Information Visualization Redesign Project

by Qirui Zhao

General metrics

14,291	1,840	170	7 min 21 sec	14 min 9 sec
characters	words	sentences	reading time	speaking time

Score

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Writing Issues

50	5	45
Issues left	Critical	Advanced

Writing Issues

12	**Correctness**	
2	Comma misuse within clauses	
6	Closing punctuation	
1	Incorrect phrasing	
1	Confused words	
1	Determiner use (a/an/the/this, etc.)	

1 Punctuation in compound/complex sentences

1 **Clarity**

1 Wordy sentences

1 **Engagement**

1 Word choice

Unique Words

Measures vocabulary diversity by calculating the percentage of words used only once in your document

36%

unique words

Rare Words

Measures depth of vocabulary by identifying words that are not among the 5,000 most common English words.

45%

rare words

Word Length

Measures average word length

6.4

characters per word

Sentence Length

Measures average sentence length

10.8

words per sentence

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Concise explanation

This critique(Figure 2) of the cooling degree visualization(Figure 1) applies a structured method based on visual perception theory and data ethics. The

process begins with identifying the infographic's intent—to communicate global cooling energy demand under climate change scenarios. It then analyzes visual encoding strategies (color, layout, resolution), evaluates perceptual clarity and[1] assesses compliance with the FAIR data principles. The critique incorporates theoretical references from Edward Tufte[2]

Edward R. Tufte, The Visual Display of Quantitative Information (Cheshire, CT: Graphics Press, 1983).

, Colin Ware

Colin Ware, Information Visualization: Perception for Design, 4th ed. (San Francisco: Morgan Kaufmann, 2021).

, and Wilkinson

Sandia National Laboratories, "FAIRer Data," 2022, https://www.sandia.gov/fairer-data.

. Based on these evaluations, specific recommendations are made to enhance interpretability, accessibility, and data transparency.

Research – Literature-Inspired Analysis

Figure 3: Flowchart of Perception! Immersion! Empowerment! Superpowers as Inspiration for Visualization(2022)

The visualization flowchart in Figure 3 systematically explores the research process, illustrating how fictional superpowers can be integrated into data visualization. This study follows the eight structured research facets outlined by Card et al.

Stuart K. Card, Jock D. Mackinlay, and Ben Shneiderman, Readings in Information Visualization: Using Vision to Think (San Francisco: Morgan Kaufmann, 1999).

and Munzner

Tamara Munzner, Visualization Analysis and Design (Boca Raton: CRC Press, 2014).

, to establish a framework for immersive and empowering visualization techniques. While traditional visualization prioritizes efficiency,[3] and accuracy, it often lacks user engagement and cognitive enhancement. Inspired by sci-fi superpowers, this research investigates how visualization can augment perception, and cognition, thereby making data interaction more intuitive, and impactful[4]

Wesley Willett, Petra Isenberg, Anastasia Bezerianos, and Pierre Dragicevic, "Embedded Data Representations," IEEE Transactions on Visualization and Computer Graphics 27, no. 2 (2021): 1171–1181.

. By incorporating elements like enhanced vision, predictive analytics, and attention amplification, visualization has the potential to[5] improve decision-making, and user experience in various fields.

A central question in this research is how superpower-inspired metaphors can be translated into effective visualization techniques that enhance user perception, and interaction. To address this, the study explores key application scenarios, including AR/VR interfaces, assistive technologies, predictive analytics, and immersive education, demonstrating the practical value of these concepts[6]

Card, Mackinlay, and Shneiderman, Readings in Information Visualization.

. The methodology involves analyzing superpower mechanics in fiction, mapping them to cognitive, and perceptual frameworks, designing visualization prototypes, and conducting empirical user testing to measure effectiveness

Munzner, Visualization Analysis and Design.

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Findings reveal seven superpower-inspired visualization models, each offering unique improvements in data perception, interactivity, and predictive capabilities. These models bridge the gap between HCI, cognitive science, and visualization research, shifting the focus from efficiency-driven design to experience-driven and cognitively empowering approaches[7]

Willett et al., "Embedded Data Representations."

. The study's intellectual merit lies in two key aspects. First, it contributes to the literature by expanding the theoretical foundation of visualization research, referencing both seminal works like Card et al.

Card, Mackinlay, and Shneiderman, Readings in Information Visualization.

and recent advancements in immersive visualization frameworks

Munzner, Visualization Analysis and Design.

. Second, it identifies key limitations, such as the need for further empirical validation across diverse user groups, and adaptation to real-world datasets, providing a basis for future research on superpower-inspired visualization techniques.

The practical impact of this research extends to AR/VR innovation, accessibility tools, interactive education, and business analytics, where visualization can empower users through enhanced cognitive capabilities. Future studies can refine these techniques, exploring new cognitive frameworks, and evaluating their long-term impact on data interaction and decision-making. By integrating fictional cognition into real-world visualization, this research redefines visualization as an immersive, empowering medium for human-computer interaction.

2

Practice – Tool-Driven Redesign Preparation

Experiment with Amazon QuickSight (Theory & Practice)

Figure 4: Workflow of the Visualization Process by Amazon QuickSight

Figure 5: Analysis of the Impact of Discounts and Quantity on Profit

Dataset Description

The dataset used in the heatmap visualization is sourced from SaaS-Sales.csv and analyzes the relationship between Discount, Quantity, and Profit (Amazon Q, n.d.)

Amazon Q, "AI Assistant — Amazon Q — AWS," n.d., https://aws.amazon.com/cn/q/.

. It contains 9,994 transaction records from SaaS product sales, covering multiple industries, customer segments, and regions. This dataset helps businesses understand how discounting strategies impact profitability by examining different discount levels and purchase quantities.

Key Variables

Discount (%) – The percentage reduction applied to sales prices, which directly influences revenue and customer purchase decisions.

Quantity – The number of units sold per transaction, affecting overall sales volume and revenue generation.

Profit ($) – The total profit generated after applying discounts, reflecting the financial performance of sales strategies.

Dataset Scope and Structure

Figure 5 (Analysis of the Impact of Discounts and Quantity on Profit) visualizes profitability trends across different discount and quantity combinations. Key insights derived from this visualization include:

1. Trends and Patterns Identified

High-profit regions (red areas) emerge when discounts are low and sales quantities are high, highlighting the effectiveness of moderate pricing

strategies.

Significant losses (blue areas) occur when high discount rates coincide with low sales volumes, emphasizing that excessive discounting without sufficient demand erodes profitability.

Missing data points (purple areas) indicate that certain discount-quantity combinations were either rare or nonexistent in recorded transactions.

2. Decision-Making and Understanding the Data

The insights from this dataset assist businesses in refining their discount strategies by:

Identifying the optimal discount levels that maximize revenue while maintaining profitability.

Avoiding discounts that lead to negative profits, ensuring sustainable business performance.

Using data-driven pricing models to balance competitive pricing with financial health.

By leveraging these insights, businesses can develop strategic pricing policies that drive long-term revenue growth while minimizing financial risks[8]

Gartner, Magic Quadrant for Analytics and Business Intelligence Platforms, 2023, https://www.gartner.com.

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Critical Evaluation of Amazon QuickSight

Amazon QuickSight is an effective data visualization tool that efficiently extracts insights from datasets and provides interactive visualizations without coding. The tool provides[9] customization options for legends and labels, allowing users to adjust visual elements to some extent. Additionally, Amazon Q helps users generate relevant tables for exploring specific analytical questions

and enables modifications based on requirements. Furthermore, QuickSight includes predictive modeling capabilities, allowing users to identify trends and forecast future outcomes, making data-driven decision-making more effective. However, QuickSight has several limitations. For instance, the heatmap visualization does not allow setting a middle reference value, such as zero for Profit, which makes it harder to differentiate between positive and negative values effectively. Amazon Q struggles with handling complex modifications, making it difficult to refine charts beyond basic settings. Additionally, the interface lacks flexibility for advanced users who require detailed adjustments to elements like axis scaling and conditional formatting, making it not versatile enough to use.

Improvements & Recommendations

To improve the user experience, QuickSight should introduce more customization options, such as allowing manual adjustments to color scales and axis references.

Enhancing Amazon Q's AI capabilities to interpret and execute complex modifications would also make the tool more adaptable to user needs. Gartner's 2023 BI report highlights QuickSight's strong cloud-based analytics but acknowledges its UI limitations. Addressing these areas would help QuickSight compete more effectively with industry leaders.

A Summary of Tool Exploration and Redesign Strategy

As part of my visualization critique and redesign process, I initially explored Amazon QuickSight as the primary tool for reworking the filled map visualization. However, due to QuickSight's limitation in exporting complete interactive visualization data, I decided to generate reference images using QuickSight and then use Google Colab to edit Python code and recreate the

visualization manually. This approach allowed me to retain QuickSight's visual style while overcoming its data export constraints.

In this process, QuickSight was used to experiment with dynamic filtering, tooltip customization, and enhanced legends. The generated images served as prototypes and the final visualization was recreated in Colab through customized coding, enabling precise control over visual elements and interactivity that were otherwise limited in QuickSight.

This hybrid approach of combining QuickSight's visual capabilities with the flexibility of Colab coding ensures that the redesigned visualization not only maintains aesthetic consistency but also provides greater control over data representation and interaction.

Innovation – Final Redesign and Integration

Redesign Summary

Title

Enhancing Climate Risk Communication

Inspiration and Theoretical Foundations

This redesign is inspired by a combination of theoretical and practical sources:

Tufte[10]

Edward R. Tufte, The Visual Display of Quantitative Information (Cheshire, CT: Graphics Press, 1983).

– For minimizing chartjunk and maximizing data-to-ink ratio.

Ware

Colin Ware, Information Visualization: Perception for Design, 4th ed. (San Francisco: Morgan Kaufmann, 2021).

– For applying perceptually effective color schemes and reducing cognitive load.

FAIR Data Principles

Sandia National Laboratories, "FAIRer Data," 2022, https://www.sandia.gov/fairer-data.

– To ensure data transparency and reuse.

Tools

Amazon QuickSight

Amazon Q, "AI Assistant — Amazon Q — AWS," n.d., https://aws.amazon.com/cn/q/.

(for generating reference images)

Google Colab

Google Colab is a hosted Jupyter notebook[12] environment by Google used here for customized visualization development.

(for code-based visualization recreation)

Source

Climate Risk and Economic Losses

https://www.kaggle.com/datasets/thedevastator/global-climate-risk-index-and-related-economic-l?resource=download

Redesign Improvements Over Original[13]

The redesign introduces several key improvements over the original filled map. While QuickSight was used to prototype the visualization and generate reference images, the final version was recreated using Google Colab to enable more detailed customization and flexibility.

A color gradient from red to yellow to blue was applied, clearly distinguishing the Climate Risk Rank across regions while also improving accessibility for visually impaired users. Additionally, the dark mode of the QuickSight map was utilized in the reference images, reducing background clutter and enhancing data contrast.

The background source data was provided, allowing users to accurately pinpoint the location of the visualized data in the source tables. To further enhance interactivity, hover functions were implemented in the Colab-recreated version, allowing users to view the Climate Risk Rank and Climate Risk Score for each region when hovering over different areas. Furthermore, the redesign includes metadata links and relevant licenses, ensuring that the data is open and compliant with the FAIR principles—Findable, Accessible, Interoperable, and Reusable. These improvements not only make the heatmap more visually intuitive and accessible but also significantly enhance the user interaction experience,[14] while ensuring the data meets high standards for transparency and usability.

Bibliography

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Sandia National Laboratories. "FAIRer Data." 2022. https://www.sandia.gov/fairer-data.

Tufte, Edward R. The Visual Display of Quantitative Information. Cheshire, CT: Graphics Press, 1983.

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Additional Flowcharts

Figure 6: Final project implementation process

Figure 7: Overall Redesign Workflow

1.	, and	Comma misuse within clauses	Correctness
2.	Tufte.	Closing punctuation	Correctness
3.	efficiency,	Comma misuse within clauses	Correctness
4.	impactful.	Closing punctuation	Correctness
5.	can potentially	Wordy sentences	Clarity
6.	concepts.	Closing punctuation	Correctness
7.	approaches.	Closing punctuation	Correctness
8.	risks.	Closing punctuation	Correctness
9.	~~provides~~ → offers, includes	Word choice	Engagement
10.	Tufte.	Closing punctuation	Correctness
11.	– *For minimizing chartjunk and maximizing data-to-ink ratio.*	Incorrect phrasing	Correctness
12.	~~notebook~~ → Notebook	Confused words	Correctness
13.	the Original	Determiner use (a/an/the/this, etc.)	Correctness
14.	experience,	Punctuation in compound/complex sentences	Correctness