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Making Graph Visualization a User-Centered Process

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Abstract

Many problems in application domains deal with graphs. Graphs are often visualized into node-link diagrams for better understanding of them. Traditionally, graphs are visualized to meet some pre-defined quality metrics, or aesthetics. It is commonly agreed that graphs that are drawn based on aesthetics are more likely to be not only beautiful but also comprehensible. However, those aesthetics were originally proposed by researchers based on their intuitions from a designer's perspective. Although some of them have been empirically validated, to produce truly user cognitively friendly visualizations, well-grounded cognitive theories and design guidelines are needed.

In this paper, we attempt to explore a cognitive approach that follows a user-centered process in visualizing graphs. We begin by proposing a graph visualization model, which is further conceptualized into a two-stage assessment cycle. It is argued that 1) to provide effective cognitive support, it is essential to understand the cognitive process of a particular task in association with the attributes of the end user and the visual representation. 2) to develop a set of design principles, what cognitive processes or graph reading strategies are involved should be part of evaluation. We materialized the model by reviewing the literature and providing relevant examples in the context of providing cognitive support and understanding cognitive process. We introduce theories from other disciplines such as perceptual and cognitive psychology, summarize methodologies that have been used in prior research, and discuss their implications for producing user-centered visualizations.

Keywords: Graph visualization, design principle, evaluation, cognitive support

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