Perception manipulation and subjective reception of data

Filip Horst

Faculty of Electrical Engineering, Warsaw University of Technology, Warsaw, Poland

Introduction

There are numerous data perception studies, but not many of them focus on this unethical use case - **manipulation**. This study involves research on how to use various visual attributes and strategies to manipulate and how effective it really is.

Methodology

- An experiment where **10** tasks based on manipulated charts were presented to a group of recipients as a typical perception study
- Participants (**40** in total, split in 3 groups) were students of Warsaw University of Technology, Applied Computer Science and Electrical Engineering degree courses
- The participants had to choose which company they would prefer to invest in. The allowed answers were names of two companies: **A**, **B** and "**-**" meaning "Not enough data given".
- The first stage involved presenting the charts for **6** seconds.
- In the second stage, the same visualizations were shown again for additional **15** seconds.
- Prior to the last - third - phase, the participants were informed that some of the plots were **manipulated** in an attempt to alter their perception. Then, the charts were presented again for 10-20 seconds.

Results

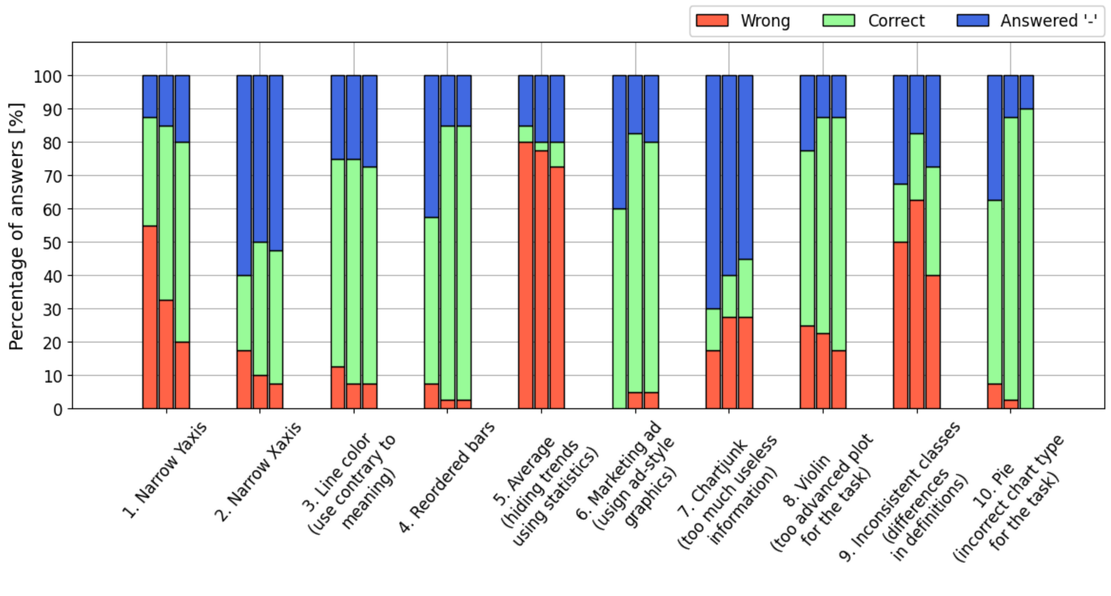

Figure 1: Percentage of different answers in each stage (1 to 3 from left to right) for all tested manipulations (number and label on x-axis)

- The percentage values of the wrong answers (red) show which strategies are the most effective
- Values for "No data" answers (blue) indicate which are the best to hide information
- The changes between the stages show the impact of time and how a more detailed analysis usually leads to less errors

Other observations

Thanks to a more detailed analysis, it can be concluded that:

- Some tasks (chartjunk, violin) were very effective, but only on a small group of recipients
- The observed relationships are insufficient to conclusively determine a correlation between the participants' education and their susceptibility to manipulation

The most effective manipualtions

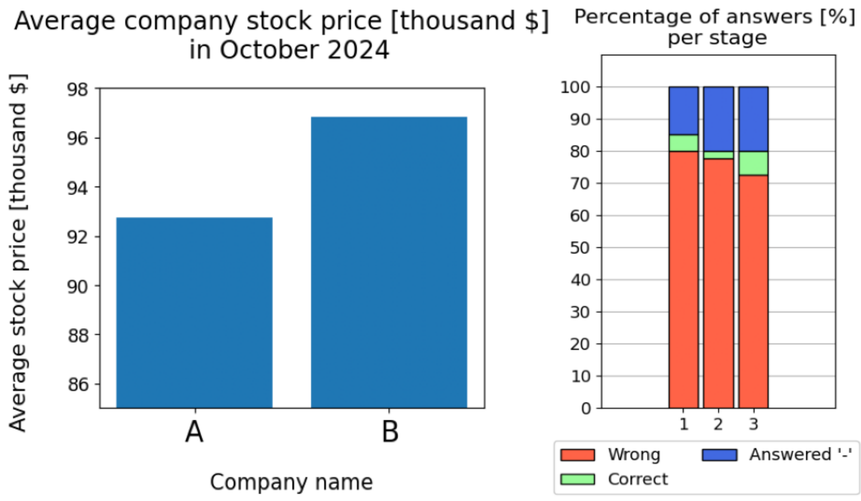

Figure 2: Chart used in the experiment as "Average" and achieved results

The Company B stock prices dropped very dynamically, yet thanks to much higher initial value, the average price in the given period was still higher than Company A's slowly, but consistently rising value.

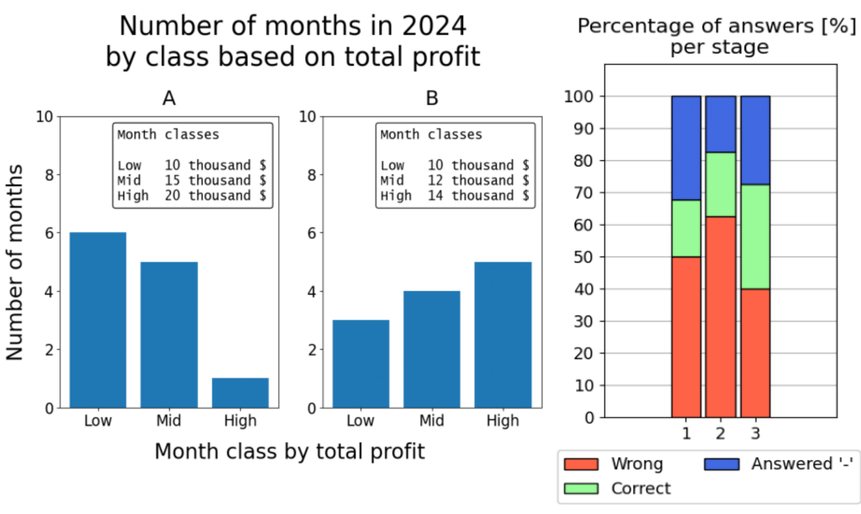

Figure 3: Chart used in the experiment as "Inconsistent classes" and achieved results

Different class definitions led to more months being classified as "High" for Company B, which at first glance made it appear as more successful than its competitor.

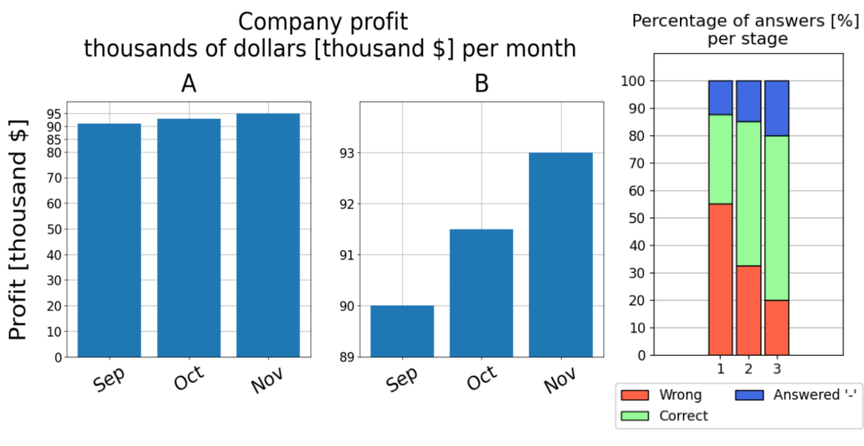

Figure 4: Chart used in the experiment as "Narrow Yaxis" and achieved results

Narrower Y-axis increases the contrast between the values. This results in Company B profit increases looking higher and more dynamic, while in fact the Company A has a better trend.

Conclusion

The experiment confirmed that manipulation in data visualization tasks is not only quite effective, but also relatively easy to achieve.

Key takeaways

- Data visualization can be **easily manipulated** to change the recipients' opinions
- Manipulation involves **not only lying** about the data, but also **hiding** its crucial values
- Anyone can be a **victim**
- **Thorough analysis** of the graphs and **refraining from sudden decisions** are the best strategies to stay safe