First Principles in Information Visualization Design

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Abstract

Humans bring to bear a wondrous variety of perceptual and cognitive faculties to perceive, filter and make sense of the world. Cognitive and perceptual psychologists have spent the last century identifying a variety of visual processing capabilities that appear to be employed in visual information processing and in understanding conceptual relationships. Many of the findings can be applied to novel information visualization techniques in order to help people identify, process, remember and understand visual concepts and relationships. At the same time, strict limitations in perceptual and cognitive abilities have been identified by psychologist. In particular, information density, time and memory play a complex and important role in human performance. Numerous psychological studies manipulate the amount of memory load, the amount of time or the number of items required for tasks to be accomplished, or examine these variables in terms of how they influence task times.

The holy grail of information visualization research has been to enhance human perceptual and cognitive limitations via advancements in visualization techniques. Visualizations of complex relationships could bolster the abilities of both information workers and more typical consumers of personal computing, allowing them to more efficiently handle the ever increasing amounts of information available to them, and supporting attention and memory over longer time periods.

In the pursuit of this holy grail, researchers have at times leveraged prior psychological findings in novel designs in HCI to enhance our understanding of and interaction with complex information spaces. However, most work in the creation of these visualizations has remained in the realm of creative, handcrafted, “point” designs. Such expert visualizations encapsulate experience and intuitions about the human problem-solving approach to an overall problem domain. However, rarely are these designs guided by our knowledge of human visual perception and cognition. Even more rarely are these visualizations evaluated for effectiveness, moving the field toward a set of first principles and eventually a theory for human-centered information visualization design.

This talk will emphasize the need for just this kind of theoretical motivation and empirical, iterative design work in the field of information visualization, with an eye toward leveraging the ever faster processors and the larger number of pixels available to be rendered in real time. Positive examples highlighting the recommended approach will be provided. At stake is our ability to move the field forward in a useful direction, focusing on the problems of real significance when it comes to usability and effectiveness in the domain of information visualization. Colleagues in this area of research at Microsoft include George Robertson, Daniel Robbins, Maarten van Dantzich and Eric Horvitz.