

Dustin Nghiem

UWP 001

21 March 2025

## **The Impact of Design and Writing Choices in Data Visualization on Audience Engagement and Understanding**

### **Introduction**

Since the early 21st century, data visualization has become a vital component of information dissemination in fields ranging from health and journalism to education. Technology has become a valuable asset, contributing to the digital age we live in where it has amplified the necessity of presenting complex information in an engaging and accessible manner. Data visualization is the graphical representation of information and data through charts, graphs, maps, and other visual formats. It has emerged as a powerful storytelling tool that allows audiences to identify patterns, trends, and relationships more easily than dealing with raw numbers or text alone. Design and writing choices play a crucial role in shaping the audience's engagement and comprehension, with factors such as cognitive load, interactivity, and visual hierarchy shaping how audiences interpret and interact with the data. Despite the growing prevalence of data visualizations, there is still a huge debate regarding the best design strategies to optimize audience understanding, where some would say that interactivity can hinder rather than help people. With conflicting perspectives, it is important to investigate which design and writing elements contribute most effectively to the success of data visualization. This ongoing debate raises important questions about which design and writing elements contribute most effectively to the success of data visualization. As someone highly interested in how data can be communicated and its

influence on decision-making, particularly how these design choices affect the audience engagement and understanding, I find it important to investigate which elements can truly make a difference in how data can be perceived.

## **Research Question**

1. How do different design and writing choices in data visualizations impact audience engagement and understanding?

## **Literature Review**

Alhadad discusses the cognitive mechanisms underlying data visualization interpretation. According to her research, human cognition has limited processing capacity, and poorly structured data visualizations can lead to cognitive overload. When users are presented with overly complex graphics, their ability to extract meaningful information diminishes, leading to confusion and disengagement. She asserts, “Managing cognitive load based on capacity limitations means ensuring that cognitive resources are best allocated to essential processing for understanding the data...” (Alhadad 63). To mitigate cognitive overload, visualization designers must consider several key strategies. First, reducing unnecessary visual elements, such as excessive colors, extraneous labels, and redundant text, can help users focus on the core message of the visualization. Second, utilizing structured layouts, such as grids and aligned text, can guide the user's eye smoothly through the data, reducing strain and enhancing comprehension. Third, breaking down large datasets into manageable chunks, a technique known as data chunking, allows users to process information in stages rather than feeling overwhelmed by an excess of figures at once. Another crucial factor in reducing cognitive load is the use of familiar visual metaphors. People process visuals more effectively when they resemble real-world experiences. For instance, bar

charts and line graphs, which mimic counting and movement patterns, tend to be easier for users to interpret compared to abstract representations like radar charts or tree maps. Cognitive research supports the notion that aligning data representation with natural human perception patterns enhances audience engagement and retention.

Perkhofer et al. explore the role of interactivity in enhancing data visualization effectiveness. Their study found that participants who interacted with dynamic visualizations completed tasks faster and reported higher satisfaction compared to those using static visualizations as indicated by the superior response times for all interactive visualization types in their given table (Perkhofer et al. 75). These findings suggest that interactivity enhances user engagement by allowing audiences to explore data at their own pace and focus on areas of personal interest. However, while interactivity offers numerous advantages, it also introduces potential drawbacks. Perkhofer et al. caution that excessive interactivity can lead to cognitive overload, particularly for users with poor data literacy. For example, it can become overwhelming rather than helpful when interactive features are too complex, requiring users to toggle multiple settings, filter numerous data points, or adjust visual parameters. Instead of aiding comprehension, excessive interactivity may cause frustration and diminish overall engagement. To optimize interactivity in data visualization, researchers suggest incorporating guided interactivity. This involves structuring interactive elements to provide progressive disclosure, revealing data insights step-by-step. Interactive dashboards, for instance, can offer preset views that highlight essential data trends while allowing users to explore deeper layers of information if desired. Additionally, hover-over tooltips, collapsible sections, and embedded explanations can help users navigate complex data without feeling overwhelmed. Another key consideration is user control. Research shows that providing users with some level of autonomy, such as allowing them to zoom in, pan

across datasets, or highlight specific values, can significantly improve engagement. However, designers must ensure that these controls are intuitive and do not require extensive prior knowledge. Well-designed interactivity enhances curiosity and exploration while ensuring that users remain focused on the primary message of the visualization.

Tong investigates the use of narrative techniques in data visualization. His research underscores the importance of storytelling elements in improving audience engagement and comprehension. He states that a well-structured visualization with clear annotations and guided narratives enhances user comprehension and trust. The inclusion of narrative elements—such as context-setting, step-by-step explanations, and visual emphasis—allows audiences to connect with the data on a deeper level. Storytelling in data visualization goes beyond simply presenting numbers; it involves crafting a coherent narrative that guides the viewer through the information. One effective strategy is sequencing, where complex information is introduced in logical steps, similar to a traditional written story. This method prevents overwhelming the audience and helps maintain engagement. For example, The New York Times, a news organization, uses scrolling techniques, where visualizations can evolve dynamically as the user scrolls through an article. This technique combines text, imagery, and animation to create an immersive data experience (Tong 156). Additionally, color and design choices impact the effectiveness of data storytelling. Tong highlights that color-coding different data points, emphasizing key sections with contrast, and using visual hierarchy techniques (such as bold typography and layered visuals) can significantly enhance user engagement. A well-designed color scheme can guide the eye naturally across a visualization, making it easier to follow trends and derive meaningful insights (Tong 147)

Altogether, these sources provide insight into the vital factors that influence the effectiveness of data visualization, which are cognitive load management, interactivity, and

storytelling. Alhadad's research highlights the importance of designing aspects that will align with human cognitive capacities to avoid overwhelming the audience, reinforcing clarity and simplicity in presenting data. Perkhofer et al. demonstrate that interactivity can enhance engagement when structured thoughtfully, but it can cause cognitive overload if poorly implemented. Tong's study emphasizes the role of narrative techniques in data visualization that make data more accessible and meaningful to the audience. These findings are important for my study as they show the importance of balancing complexity and usability in visualization design. Implementing such principles aims to explore how different combinations of interactive elements, visual clarity, and storytelling impact audience engagement and comprehension.

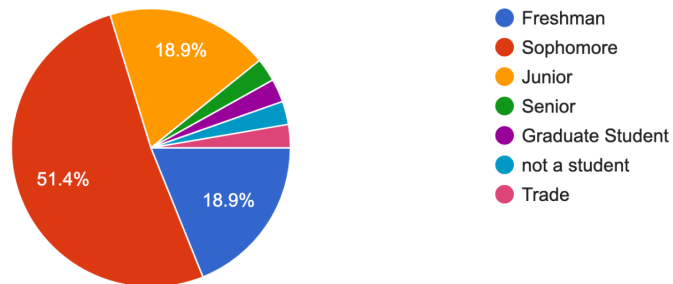
## **Methods**

My primary research involved creating a survey through Google Forms and distributing it to students who provided their answers anonymously. For this case, surveys are the better form of collecting data for gathering and figuring out general trends through quantifiable data without being time-consuming for the participants. The survey consisted of 12 questions ranging from multiple-choice, select all that apply, and some writing portions. Having a variety of questions allows me to get a straight-up answer while also allowing the people to give their answers and opinions. This Google survey was distributed through social media accounts such as Instagram, Discord, and iMessage to get some variability in the data. The number of participants in this survey was thirty-seven students, which consisted of both UC Davis students and those outside of Davis. The data is presented through a multitude of graphs, such as pie charts and bar graphs, to visualize the general trends. The conclusions that are formed from these graphs are discussed further in the article. The survey's responses involved seven freshmen students, nineteen sophomores, seven juniors, and one senior, and the rest were graduate students, not students or in trade school. The

percentage distribution of the university year is shown below. The number of freshmen and juniors was equal, while the sophomores made up the largest percentage of the total participants.

What year are you in college?

37 responses

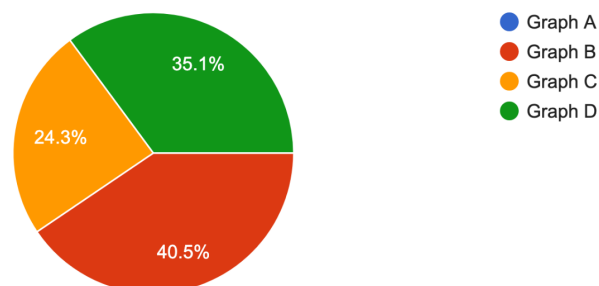


## Results

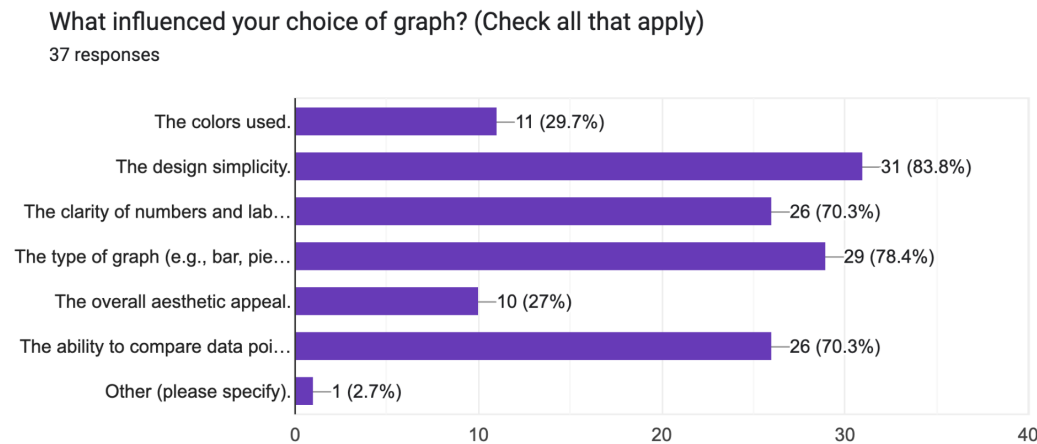
The foundation for this survey revolves around four graphs, which can be found in the appendix, showing different ways a certain dataset could be visualized. The participants were then asked to choose only one out of the four visuals that made it easier for them to understand while also keeping them engaged. The graph below shows that 40.5% of the participants chose graph B, which was the popular pick for this survey. In general, we would want to understand what influenced them to choose their respective graph.

ABOVE are four different graphs visualizing data of monthly sales. Please select the one that you find the MOST engaging and EASIEST to understand (top left of each graph has a letter)

37 responses



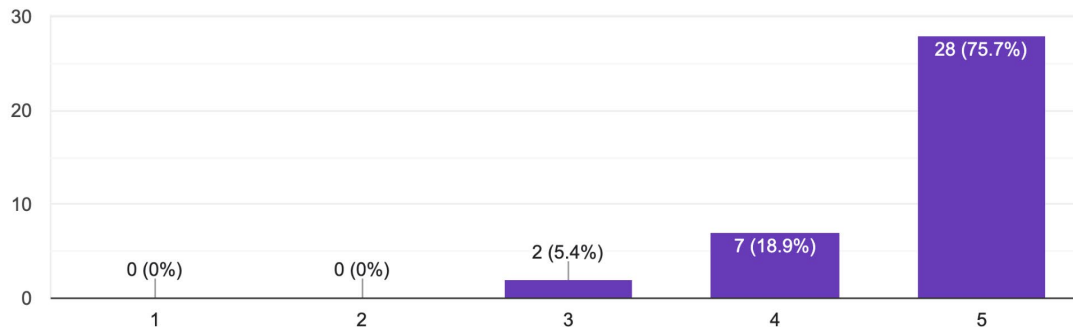
The following graph and the three graphs below will show the distribution between their respective choices without the inclusion of what graph they chose. The most frequent answer for what influenced the participants to choose their respective graph was its design simplicity at 83.8%. If we narrow it down to why Graph B was the popular choice between the four graphs, we find that design simplicity was the top influence, followed by the type of graph chosen for that specific dataset, and how simple it was to compare the data points.



Based on the two graphs below, we find that 75.7% of the participants found their chosen graph to have a max score of 5, meaning that it was very easy to interpret the data. On average, the graphs in the survey were given a 4.7 out of 5 for how easy it was to interpret the data from their respective graphs. We also find that most people found their respective graphs fairly engaging, with most giving it a 4 out of 5. On average, the graphs in the survey were given a 3.9 out of 5 for how engaging it is.

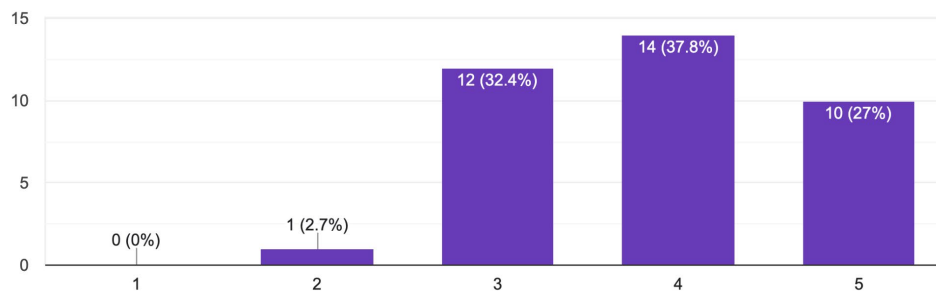
How easy was it to interpret the data from your chosen graph?

37 responses



How engaging did you find the graph?

37 responses

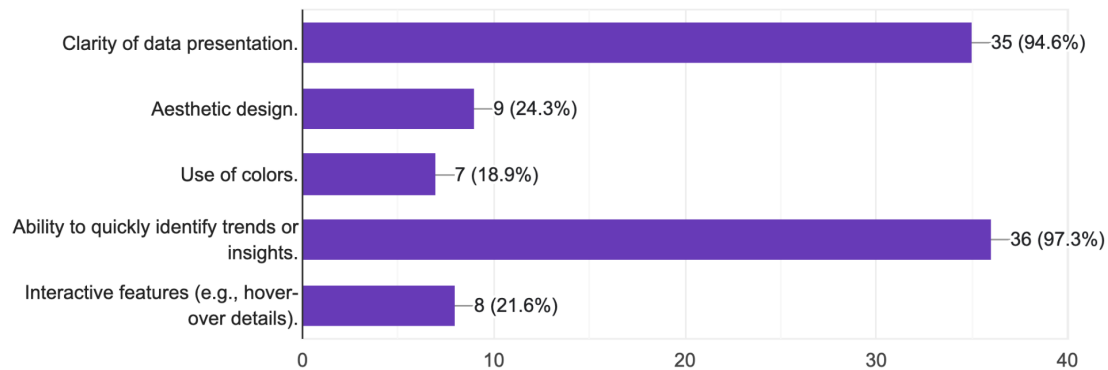


The survey result clearly shows that the two frequently chosen factors for what they value most in data visualizations among respondents are the clarity in the data presentation and the ability to find trends and insights. Many participants emphasized that excessive visual clutter, unclear labels, and overly complex designs made visualizations harder to interpret. One respondent noted, "Find a way to make them easier on the viewer. (Graph) A does not make visual sense. A data visualization should be quickly consumed, not a long process of dissecting what is going on..." (Survey Short Answer). When asked about what can be improved for the graphs they did not choose, many of the responses suggest "make them easier to understand" or to integrate differentiating colors and clearer labels.



**What do you value most in a data visualization? (Choose all that apply)**

37 responses



One of the short answer prompts asked the respondents if they preferred visualizations to include written narratives or explanations within the graph, but the responses varied. Out of the 37 responses for this prompt, 20 people prefer to have written narratives within the graph, suggesting that they want something minimal while adding “more context for the data and what the viewer should be observing as it provides clarity” (Survey Short Answer). On the other hand, the people who preferred not to have some written explanation explained that the visualizations should “speak for itself” and that “too many words on the graph can take away from the focus of what the graph is, along with adding too many distractions” (Survey Short Answer).

**Discussion**

Based on the data from the graphs above and the short answer responses from the survey, it is evident that what most people value the most and prefer out of visualizations is the visual clarity and ability for anyone to quickly identify trends. This aligns with Alhadad’s research, which highlights how excessive cognitive load reduces comprehension and engagement. Visualization designers must minimize unnecessary elements and prioritize clarity to ensure that cognitive resources are allocated effectively. The majority of respondents expressed a preference for data

visualizations that incorporate written explanations and narratives. This directly supports Tong's argument that narrative techniques enhance comprehension. By providing guided annotations, context-setting, and sequential storytelling elements, data visualization designers can help audiences engage with the data more effectively and efficiently.

This research focuses on students both from and not from UC Davis, and those who do not go to school. An additional aspect of this survey is that the students were not randomly selected to answer it since it was shared through Instagram. This means that the participants who answered it came from different majors with different backgrounds. Future research could address these limitations by implementing a more random sampling method to capture a wider range of user experiences and by sharing the survey through more social media accounts. Additionally, potentially looking into the demographics and seeing how that affects the preferences for data visualization to find more insight on better practices for specific fields and audiences.

## **Conclusion**

This study reinforces the importance of cognitive load management, interactivity, and storytelling in data visualization. The survey results demonstrate that design simplicity is the most valued aspect of a visualization, excessive interactivity can be overwhelming, and storytelling elements are preferred by the majority to enhance comprehension. By applying these principles, designers can create visualizations that balance engagement and usability, ultimately improving data communication. Future research could further explore how these elements interact in different contexts, such as business analytics, journalism, and education.

### Works Cited

- Alhadad, Sakinah S. J. “Visualizing Data to Support Judgement, Inference, and Decision Making In Learning Analytics: Insights from Cognitive Psychology and Visualization Science.” *Journal of Learning Analytics*, vol. 5, no. 2, 2018, pp. 60–85
- Perkhofer, L., Walchshofer, C., & Hofer, P. “Does Design Matter When Visualizing Big Data? An Empirical Study to Investigate the Effect of Visualization Type and Interaction Use.” *Journal of Management Control*, vol. 31, 2020, pp. 55–95.
- Tong, Jingrong. *Data Journalism and the COVID-19 Disruption*. 1st ed., Taylor & Francis Group, 2024.

## Appendix

1. What year are you in college?\*

- A. Freshman
- B. Sophomore
- C. Junior
- D. Senior
- E. Graduate Student
- F. Other:

2. How familiar are you with data visualization?\*

- A. Not familiar: I've rarely or never encountered data visualizations.
- B. Somewhat familiar: I've seen data visualizations but don't analyze them often.
- C. Familiar: I understand and interpret data visualizations regularly.
- D. Very familiar: I frequently create and analyze data visualizations.
- E. What is your major or field of study?\*

Your answer

### **VISUALIZATION SELECTION**

Graphs



3. ABOVE are four different graphs visualizing data of monthly sales. Please select the one that you find the MOST engaging and EASIEST to understand (top left of each graph has a letter)\*

- A. Graph A
- B. Graph B
- C. Graph C
- D. Graph D

#### FOLLOW-UP TO VISUALIZATION SELECTION

4. What influenced your choice of graph? (Check all that apply)\*

- A. The colors used.
- B. The design simplicity.
- C. The clarity of numbers and labels.
- D. The type of graph (e.g., bar, pie, line).
- E. The overall aesthetic appeal.
- F. The ability to compare data points easily.
- G. Other (please specify).

5. How easy was it to interpret the data from your chosen graph?\*

VERY DIFFICULT

1

2

3

4

5

VERY EASY

6. How engaging did you find the graph?\*

NOT ENGAGING

1

2

3

4

5

VERY ENGAGING

7. Did the graph effectively communicate the key insights of the data? \*

A. Yes

B. No

8. If no to the previous question, what improvements would you suggest?

9. How would you improve the graphs you did not choose?\*

**GENERAL PREFERENCE**

10. What do you value most in a data visualization? (Choose all that apply) \*

A. Clarity of data presentation.

B. Aesthetic design.

C. Use of colors.

D. Ability to quickly identify trends or insights.

E. Interactive features (e.g., hover-over details).

11. Do you prefer visualizations to include written narratives or explanations? Why or why not?  
(Short answer)\*

12. Have you encountered any visualizations that were difficult to understand? If so, what made them challenging?\*