

# Crafting Visual Narratives: A Case Study on Developing an Engaging Visualisation Poster Using U.S. Immigration Data

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## Abstract

*This paper presents a design study that elucidates the process of creating an engaging visualisation poster using U.S. immigration data as the focal point. The primary objective is to demonstrate the methodical journey of crafting a compelling story from raw data and effectively portraying it in a poster format. In the process, we manoeuvre through varied tactics of data display, visualisation tool implementation, and poster presentation. As a case study, we offer three important reflective insights that underscore our experience constructing such a poster, which is a practical guide for individuals pursuing similar endeavours. Key considerations underpinning this guide include prioritising a ‘big hero’ visualisation, ensuring a coherent narrative flow through the poster, and attentively curating the meta information to provide the necessary context, enabling the poster to communicate its message independently.*

## CCS Concepts

• **Human-centered computing** → **visualisation design and evaluation methods**; **visualisation toolkits**; **Visual analytics**;

## 1. Introduction

The phenomenon of international refugee movement, both in scale and frequency, continues to amplify, necessitating the development of sophisticated tools capable of accurately interpreting and addressing this pressing global issue. In the face of burgeoning refugee data complexity, conventional data representation strategies are increasingly proving inadequate, encountering difficulties in illustrating the intricate narratives embedded in refugee movements. The significant shortfall of these methods lies in their inability to present a coherent narrative, consequently obfuscating a holistic understanding of the data. This shortfall impacts both policy-making efficiency and the quality of public dialogue. Responding to these predicaments, our project, named “Storytelling of USA immigration data” utilises data visualisation as a robust medium to dissect and exhibit the complex patterns inherent to refugee movements within the U.S. Our central aim is to craft an interactive visualisation tool capable of intertwining the narrative embedded within high-dimensional refugee data, thus presenting an engaging, comprehensible storyline. Our tool integrates data from the late 20th century to the present, providing an informative historical context.

The paper unfolds an extensive case study of our project, ac-

centuating the process of developing and morphing the visualisation tool into a compelling visual narrative for a poster presentation. The resultant poster epitomises our data visualisation efforts, manifesting the potency of data storytelling in making intricate patterns comprehensible and captivating. Our contributions are three-pronged. Initially, we offer a comprehensive delineation of our methodological process; illuminating every phase, from data sourcing and pre-processing to the final implementation and evaluation of the visualisation tool. Subsequently, we delve into constructing a visualisation poster, sharing pragmatic insights and lessons learnt from our firsthand experience. Finally, we present an in-depth reflection on our journey, highlighting challenges encountered, design decisions, and their subsequent impact on the final product.

Our project situates itself at the convergence of data visualisation, information design, and storytelling. By combining these domains, our objective is to catalyse advancements in the discipline, offering invaluable insights for forthcoming projects with similar characteristics. A distinguishing aspect of our work is the fusion of visualisation and narrative, effectively communicating intricate patterns within refugee data to a diverse audience. Furthermore, we grappled with challenges such as balancing data complexity and user accessibility and safeguarding narrative integrity while upholding factual accuracy. In addition, we adopted purposeful design decisions to prioritise user engagement and comprehension. For instance, we introduce the concept of a ‘big hero’ visualisation; a central visualisation to instantly captivate viewers’ attention, along with storyboard panels to guide individuals through specific

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refugee trends and events. These choices, among others, greatly enhanced our visualisation tool's success as an informative and engaging narrative medium.

Ultimately, our project accentuates the transformative potential of integrating narrative-driven visualisations into policy-making and public discourse. It underscores explicitly the potential of compelling visual storytelling in fostering a more profound comprehension of complex sociopolitical phenomena such as the global refugee crisis. This enhanced understanding can, in turn, steer policy decisions, stimulate informed public dialogue, and facilitate more empathetic and effective responses to refugee movements.

Anticipated outcomes of our work encompass increased public engagement with refugee data, amplified understanding of refugee movements, and, consequently, more informed public dialogue and policy-making. While the impact of our work may not be immediately quantifiable, we anticipate that the employment of similar data storytelling strategies can gradually redirect public understanding and policy approaches towards more informed and empathetic responses to refugee crises. Notable contributions to the field of visual narratives for policy-making and public discourse, particularly in the context of complex issues such as refugee movements, have been made by Segel and Heer [SH10], storytelling of Covid-19 (e.g., Chen et al. [CAA\*22]), or visual analytics [WaCP\*15]. By building on their foundational work and integrating further advancements in data visualisation, information design, and storytelling, our project seeks to enrich this critical and ever-evolving field with a fresh perspective.

## 2. Related Work

Data storytelling, an art of strategic communication, is increasingly recognised for its effectiveness in making sense of complex data. In this context, numerous research contributions have refined and explored this practice. Notably, Segel and Heer [SH10] have been instrumental in emphasising narrative visualisation's potential to transmute intricate datasets into visually compelling stories. Kosara and Mackinlay's [KM13] work underscored the delicate balance between author-driven and reader-driven narratives, offering crucial insights for our poster's design. Additionally, the significance of narrative flow and viewer engagement in crafting visualisation stories was asserted by McKenna et al. [MHL\*17] which greatly influenced our approach. As we transitioned from storytelling to poster design, effectively conveying large datasets within a confined space emerged as a principal challenge. Viegas et al. [VWvH\*07], through their pioneering work on the ManyEyes project, demonstrated the feasibility of engaging users to tell stories, while spatial constraints in Wordle [VWF09] help to craft impactful data-rich narratives. Complementing our systematic approach, Liu et al. [LNS08] advocated a modular design approach for data visualisations – a principle vital for maintaining the visual coherence of our poster.

The growing body of case studies on data visualisation also offered invaluable inputs. For example, Munzner's [Mun09] nested model for visualisation design and validation fostered a more profound comprehension of the systematic process involved in crafting visual narratives. Moreover, Stasko's [Sta14] research on evaluat-

ing information visualisations underscored the necessity of continual evaluation throughout our project. Our research integrates these critical learnings, providing a unique case study that sheds light on the process of designing a visual narrative poster.

In our design approach, Roberts et al. Five Design-Sheet (FdS) methodology [RHR16] proved to be significantly influential. The FdS methodology, encompassing ideation, development, and refinement stages, guided our design iterations, permitting an exploratory approach towards the possible visualisation strategies. Furthermore, we incorporated Roth's taxonomy into our discourse [Rot13]. Roth's interactive visualisation framework, provides an exhaustive classification of interactive techniques, enhanced our understanding of the interplay between data exploration and presentation tasks in our project. Our project situates itself within a broader research discourse emphasising data visualisation storytelling, particularly in the context of poster design. By offering a case study that delineates the process of crafting a visual narrative poster, we can extend the discourse's scope and provide a more nuanced understanding of the intricate interplay between data, visualisation, and storytelling. This unique blend of different research fields positions our work within the larger academic dialogue and sets the stage for future research at the intersection of data visualisation, information design, and narrative-driven policymaking.

## 3. Methodology

Our methodology aimed to create a visualisation poster that effectively narrates the story embedded within U.S. immigration data. This process unfolded in distinct stages, guided by the Five Design-Sheet (FdS) methodology as our primary design framework [RHR16].

**Data Collection and Preprocessing:** We began with the task of data collection and preprocessing. The U.S. Department of State's Refugee Processing Center was our primary data source [US 22]. The database contained multi-faceted immigration data from the late 20th century onwards. This vast dataset served as the starting point for our study. Preprocessing (data wrangling [KHP\*11]) involved rigorous data cleaning to rectify anomalies and missing data, and to remove personally identifiable information, ensuring the integrity and ethical handling of data [Hel08].

**Exploratory Data Analysis and Story Identification:** We conducted a comprehensive exploratory data analysis (EDA) post-preprocessing to glean significant trends and patterns. This EDA allowed us to sift through the raw data using various analytical and statistical methods, thereby revealing patterns that could form the basis of our narrative [FW08; LNS08]. In the process of story identification, we evaluated several potential narratives revealed during EDA, choosing the one that most effectively addressed our research question while engaging viewers and highlighting crucial aspects of U.S. immigration history. This deliberate and thoughtful choice facilitated the creation of a cohesive narrative that formed the foundation of our visualisation design.

**Ideation and Exploration (FdS1):** With the story identified, we ventured into the ideation phase. Using the FdS methodology, we engaged in a series of ideation, development, and refinement stages. In the first (FdS1), of three primary stages we brainstormed and

sketched potential visualisation designs. Some designs are shown in Figure 1. The designs were chosen to aid the unfolding of our narrative straightforwardly across the poster while drawing upon established practices in narrative visualisation [SH10; KM13].

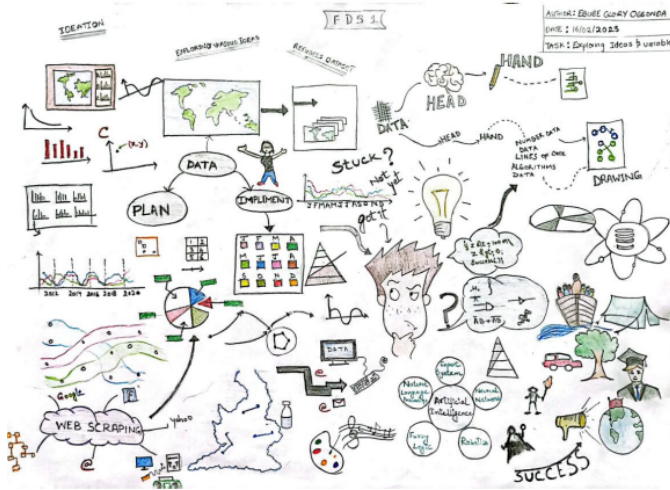


Figure 1: Sketches from the first sheet of the five-sheets (FdS) design process [RHR16], depicting visual narrative and initial ideas.

**Design Development (FdS2 - FdS4):** Following FdS1, we focused on three equally viable alternative ideas (FdS2, FdS3, and FdS4). Our design development was an iterative process that explored three alternative ideas. During this stage, we evaluated each visualisation design based on its effectiveness in data presentation, story clarity, aesthetic appeal, and potential for user engagement. Informed by Kosara and Mackinlay’s work [KM13], we aimed to balance author-driven and reader-driven content, promoting user engagement without compromising the narrative flow [LNS08; Mun09]. This rigorous assessment allowed us to discard certain designs (e.g., the tree map) and prefer others (e.g., geographic maps and circle plots).

**Poster Design and Layout (FdS5):** The FdS5 guided our final design and poster layout. Transforming our interactive visualisation into a static poster presented unique challenges. We were inspired by Viegas et al.’s work on spatially constrained formats [VVF09] to ensure that our poster effectively represents the data-rich narrative. We designed our poster with a central ‘big hero’ visualisation to immediately engage viewers and utilised storyboard panels to guide them through specific refugee trends and events. Our layout planning ensured a logical information flow. Inspired by Liu et al.’s modular design principle [LNS08], our visualisation incorporated different visual components, each focusing on specific aspects of the data while maintaining coherence with the overall narrative. The hero visualisation was positioned centrally, and additional elements were arranged to support the main narrative. We also ensured that our poster was comprehensive, including essential meta-information such as title, introduction, labels, legends, and colour maps, to facilitate standalone understanding without requiring additional verbal explanation.

**Implementation:** The final stage encompassed the construction of

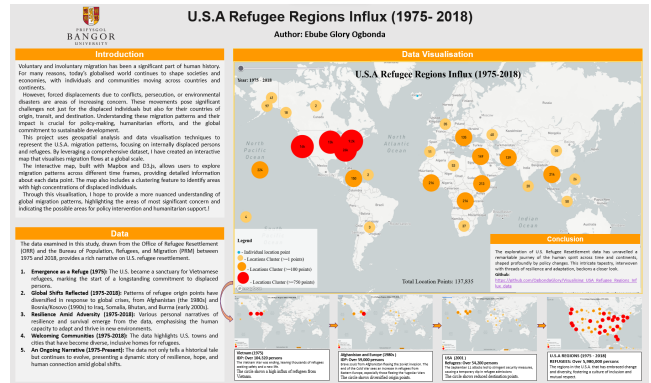


Figure 2: Visual narrative poster of U.S. Immigration data, showing main ‘hero’ visualisation and several storyboard frames.

an interactive visualisation while simultaneously integrating this visualisation within a well-structured poster design. The objective was to achieve an optimal balance between narrative clarity, viewer engagement, and visual aesthetics. We amalgamated our meticulously processed dataset with the Mapbox and D3.js libraries. This process transformed the raw refugee migration data into an interactive geospatial visualisation, paving the way for the subsequent design of our poster. Both D3.js [BOH11] and Mapbox [Map23] frameworks facilitated the creation of each component, such as the map, timeline, and data charts. These elements were designed to function interactively, enhancing the user engagement factor.

The primary focus of our poster was an interactive map constructed using Mapbox [Map23]. This map incorporated multi-circle clusters to represent individual refugee movements. The dynamic nature of the data presentation on this map, coupled with responsive interactions enabled by D3.js, allowed users to delve into multiple layers of the visualisation - ranging from a broad geographical view to minute, detail-specific information [Bos15]. In the creation of our narrative, visual and interactive elements played a crucial role. These components were meticulously designed to intuitively guide the viewer through the poster, visually emphasising significant trends and events in U.S. refugee history. By adopting this narrative approach, we uncovered and presented the intricate stories embedded within the extensive dataset, making a complex sociopolitical issue comprehensible to a non-specialist audience [SH10].

A three-tier visual hierarchy guided our poster layout, as shown in Figure 2 and [Ogb23]. First, the poster showcases a dominant ‘big hero’ visualisation – our interactive map – which immediately attracted the viewer’s attention by providing a snapshot of the refugee data [KR16]. Following this, storyboard panels beneath the ‘big hero’ visualisation guide the viewer through specific refugee trends and events, elaborating on the data represented in the central visualisation. Finally, auxiliary meta-information – including the title, introduction, legends, and colour maps – provide the viewer with contextual and additional layers of understanding, ensuring the poster’s self-sufficiency as an information source [KDHL08].

**Evaluation:** We adhered to the Five Design Sheets (FdS) methodology throughout the design process, which guided the itera-

tive design process. This method enabled us to prototype, evaluate, and refine the poster's design, ensuring the final product was user-friendly, informative, and a compelling narrative delivery [RHR16]. Continuous user feedback was solicited and integrated, resulting in a design optimised for engagement and comprehension. Our methodology and design choices underscored the potential of narrative-driven visualisations in a poster format, offering a unique and engaging perspective on complex sociopolitical issues such as refugee movements.

Throughout the design process, we adopted value-driven evaluation principles [Sta14]. This evaluation was focused on refining our designs based on feedback and insights obtained through the FdS process. The aim was to enhance the interpretability and engagement aspects of the visualisation.

#### 4. Results, Reflection, and Lessons Learned

Our case study yielded a narrative-driven visualisation poster that succinctly represents U.S. immigration data, transforming it into a compelling story highlighting critical trends [Sti13]. We employed various metrics to evaluate the efficacy of our visualisation, and sought feedback from a diverse set of participants, ranging from laymen to experts in data visualisation. Their invaluable insights have not only affirmed the success of our poster but also provided opportunities for further refinement [Mun09].

At the heart of our poster is the 'hero visualisation', an intuitive representation of the data that is captivating and easy to grasp. Complementing this centrepiece are storyboard elements that enrich the narrative by providing additional context, detail, and depth [Few12]. Feedback from various evaluators confirmed the poster's effectiveness in communicating the narrative while retaining its visual allure. Furthermore, our evaluation framework enabled us to make data-driven refinements to our design, improving its aesthetic and informational value.

The journey through the design process elicited several key insights, providing us with a rich understanding of the challenges and opportunities inherent in the creation of narrative visualisations.

1. **Understanding the Data:** The critical initial phase involved extensive exploratory data analysis (EDA) to understand the dataset's complexities fully. This phase significantly influenced our subsequent decisions regarding which aspects to emphasise and how to represent them [Few09] visually.
2. **Identifying the Story:** Following data comprehension, we embarked on extracting the narrative from the immigration data. We analysed the dataset meticulously, identifying crucial trends, anomalies, and patterns. The most significant and impactful narrative was then chosen for visual representation [SH10].
3. **Telling the Story:** With the narrative identified, the challenge lay in deciding how to present it effectively. The 'big hero' visualisation became the anchor, instantly drawing attention, while storyboard elements provided additional details to enhance the narrative's depth [SH10].
4. **Balancing Textual and Visual Elements:** We faced the challenge of achieving a harmonious balance between text and visuals. Excessive text could overwhelm the viewer, while too little could lead to confusion. We endeavoured to achieve a symbiotic

balance that would promote understanding without compromising engagement [Few12].

The project provided us with valuable insights into the design of visualisation posters. Of these insights, the need for a balanced design — integrating title, affiliation, big hero visualisation, storyboard elements, and legend — stood out. This balance significantly enhanced the poster's standalone capability [LRC12]. Additionally, our methodical approach — understanding the data, identifying the narrative, the design development and deciding on the presentation — underpinned the entire design process. This framework of steps may serve as a valuable guide for future projects involving similar visualisation design [FW08].

#### 5. Conclusion and Future Work

Our project contributes to data visualisation by defining a process to create engaging posters embodying narrative storytelling techniques. Through our case study using U.S. immigration data, we have demonstrated the value of thoughtfully planned and executed visualisation posters. Our process underlines the essence of creating a compelling 'hero' visualisation, establishing a coherent narrative flow, and balancing informational content across text and visual elements. Moreover, our paper has further implications, demonstrating the utility of data visualisation in transforming complex data into accessible and engaging narratives. This is particularly relevant today, where data-driven insights are critical for decision-making across diverse sectors, from public policy to business strategy.

There are several avenues for further enhancement of our work. First, there is scope to incorporate more user feedback into the design process. Although our design methodology was carefully crafted, additional user perspectives can offer valuable insights into enhancing the poster's readability and overall impact. Furthermore, integrating interactive features in the poster design can significantly augment user engagement and comprehension. Digital platforms that support such interactivity could be explored for this purpose. Second, applying our methodology to diverse datasets can further validate its applicability across different scenarios. This paper's design principles and techniques are not exclusive to immigration data and can be extended to other areas. Testing our approach on different datasets and refining it based on the unique characteristics of each dataset will enhance its robustness and versatility. Third, we plan to automate some aspects of the poster creation process. Machine learning algorithms could be utilised for determining optimal layouts and design elements based on the nature of the data, the intended narrative, and user preferences.

In conclusion, our work illuminates the potential of narrative data visualisation in poster format, serving as a foundation for future endeavours in this domain. The case study highlights the crucial role of meticulous, insightful design in creating effective visual narratives. Indeed it underscores the necessity for continuous learning, adaptation, and refinement in the process of design and highlights the potential of well-crafted visual narratives as tools for communication. Our approach can be applied and further refined by others interested in creating data-driven, visually compelling, and informative posters.

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