Does Visual Complexity Impact Reader Confidence and Comprehension of Data Visualizations?

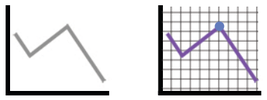
Kylie Lin[1]; David Rapp, PhD[2]; Cindy Xiong, PhD[3]

[1]School of Interactive Computing, Georgia Institute of Technology, [2]Department of Psychology, Northwestern University, [3]Department of Computer Science, University of Massachussetts Amherst

Background

How can you design a visualization that optimizes comprehension?

In visualization design...



...researchers have suggested a trade-off between **visual complexity** (VC) and information **comprehension** (COMP)[7].

What do people do when making sense of data?

1. People can overestimate their ability to understand and perform (overconfidence)[8].

estimations > performance

2. Familiarity (FAM) is associated with higher accuracy in recall (familiarity effect)[6].

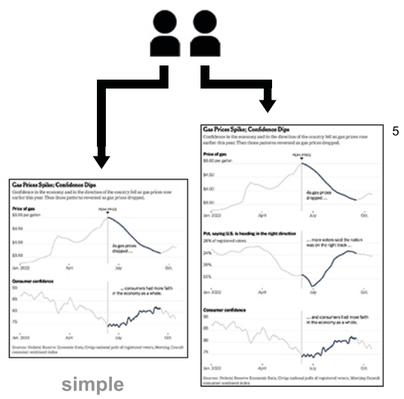
Questions & Hypotheses

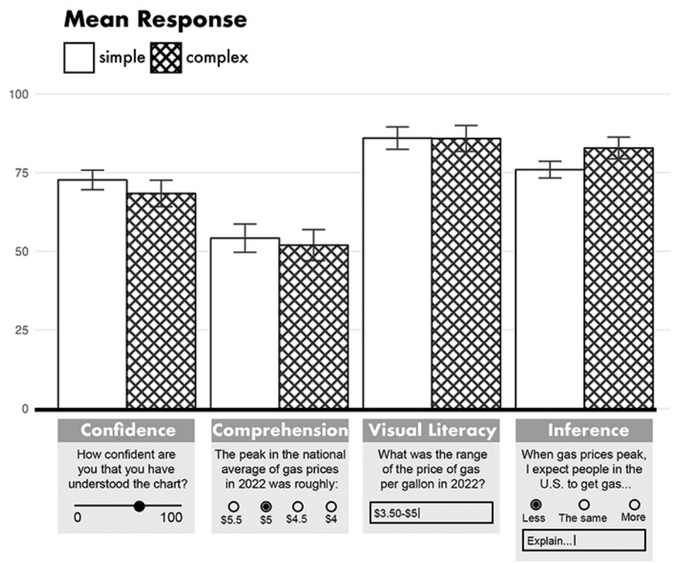
How does...

RQ1	**VC** influence **CONF**?
RQ2	**VC** influence **COMP**?
RQ3	**CONF** align with **COMP**?
RQ4	**FAM** influence **CONF** & **COMP**?

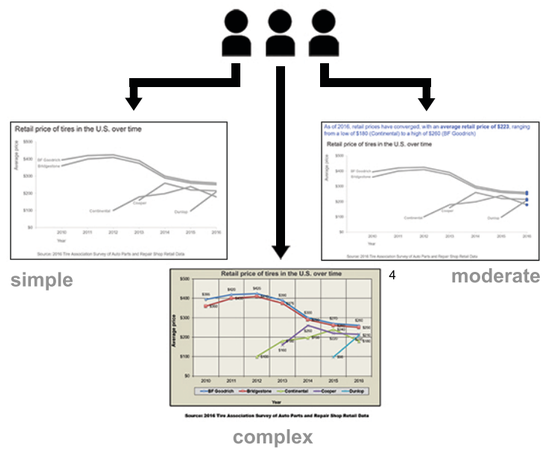
H1	simple = higher **CONF** complex = lower **CONF**
H2	NO effect of **VC** on **COMP**
H3	simple = overconfidence complex = accurate confidence
H4	unfamiliar = overconfidence

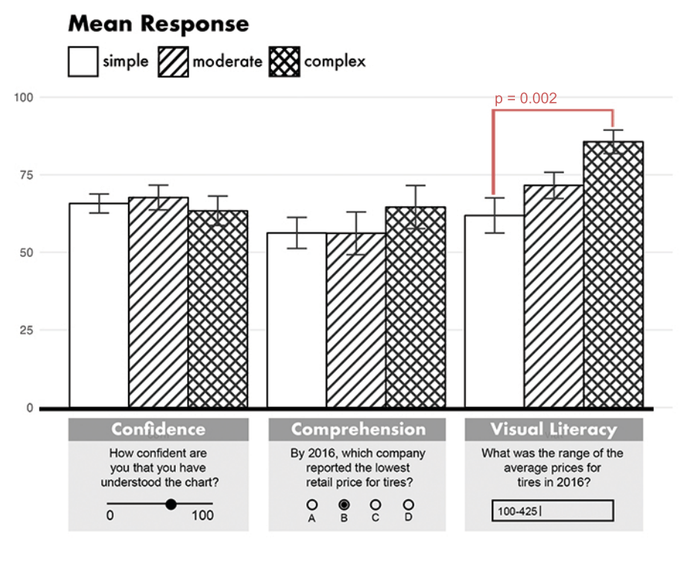
RQ1 RQ2 RQ3 EXP 1 Small Multiples





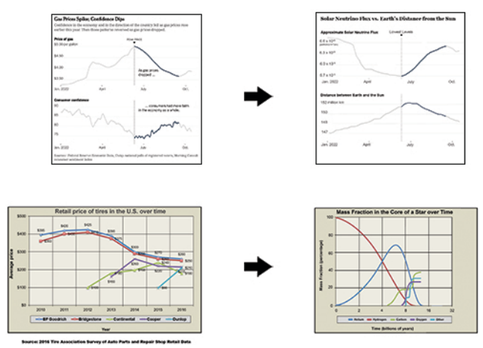
RQ1 RQ2 RQ3 EXP 2 Visual Clutter

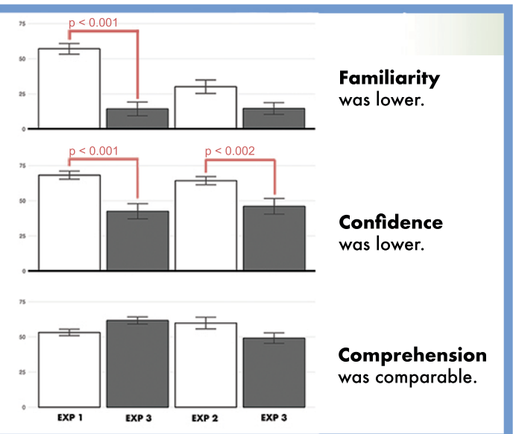




RQ4 EXP 3 Topic Familiarity

Changed topics to be **less familiar** to participants:





Conclusions

As predicted, comprehension scores remained constant regardless of experimental conditions.

Confidence scores also were comparable between experimental conditions.

In addition, people who viewed more unfamiliar topics were less confident in their responses despite performing comparably on comprehension tests.

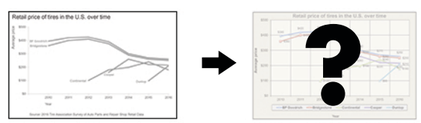
Overall...

...modest changes to visual complexity do not impact reader confidence and comprehension.

Future Work

For this study, we made modest changes in complexity to the charts.

For future work, we plan to examine charts of **a greater range of complexity** to determine if there is a point at which changes in complexity impact confidence or comprehension.



References

[4]Ajani, K., Lee, E., Xiong, C., Knaflic, C. N., Kemper, W., & Franconeri, S. (2021). Declutter and focus: Empirically evaluating design guidelines for effective data communication. IEEE Transactions on Visualization and Computer Graphics, 28(10), 3351-3364.

[5]Badger, E., & Washington, E. (2022, October 25). Why the price of gas has such power over US. The New York Times. Retrieved April 20, 2023, from https://www.nytimes.com/2022/10/25/upshot/gas-prices-biden-midterms.html

[6]Gagné, E. D., Bell, M. S., Yarbrough, D. B., & Weidemann, C. (1985). Does familiarity have an effect on recall independent of its effect on original learning?. The Journal of Educational Research, 79(1), 41-45.

[7]Hullman, J., Adar, E., & Shah, P. (2011). Benefitting infovis with visual difficulties. IEEE Transactions on Visualization and Computer Graphics, 17(12), 2213-2222.

[8]Kahneman, D. (2011). Thinking, fast and slow. Macmillan.