Microsoft Research (2016 - 2019) and as a senior research staff member of Tableau Research (2019 —). During this period, *TVCG*'s h5-index was 82 (Google Scholar, Dec. 2021).

Beyond citations, my research contributions have also benefited the visualization practitioner community. First, a prototype application described in TVCG-17 led to the development and release of **Microsoft's Timeline Storyteller**, a standalone web application and Power BI extension for visualizing event sequence data, one which appeared in the opening keynote of the 2017 Data Insights Summit, a conference that attracted thousands of Microsoft customers. Similarly, **Microsoft's Charticulator** is a web application for constructing bespoke charts and Power BI templates; in addition to our research paper receiving an honorable mention at IEEE VIS 2018 (TVCG-19A), the Charticulator project was also shortlisted for Kantar's *Information is Beautiful Awards* in 2018, an annual event honoring achievements in visualization and information design. Finally, I have had the unique privilege to have spoken about my research at customer conferences hosted by two leading business intelligence vendors (Microsoft and Tableau), and I have published articles about my research on official customer-facing Microsoft and Tableau blogs. Speaking to and writing for practitioners has been both challening and rewarding, and I aspire to continue these forms of outreach throughout my career.

Finally, my contributions to the visualization community are reflected in my involvement in various committees. These include the program committees of academic conferences such as IEEE VIS / InfoVis and practitioner-oriented conferences such as Information+, the organizing committee of IEEE VIS (in which I organized the **VisInPractice** associated event between 2018 and 2021), the IEEE VGTC subcommittee to attract and retain practitioners at VIS, and the **Data Visualization Society's** executive board nominations committee.

PHILOSOPHY

When I consider my research philosophy, I refer to three cultural values that motivate me. These include a respect for creativity, an appreciation for critical and provocative thinking, and the adoption of a humanist perspective on data.

Creativity. Depending on who you ask, data visualization is described as a process, a skill, a trade, or even a language. Personally, I view data visualization as a *craft* and as a critically important communication medium for the 21st century. From this standpoint, my research aims to both understand and support the unique creative potential of individuals and teams that communicate with data, to augment rather than automate creative processes, and to better understand what constitutes success and impact with respect to creative data visualization.

Critical and Provocative Thinking. The aim of my research is to foster critical thinking within the data visualization community as well as within society at large. Provocative research must strive to be more than technical innovation; it should illuminate new challenges, frame existing challenges in a new light, and call current conventions into question. With respect to data visualization, many design conventions are inherited from those established in the era of static printed charts; in contrast, my research aims to illuminate the design space for dynamic, interactive, and situated data visualization. Similarly, the visualization community's collective understanding of graphical perception rests largely upon experimental research that lacks external validity, and I argue that this foundation limits the field's creative potential.

(Data) Humanism. The aggregate and abstract representations of data used in visual analysis are at times inappropriate for visual communication, particularly when the data reflects human activity. Moreover, contemporary data visualization practices often hide the individuality of the author and their unique perspectives on the data, as well as the human effort invovled in data collection and curation. Audiences of communicative visualization often lack adequate context for the data, particularly when they interact with this medium individually and asynchronously. To effectively communicate with data and establish trust with audiences, my research considers ways of visualizing data with care and respect, preserving human individuality and restoring both human agency and context whenever possible.

METHODS

The projects in my portfolio typically incorporate one or more of following sets of methods:

Research through Design. I develop interactive tools that allow me (and project stakeholders) to expand and document visualization design spaces. One approach is to fixate on a particular data abstraction, such as event sequence data (TVCG-17). Another approach is to develop new techniques for navigating large combinatorial design spaces, such as by applying principles of generative design to the construction of multidimensional data glyphs (TVCG-22A). In applied visualization research (known within the research community as *visualization design studies*), I consider a specific combination of data and task abstractions and collaboratively review the corresponding design space with stakeholders from the application domain as a form of participatory design (TVCG-16A). Each of these approaches aim to add structure to the palette of visualization design choices, from static and dynamic visual encoding channels to multimodal interactions with data.

Quantitative Experimentation. I have designed and conducted both laboratory- and online-based human factors experiments that compare design alternatives according to metrics of task completion time and accuracy. The motivating purpose of these experiments may vary, from examining the feasability of a proposed telehealth intervention (CHI-12) to questioning design conventions, such as by replicating prior experimental results in a new context or with more nuanced statistical approaches (TVCG-19A and TVCG-20A).

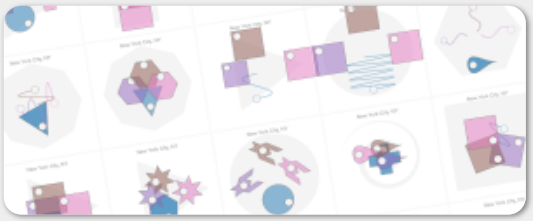
Qualitative Inquiry. Much of my knowledge of existing visualization and data analysis practice comes from interview studies (BELIV-14A) and design probe studies (TVCG-22B), or studies that I characterize as *pre-design empiricism* (BELIV-14B). I have similarly employed qualitative methods in evaluations of functional visualization tools and techniques, from retrospective interviews (TVCG-14) to think-aloud usability studies and chauffeured demonstrations (TVCG-22A, TVCG-16A).

THEME: CREATIVE EXPRESSION WITH DATA FOR COMMUNICATION AND PRESENTATION

Visualizing data to support communication with an audience is a craft, encompassing goals and processes that are distinct from those associated with visualization in the context of data analysis. While I retain a degree of concern for whether a particular visualization or interaction technique is capable of eliciting accurate and efficient judgments about data, my focus on communication-oriented visualization prioritizes other criteria. These criteria include the originality and memorability of particular visual representations, as well as audiences' affective responses to these representations. Beyond understanding these constructs from an audience perspective, I am also invested in the design and development of visualization construction tools centered around these criteria, thereby allowing me to identify and understand the barriers that prevent people from expressing themselves with data.

Since 2015, I have contributed to the design and development of four interactive communication-oriented visualization construction tools, spanning three mediums of presentation: static images (PVIS-17 and TVCG-19B), comic strips (CHI-19), and dynamic multimedia slideshows (TVCG-17 / C+J-19). Evaluating these tools required methodological innovation beyond the study of isolated task performance, toward a more holistic and qualitative study of creative visualization workflows.

In a joint reflection on visualization construction tools with two other teams of tool-builders (TVCG-20B), I came to realize that these tools are built with the assumption that those who use them come to these tools with visualization design ideas already in mind. Absent these ideas, people confront a blank canvas and may resort to reproducing existing (and unoriginal) design ideas. With this realization in mind, I turned to study the potential of techniques and tools for generating visualization design inspiration, beginning with our recent Diatoms project (TVCG-22A, see inset).



SPOTLIGHT: GENERATIVE GLYPH DESIGN WITH DIATOMS

Our Diatoms technique (TVCG-22A) was motivated by principles of generative design and is capable of producing a diverse sequence of design ideas for multidimensional glyphs. The technique samples from palettes of mark shapes and visual encoding channels such as size, rotation, amplitude, and frequency. An accompanying interactive curation experience allows people to identify promising designs, such as those that trigger figurative associations.

Another recent realization is that communication-oriented visualization research has historically fixated on the model of web-based data journalism, in which a distributed audience consumes content asynchronously and individually without directly engaging content authors. This fixation has resulted in the neglect of synchronous communication scenarios, such as meetings and presentations centered around data occurring within organizations. Our recent interview study (TVCG-22B) with those who prepare and deliver presentations about data to colleagues, executives, and customers revealed several opportunities to innovate. Our findings prompted me to investigate the multimodal nature of synchronous communication and the related implications for presenting data. In particular, I have recently begun experiments with gestural and proxemic interaction that allow presenters to draw an audience's attention and elicit desirable affective reactions to aspects of the data (see my *Information+ 2021* conference talk: **vimeo.com/592591860**). In general, presentations about data delivered by a human orator represent an understudied scenario in visualization research, one offering unique challenges and opportunities with respect to accessibility, audience engagement, and responsive design.

THEME: VISUALIZING TIME-ORIENTED DATA

I have been captivated by aspects of time-oriented data since embarking on my doctoral research: aspects such as trends, correlations, event sequences, periodic patterns, and seasonal variations. My most well-known research contribution related to the theme of visualizing time-oriented data is a design space for presenting event sequences as timelines (TVCG-17, see inset):

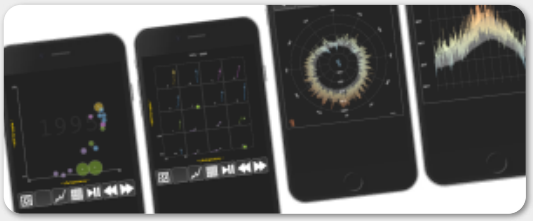
SPOTLIGHT: A DESIGN SPACE FOR TIMELINE NARRATIVES

Based on a survey of over 250 event sequence timelines spanning a vareity of application domains and topics, we characterized a design space (TVCG-17) for narrative visualization encompassing the dimensions of timeline representation, scale, and layout. This design space later became the basis for **Microsoft's Timeline Storyteller** (C+J-19), an interactive presentation tool for the web and for Microsoft's Power BI.

Beyond event sequences, I have focused on techniques for representing quantities over time to support specific tasks. These include comparing normalized quantities to identify seasonal variations and anomalies (TVCG-16A), comparing range values across temporal granularities (TVCG-19A), and presenting multidimensional trends (TVCG-20A). Currently, I am focusing on narrative conventions for presenting time-oriented data and the implications for presentation tools.

THEME: INTERACTING WITH DATA BEYOND THE DESKTOP

Visualizing data on anything other than a standard desktop or laptop display provides both challenges as well as creative opportunities. My foray into *beyond-the-desktop* visualization began in 2017, initially motivated by a Microsoft team working on personal health tracking on phones. The team had seen my timeline visualization work and invited me to consider how to best visualize data over time on small screens. This consideration led to two experiments comparing the efficacy of alternative visualization design choices on mobile phones (TVCG-19A and TVCG-20A, see inset).



SPOTLIGHT: TRENDS AND RANGES ON MOBILE DEVICES

Our studies of alternative visualization design choices for mobile phone displays considered animated versus static *small multiples* representations of trends (TVCG-20A) and cyclical and linear options for visualizing ranges over time (TVCG-19A). In both cases, we conducted online crowd-sourced experiments with participants completing a series of graphical perception tasks using their own phones.

My involvement in *beyond-the-desktop* visualization research continued as an organizing committee member of the CHI 2018 workshop on mobile data visualization, as well as in research projects specific to phones (CGF-20) as well as pen + touch-enabled tablets and surfaces (CHI-19 and ISS-19). Finally, my most recent contribution to this emerging area is a comprehensive review of interaction design for visualization appearing in *Mobile Data Visualization* (CRC Press, 2021). Looking ahead, I am extending my scope for *beyond-the-desktop* visualization research, such as in augmented reality for presenting data remotely via video.

THEME: APPLIED VISUALIZATION RESEARCH

Applied visualization research has the potential to trigger new research directions and ideas for visual encoding and interaction design choices that may be transferible beyond the initial application context. I also enjoy applied visualization research as it provides opportunities to extend a network of diverse collaborators and engage in participatory design with those having a different perspective on visualization.

Journalism. I am particularly intrigued by applied visualization research in public-facing domains such as journalism, where visualization can provide new critical lenses on socio-technical phenomena. My contributions in this domain include a longitudinal interview-based evaluation of the *Overview Project* (TVCG-14), a tool for investigating large document collections obtained from freedom of information requests and whistleblowers, as well as *TimeLineCurator*, a tool for extracting structured temporal references from unstructured text documents (TVCG-16B).

Resource Conservation. The ongoing shifts to renewable energy and highly instrumented energy conservation protocols will produce new opportunities for data-based decision-making throughout the decades to come; I foresee that visualization will provide pivotal support for these decisions at various scales, from nations to organizations and individual households. I have already contributed visualization research aimed at the organizational level (TVCG-16A), and I would welcome opportunities to continue work in this domain, especially at the scale of individual households.

Health. My two contributions relating to visualizing helath data include a system for healthcare quality assessments at the institutional level (TVCG-21) and design choices for presenting personal health data on mobile devices (TVCG-19A). Looking ahead, the COVID-19 pandemic has demonstrated the important role that visualization plays in both analyzing and communicating health-related data, whether it be personal health or public health, and as with the two prior application areas, I look forward to revisiting this domain in my future research.