

Discussion of the role of perception in visualization: From Cleveland to Heer, we understand how much and why it is important

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Abstract: This paper starts with the literature review from Cleveland to Heer, and deeply discusses the role of perception in the visualization process, and the importance of understanding this role. The study points out that visualization is not only a process of conveying data, but also a process of interacting with the audience's perception. Effective visualization leads viewers to better understand and interpret the data, which also relies on a deep understanding of the perceptual process. By exploring the role of perception in the visualization, this paper highlights the importance of perception in the design process, and provides designers with suggestions on how to better utilize perceptual principles to improve the effectiveness and influence of data visualization.

Keywords: Perception; Visualization; Data interpretation; Cognitive process; Design principles.

1. Introduction

In today's data-driven era, data visualization has become an important means of information transmission. From simple graphs to complex interactive visualizations, these tools play an integral role in helping us to understand, interpret and explore data. However, the visualization is not only about the data. It is about how we interact with the data and how we understand and interpret it. In this process, our perception plays a decisive role. We see the importance and complexity of perception in visualization from the Cleveland to Heer et al. This paper aims to delinto the role of perception in visualization and address why understanding this role is crucial.

2. Knowledge of the role of perception in the visualization

Cleveland and McGill Article points out that perception plays a crucial role in visualization. Visual perception is the main way for human beings to obtain information. By presenting the data into graphics or images through visualization, people can obtain and understand the information in the data more quickly and more accurately. In addition, the Heer and Bostock article also highlights the importance of perception in visualization, indicating that perception can help people understand the relationships and patterns between data.

3. Why it is important to understand the role of perception in visualization

Understanding the importance of the role of perception in visualization has several reasons for improving data interpretation and understanding, promoting cross-cultural and cross-language communication, and improving decision-making efficiency and accuracy.

By using the principle of perception, we can design more effective visualization schemes that can help people better

interpret and understand the data. This has important implications for scientific research, business analysis, and the processing of large amounts of data in daily life.

In many fields, such as medicine, finance and weather forecasting, accurate perceptual visualization is crucial to improve decision-making efficiency and accuracy. Understanding the role of perception in visualization can help us to design more effective decision support tools.

In my opinion, visual language is a global universal language, and through the role of perception in visualization, we can better use visual elements and design to convey information and promote cross-cultural and cross-linguistic communication.

4. What is the relationship between perception and visualization

Perception is the process of people acquiring and understanding the information in the surrounding environment. Visualization is the presentation of data, information and knowledge in visual form for people to understand and analyze. Thus, the relationship between perception and visualization is closely related. Visualization helps people to better perceive and understand information by transforming complex data into easy-to-understand visual forms. At the same time, people's perceptual ability also limits the effect of visualization, because people can only perceive the limited information presented by the visualization. Therefore, in the visualization design process, people's perceptive characteristics and limitations need to be fully considered to improve the visualization effect as much as possible.

5. What are the similarities and differences between Cleveland and Heer

Cleveland and Heer are two important scholars in the field of visualization, and their theories or methods exist in some ways. The same point is that both Cleveland and Heer emphasize the importance of visualization in scientific

research and exploration. They believe that visualization can help scientists better understand data and phenomena, discover new laws and patterns, and better conduct scientific communication and cooperation. In addition, they are all committed to promoting the development and innovation of visualization technology to meet the growing demand of data volume and complexity.

The difference is that Cleveland pays more attention to the research of basic visualization methods and principles. He emphasizes the status of basic disciplines of visualization and the importance of interdisciplinary disciplines. Heer, on the other hand, focuses more on the application and practice of visualization, on promoting the practical application and popularization of visualization, as well as the crossover research with other fields. In addition, with time and technology, Heer's visual academic ideas are evolving and deepened.

6. How to evaluate the role of visualization in decision-making

Evaluation of the role of visualization in decision making is an important issue, as visualization is widely used in many fields to assist decision making and problem solving.

To assess the role of visualization in decision making, consider the evaluation by comparing the quality of decisions before and after the use of visualization. If the use of visualization improves the quality of decision making, then it can be considered that visualization plays a positive role in decision making.

And visualization can help people quickly understand and



Fig. 1 Using data ink ratio to organize data and make it occupy a central position

7.2. Use color and text effectively

While bringing data to life through effective use of color and text, the power of color and the wisdom of language communication is the simplest design decision, which can take your data visualization from excellence to excellence. Discuss the importance of color. Strategic use of color can increase memory points, aid in pattern recognition, and attract attention to priority information. It is important to use color effectively to trigger associations and make important information stand out. But, we should be careful not to let too many colors over whether audience, because the brain can hardly handle many different things at once. Therefore, using the correct color set in the visualization will improve the insight speed.

Stories need to have words, so annotated notes with words can add additional detail, emphasize points of interest, or just as a means of interpretation. However, overcrowding with

analyze data, thus improving the speed of decision making. Therefore, the effect of visualization in decision making can also be considered when assessing its role on decision speed. Visualization can also serve as an effective communication tool to help people of different backgrounds and professionals to better understand and communicate information. Therefore, when evaluating the role of visualization in decision making, one can also consider the advantages in terms of its communication effects.

7. Methods to enhance the visualization effect

This section will go through several practice examples, and below I list 4 methods followed to improve visualization and make it more effective and attractive. The first step is to organize it, so that the data can take up a central position. Second, use color and text effectively to bring the data to life. Step 3 uses diagrams to show my insights or information. The last step connects the points and effectively visualizes the data.

7.1. Organize the data

We need to organize the data first and let it get the data at the center. Edward Tufte, an authority on data visualization, designed a formula to understand the amount of distraction present in data visualization. He called the formula the "data-ink ratio". Good charts should contain only the data-the ink. Remove the non-data ink wherever possible. This was done to avoid attracting the audience's attention to irrelevant elements. Elimination of unnecessary content is a crucial step when effectively using the data for communication.

annotated figures may reduce the visual impact of the data. Therefore, it is important to find the appropriate balance point. Do not feel stressed to include all the information about the chart in text form. Don't want the viewer to be overwhelmed by text paragraphs, large legends, axis labels, and other words. Interesting annotation guides can be found here.

7.3. Insights or information to display using charts

Although there are many ways to visualize data, only a few graphs can deliver information effectively. So, before starting visualizing, ask yourself how many variables you want to show, how many data points you want to show, and how you want to scale the axis. Line lines, bars and bars represent changes over time. Pyramid charts and pie charts show a part of the whole.

7.4. Points connect to become an effective visualization

To answer all the questions, we may put too much information into a chart, which makes the chart viewing experience poor. Rather than creating complex charts, we can design multiple chart forms of the same data, check the iterations allowing to see what the graph sees, and then decide which version to share with our audience.

After visualizing the data in multiple different ways, choosing to use the best graph is often a daunting task. Furthermore, rigorous use of brush and link techniques to

connect multiple views can help visualization more attractive. And make sure that my visualization has clear titles and instructions. Tell people exactly what the visualizations show and how to interact with them, and highlight the elements that interest people for the first time.

The dashboard below shows the economic data of the 20th century. Interaction with this dashboard is not intuitive when I choose a year range, a return range, and even the worst and best years. This dashboard can be made more intuitive by changing something basic, like moving the filter to the top, adding action words to the filter title, and adding colors to highlight good and bad years.

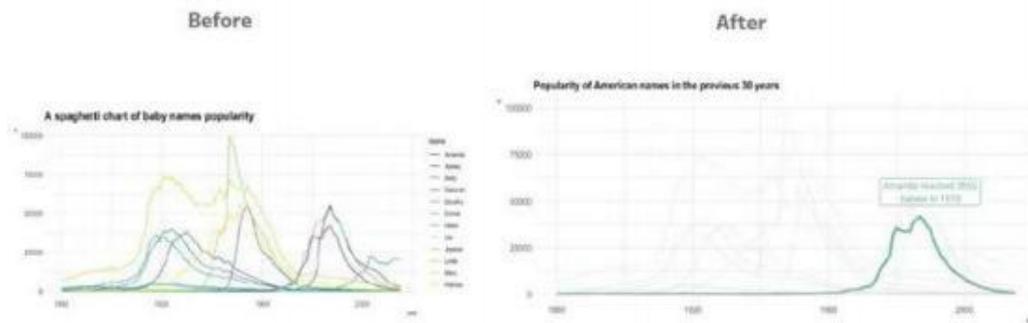


Fig. 2 Bring data to life through effective use of colors and text

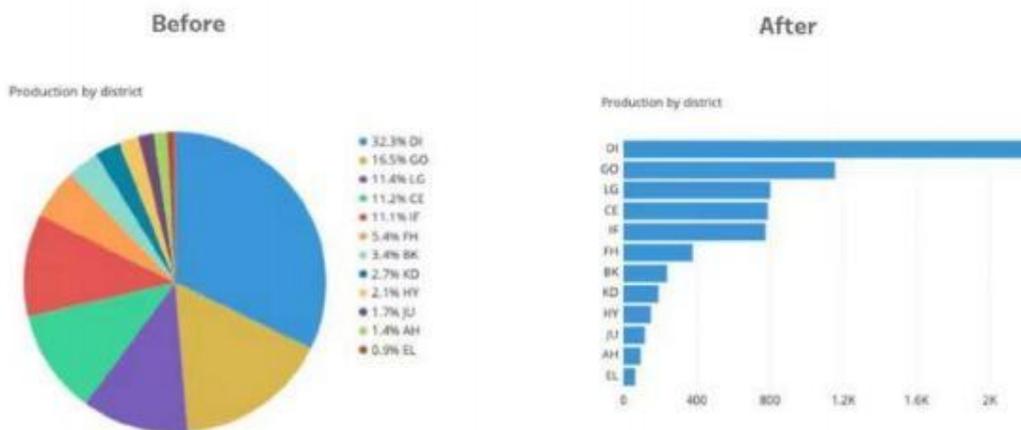


Fig.3 Convert pie charts into bar charts to display information



Fig.4 Connecting various points on the dashboard to create effective visualization

8. Conclusion

We see the importance and complexity of perception in visualization from the Cleveland to Heer et al. By gaining insight into the role of perception in visualization, we can create more effective data visualization tools that address challenges in visualization and better utilize state of the art

visualization techniques. This can not only help us to better communicate and understand the data, but also can promote the innovation and development of data visualization. Thus, understanding the role of perception in visualization is not only important, but also the key to our success in today's data-driven world. Future studies can further explore the specific mechanisms and factors of perception in visualization and

how perception principles can be applied to visualization design practices in different domains and different scenarios.

Through these studies, we are expected to further promote the development of visualization technology to better serve the development and progress of human society.

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