

# When processing relationships, visual processing capacity is far less than four

Steven Franconeri; Tal Boger

+ Author Affiliations & Notes

Journal of Vision September 2024, Vol.24, 762. doi:<https://doi.org/10.1167/jov.24.10.762>

## Abstract

Vision can provide rapid and powerful processing for some tasks, and encounter strong capacity constraints for others, with a typical limit of processing 4 objects at once. But some evidence suggests an even lower capacity limit when processing relationships between objects. We asked people to explore data visualizations with only 4 values, and found that *half* of viewers easily missed surprising improbable relationships (e.g., a child's height *decreasing* over time, or a better product costing *less*) in these trivially small datasets. The graph's design used spatial grouping cues to implicitly deprioritize an improbable relationship, and when the design instead implicitly prioritized those relationships, they were noticed 1.8x-3.4x more often. These demonstrations support an emerging view of a divide between capacity limits on visual processing: When tracking or memorizing a set of objects, capacity hovers around 4. But when computing relationships that require linking features (e.g., object heights or verbal labels) to particular objects, estimated capacity drops to 1-2. The present experiment is consistent with models that predict that surprisingly low level of ability. On the practical side, the results provide immediate guidance to the scientific community (as well as those in education and in organizations) as producers and consumers of data visualization. Graphs should be designed so that certain relationships are more intuitively recovered, and that 'data storytelling' techniques – highlighting and annotating data visualizations to help viewers quickly see the 'right' pattern – are critical, even within visualizations of trivially simple datasets.

This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](https://creativecommons.org/licenses/by-nc-nd/4.0/).

