

Cognitive Load in Visualization: Myths & Misconceptions*

[Extended Abstract]

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Cognitive load measures the mental resources expended when completing a task. In visualization, it is often employed as a usability metric to justify design decisions and evaluate visualization effectiveness. However, little work in visualization provides any formal validation of claims about cognitive load. We analyzed the 2015 IEEE VIS Proceedings and found that 27 papers (21.6%) of all papers made claims about cognitive load (VAST: 16 papers; InfoVis: 9 papers; SciVis: 2 papers). Only seven of these papers provide any explicit validation to support their cognitive load claims, and only one of these seven used a validated metric for measuring cognitive load.

We conducted a survey of 31 people in visualization and analytics communities to more deeply explore the apparent discrepancy between claims about cognitive load and empirical support for these claims. Our participants consisted of visualization researchers (14 of 31 respondents, 45.2%), practitioners (13, 41.9%), and users (4, 12.9%) gauging the visualization community’s perspectives on cognitive load. This study was designed to answer two primary research questions:

1. What is the perceived role of cognitive load in visualization?
2. How is cognitive load commonly measured in visualization?

A majority (61.3%) of respondents reported having familiarity with the general concept of cognitive load. These participants moderately rated their knowledge of cognitive load ($M = 5.4$, $\sigma = 0.8$, on a 7-point Likert scale) and most (89.9%) claimed they consider cognitive load as part of their own work when designing and evaluating visualizations. However, few respondents actually employ validated methods for evaluating claims about cognitive load in practice. Mean self-reported use of methods for validating cognitive load was as follows: intuitions ($M = 4.9$, $\sigma = 1.7$), user comments ($M = 4.2$, $\sigma = 1.9$), observations from prior work ($M = 4.0$, $\sigma = 0.8$), formal qualitative metrics ($M = 3.9$,

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Reported Methods for
Evaluating Cognitive Load

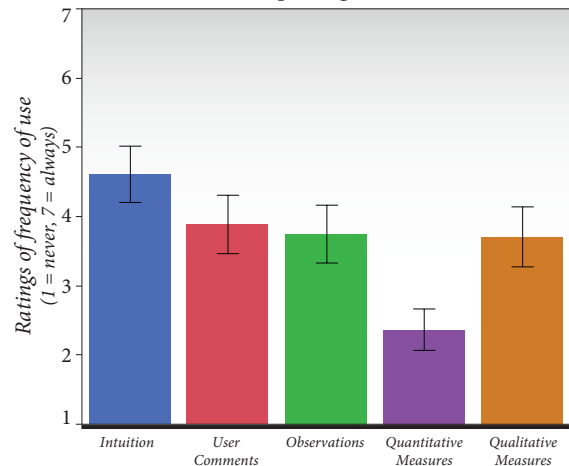


Figure 1: Self-reported frequency of use for different methods of evaluating cognitive load (7-point Likert scale, error bars encode standard error).

$\sigma = 2.0$) and formal quantitative metrics ($M = 2.5$, $\sigma = 1.4$). When asked about specific methods employed in their own work, respondents reported a breadth of possible measures. However, the majority of these measures focused on broad aspects of usability, rather than on validated metrics of cognitive load. For instance, respondents reported measuring cognitive load by “looks of confusion... embarrassed smiles” or “opinions about how intuitive a design was.”

In this talk, we will further discuss ideological perspectives on cognitive load as applies to visualization and explore the disconnect between the perceived importance of cognitive load and its use across communities. Our results show a dissonance within the visualization community between how cognitive load is measured versus the intended use of this concept in practice. This disconnect sheds light on myths surrounding the utility of cognitive load in visualization and misconceptions as to how designers might effectively use cognitive load to justify and evaluate designs. We argue that cognitive load is often used as a proxy term for other usability metrics and that there is a need for a more formal understanding of the relationship between cognitive load and visualization effectiveness.