Personalized Information Visualizations Through the Use of Adaptive Overlays

Patriz Elaine Daroy, Computer Science
Mentor: Dr. Ben Steichen
Kellogg Honors College Capstone Project

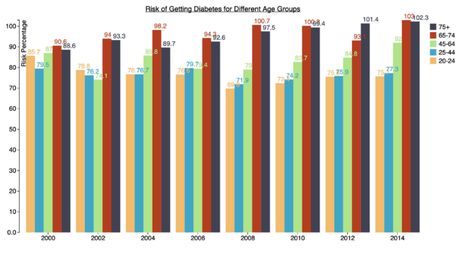
Introduction

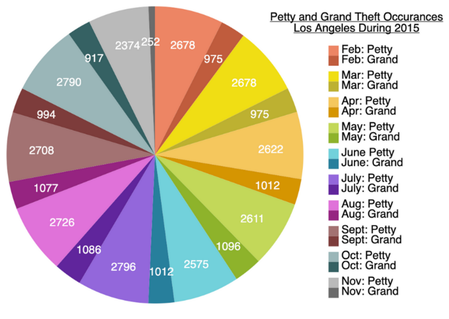
The issue of information overload continues to impact the synthesis of information across people, organizations, and communities. This can lead to decrease in productivity, loss of concentration, or increase in stress. Information visualization systems have shown to significantly help people deal with large amounts of information. However, they typically do not take into consideration an individual's preferences, abilities, or context.

Objective

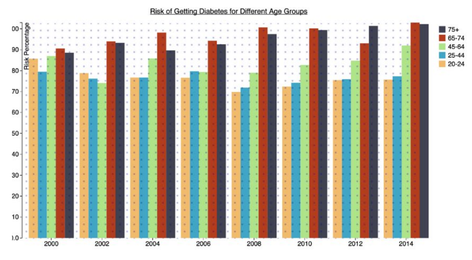
Our research aims to expand upon existing one-size-fits-all information visualizations systems by understanding how different groups of people (e.g., people differing in terms of cognitive abilities or styles) interact and synthesize information.

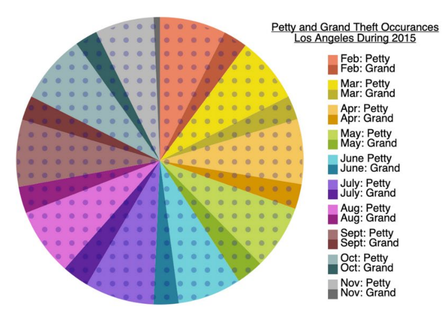
Data Values



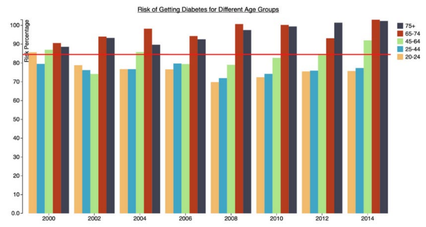


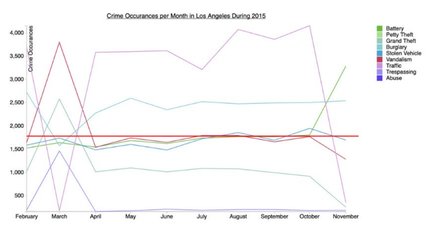
Dotted Grids



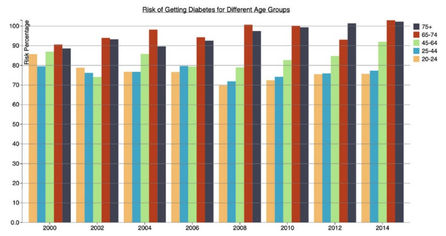


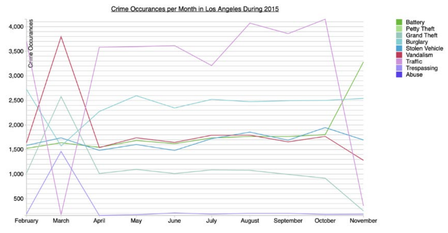
Summary Statistics





Reference Structures



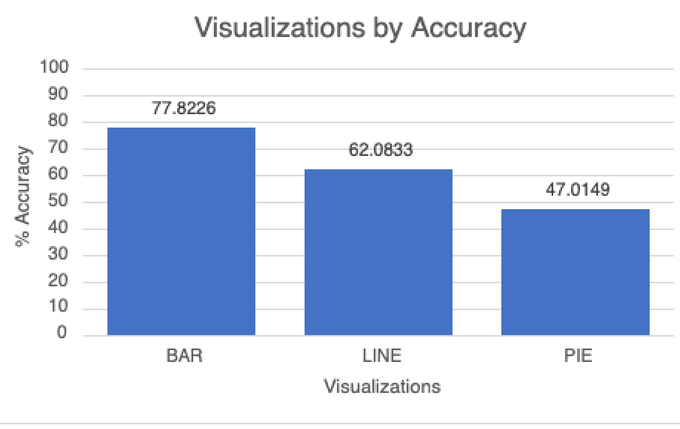


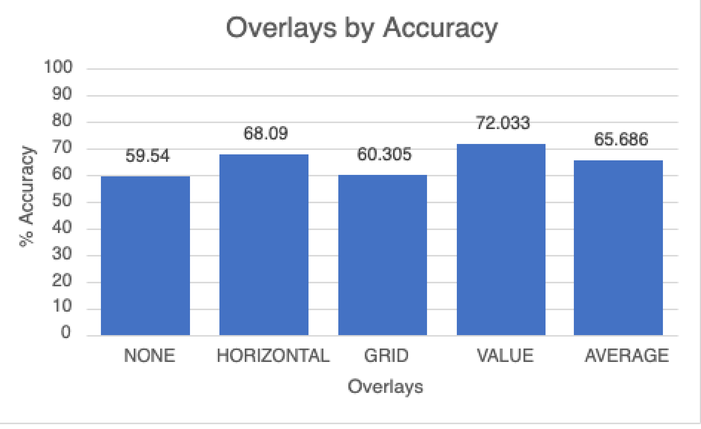
Methodology

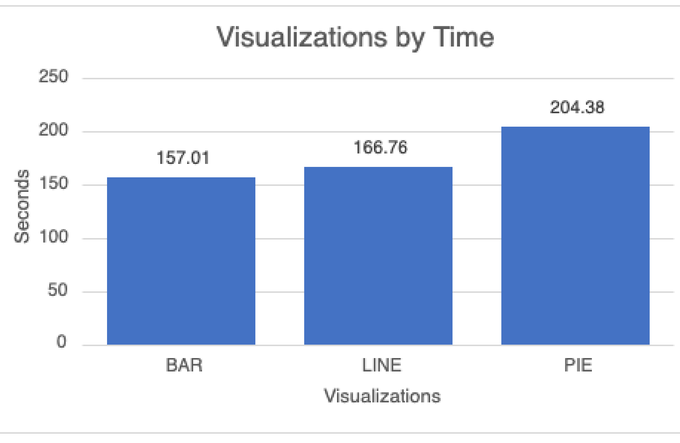
This research extends prior work [1][2], introducing graphical overlays to understand and enhance the perceptual and cognitive processes to extract information from data visualizations. We continued to explore this by testing 50 tasks against 50 people through Amazon Mechanical Turk. These tasks contain a data visualization followed by a question to be answered with the use of visual aids such as horizontal lines, data points, and dotted grids. All visualizations and overlays were created with D3.js. Upon completion, users take a post-survey to evaluate their locus of control and indicate their visualization preferences.

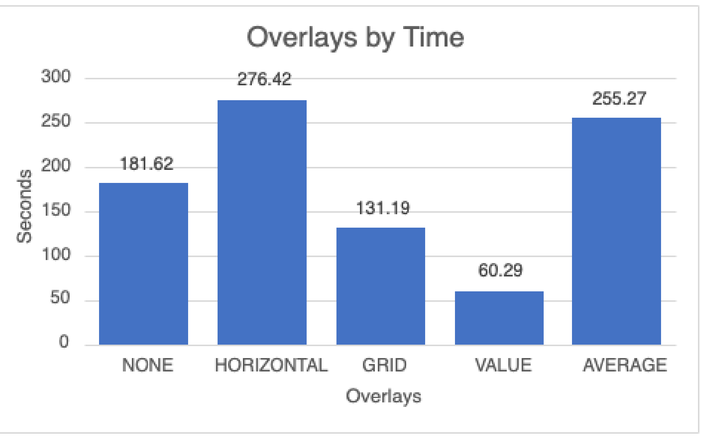
Results

Our results show the different user task performances of visualizations, overlays, and user preferences. Based on the data, we see that bar graphs are the most effective with low task completion and high accuracy of 77.82%. We also see that the data value visual aid was the most effective with an accuracy of 72.03% and a low task completion time of 60.29 seconds.









Conclusion

The goal of our study was to investigate the effectiveness of visual overlays designed to support users in visualization processing taking into consideration the user's cognitive skills, context, and preferences.

We have used our system to generate each visualization with each visual overlay. Preliminary results have shown that users with an external locus of control performed well with assisted visual overlays while workers with an internal locus of control had a greater accuracy without visual overlays.

Worker	With Overlays	Without Overlays
A (External LOC)	50%	N/A
B (External LOC)	50%	0%
C (External LOC)	100%	0%
D (External LOC)	80%	20%
F (Internal LOC)	64.71%	81.82%

Overall, users preferred the data label visual aid overlays and users expressed a preference in the bar chart over the line graph and pie charts. This has confirmed prior findings of a user's cognitive skills and preferences affecting the user's synthesis of information of data visualizations.

References

[1] Steichen, B., & Fu, B.Towards Adaptive Information Visualization - a Study of Information Visualization Aids and the Role of User Cognitive Style. (2019)

[2] Kong, N., & Agrawala, M. Graphical Overlays: Using Layered Elements to Aid Chart Reading. (2012)

Acknowledgements

Human-Centered Adaptive, and Personalized Information Interaction (HAPI)) Lab

Special thanks to Dr. Ben Steichen for being a great mentor and guiding me to equip my interests in Human-Computer Interaction through this research.