How To Not Lie

Maximize the Data-Ink Ratio

Data-Ink Ratio

$$\text{DIR} = \frac{\text{Ink used in Data}}{\text{Total ink used in the Graphic}}$$

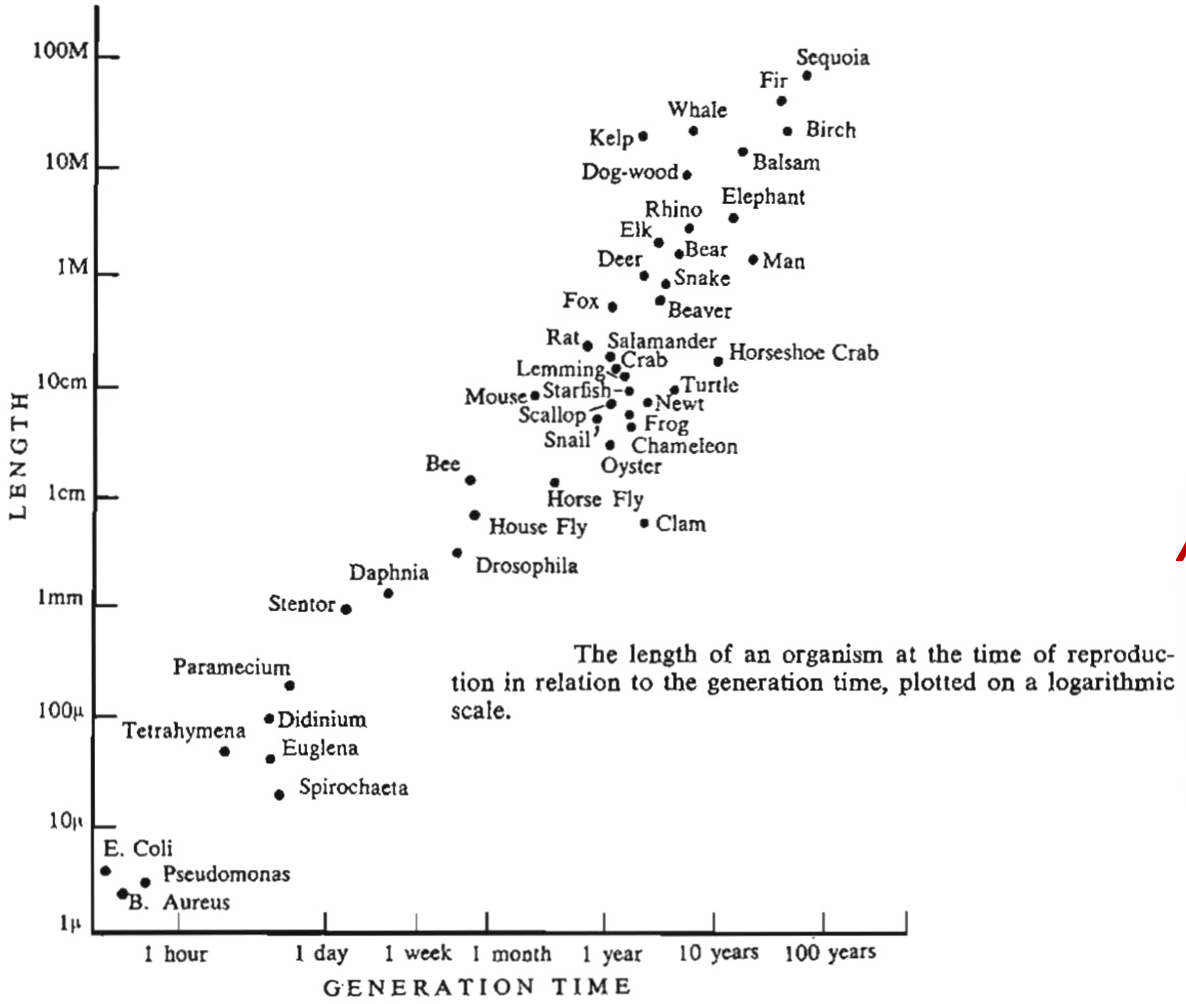
$$= \text{proportion of a graphic's ink devoted to non redundant display of data information}$$

$$= 1.0 - \text{proportion of a graphic that can be erased without loss of data information}$$

Data-Ink Ratio

- *The goal* is to aim for *high data-ink ratio*
- *Ink* used for the *data should be relatively large* compared to the *ink* in the *entire graphic*

High Data-ink Ratio Example

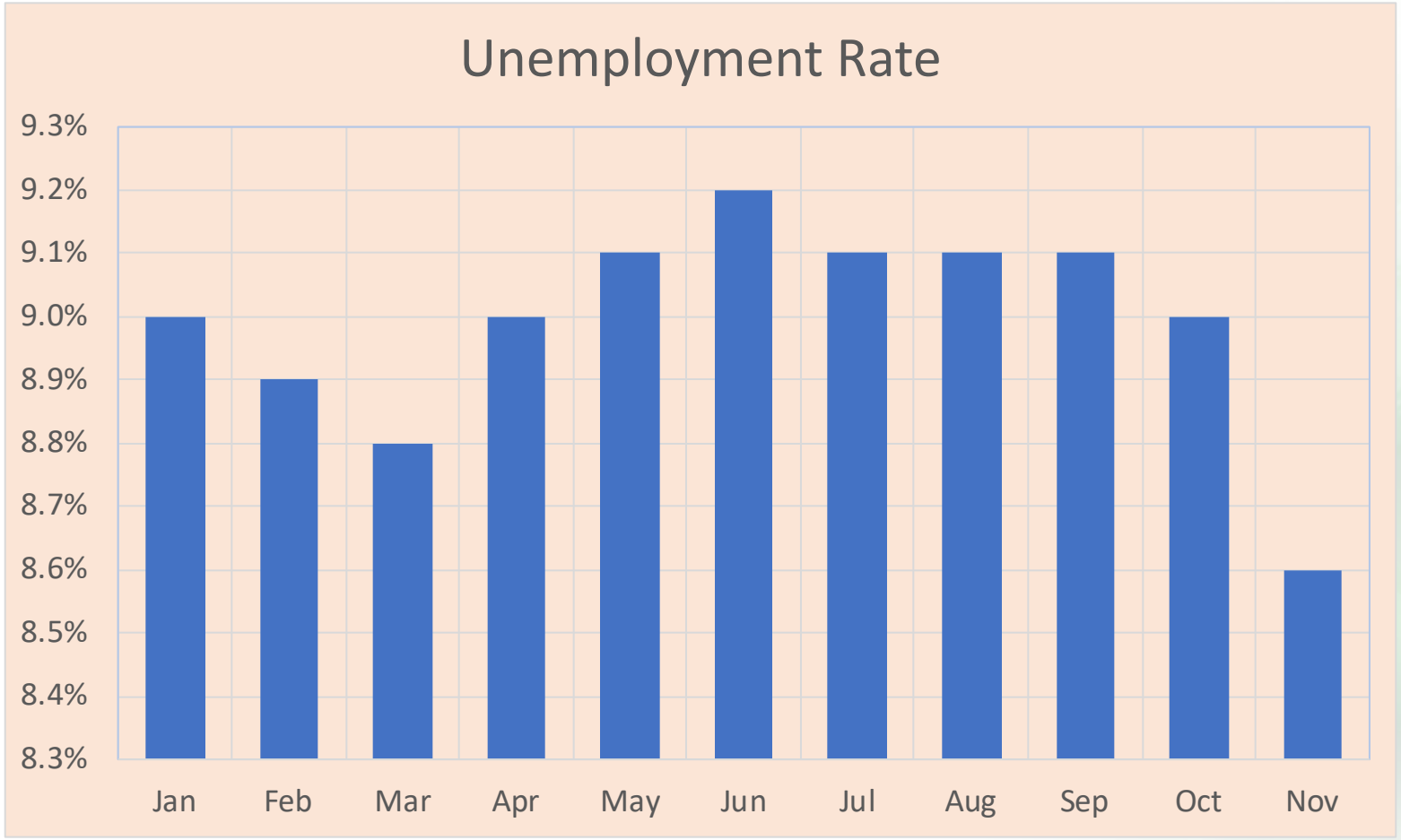


The length of an organism at the time of reproduction in relation to the generation time, plotted on a logarithmic scale.

It's *around 80%~* of ink in this graph is *data-ink* (dots & labels)

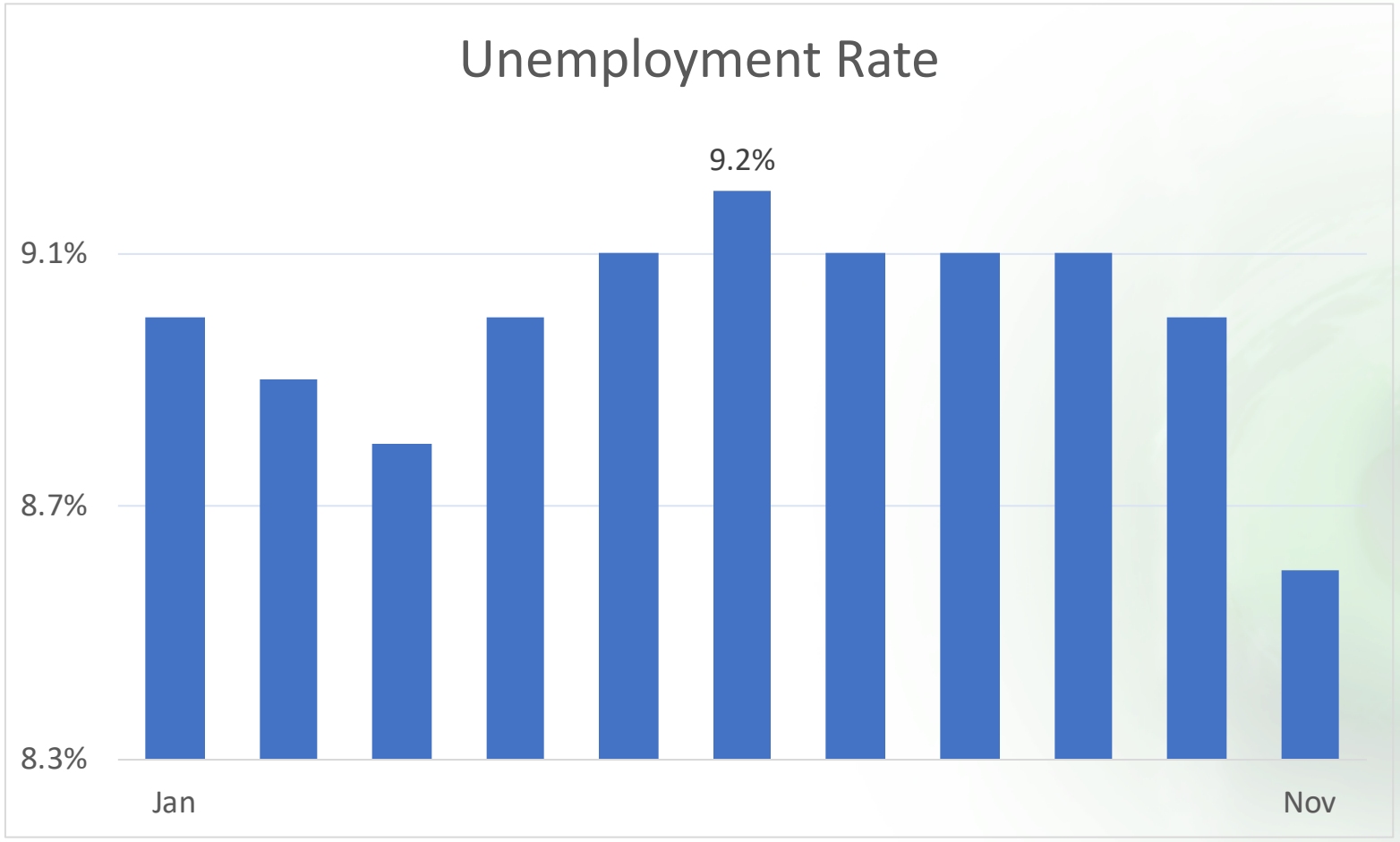
Around ~20% is *non-data-ink* (frame & ticks)

High Data-ink Ratio Example



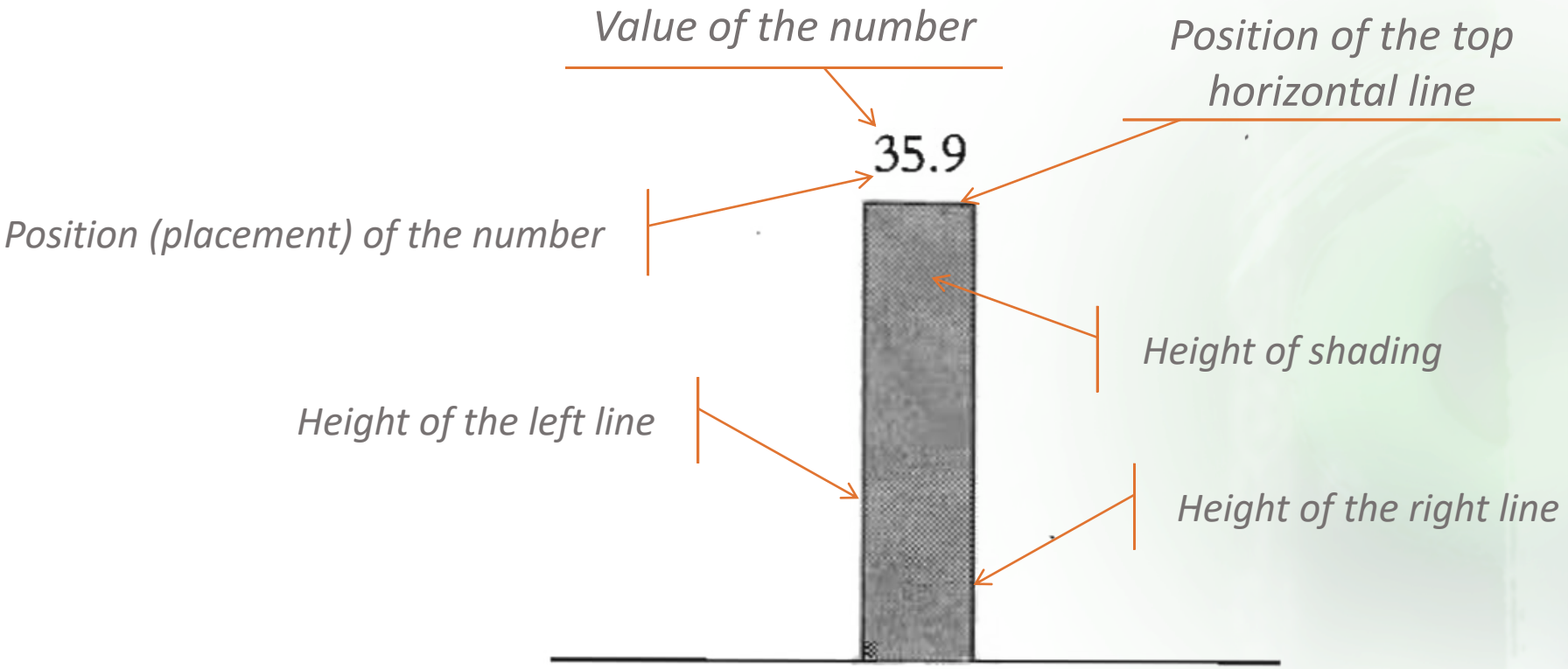
High Data-ink Ratio Example

Improved



Erasing Non-data Ink

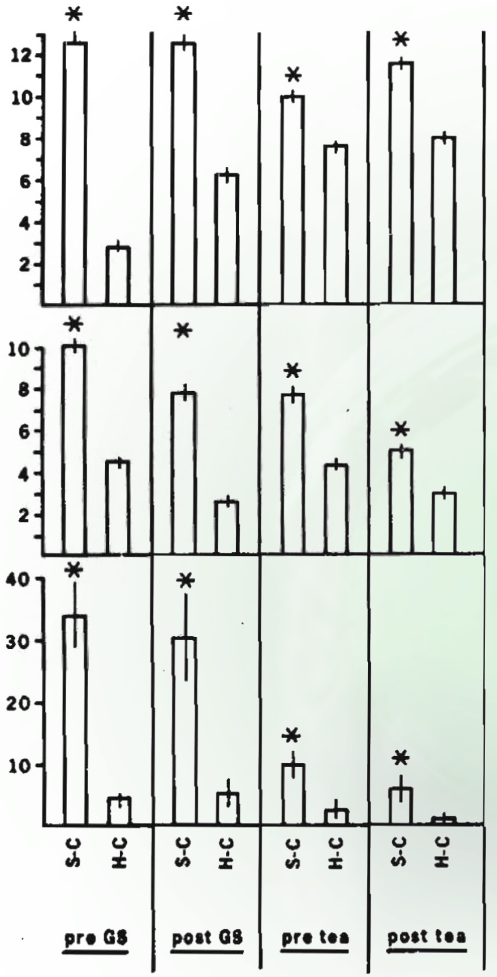
How *many times* is *height* encoded!



Erasing Non-data Ink

Example

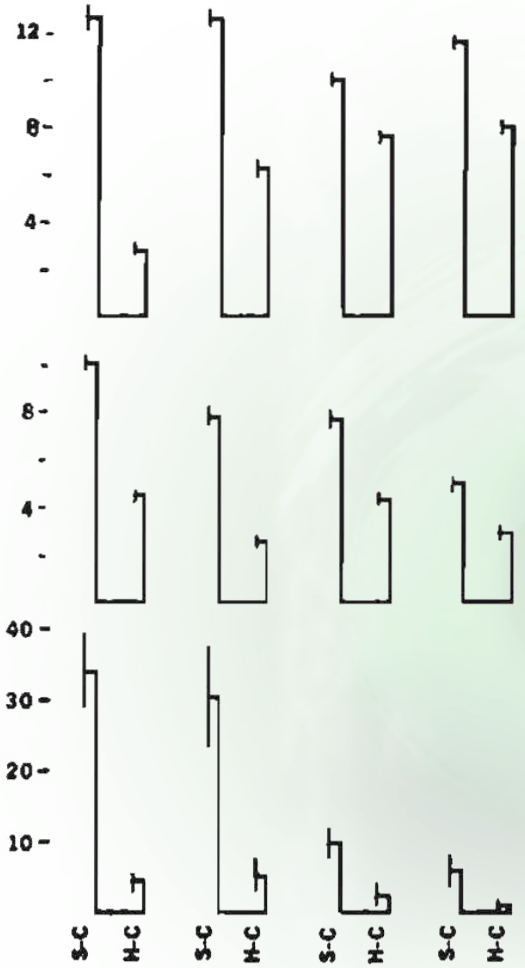
Results of a study indicating that one type of element always has a higher value under different experimental conditions



Erasing Non-data Ink

Example

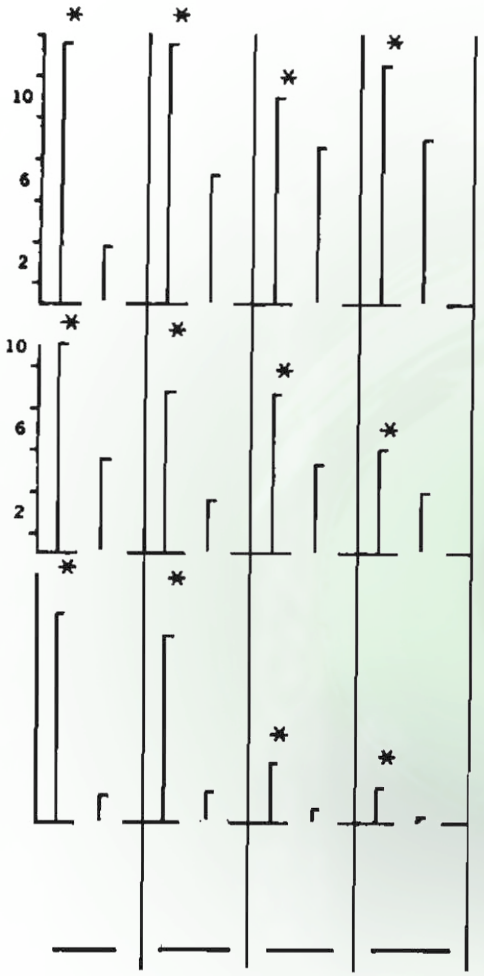
After removing all non-data ink



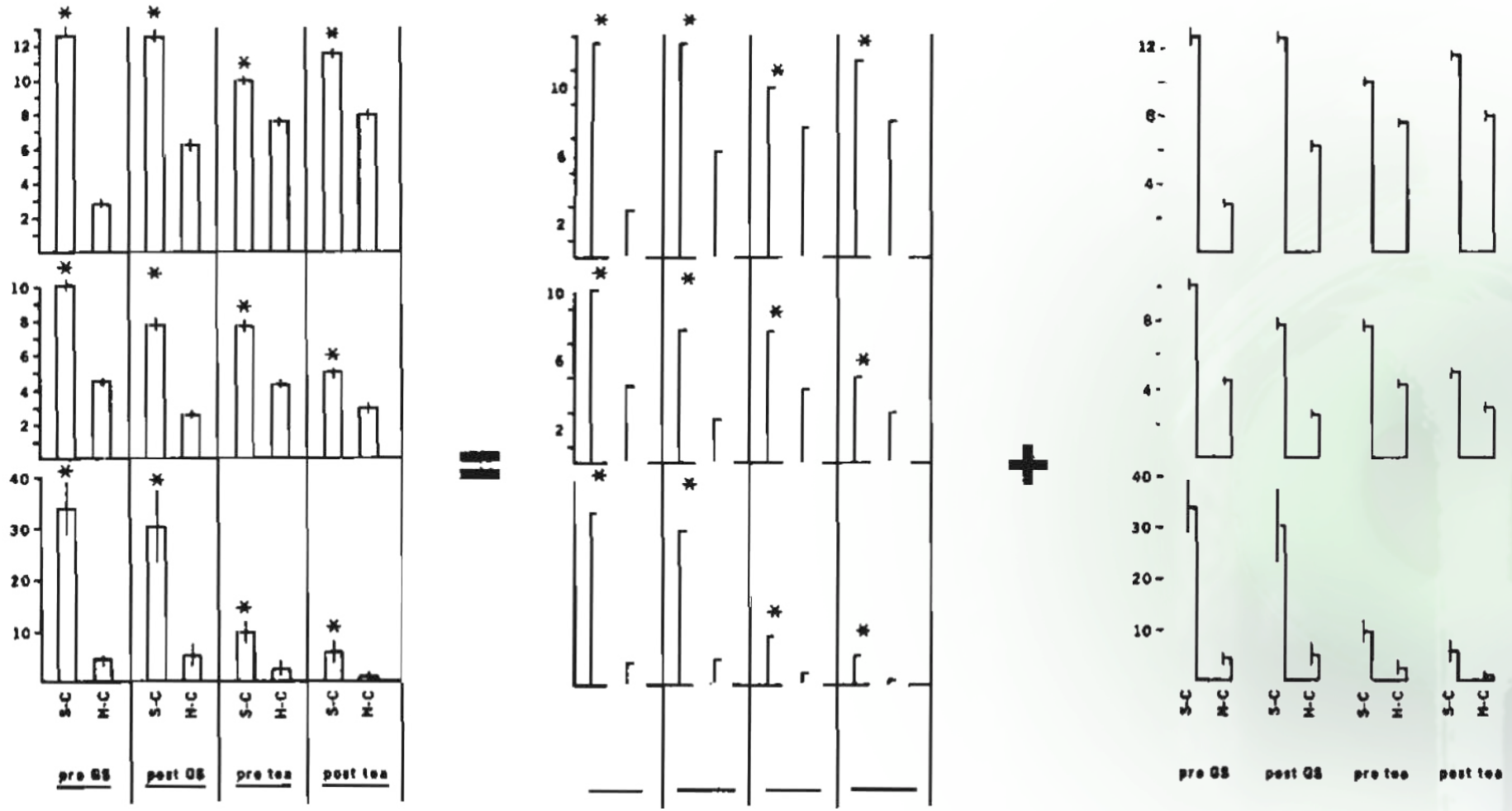
Erasing Non-data Ink

Example

The ink that has been removed



Data Graphic Arithmetic



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H. Hauser, H. Pfister, and J. J. van Wijk
(Guest Editors)

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A User Study of Visualization Effectiveness Using EEG and Cognitive Load

E. W. Anderson[1], K. C. Potter[1], L. E. Matzen[2], J. F. Shepherd[2], G. A. Preston[3], and C. T. Silva[1]

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[2]Sandia National Laboratories, USA
[3]Utah State Hospital, USA

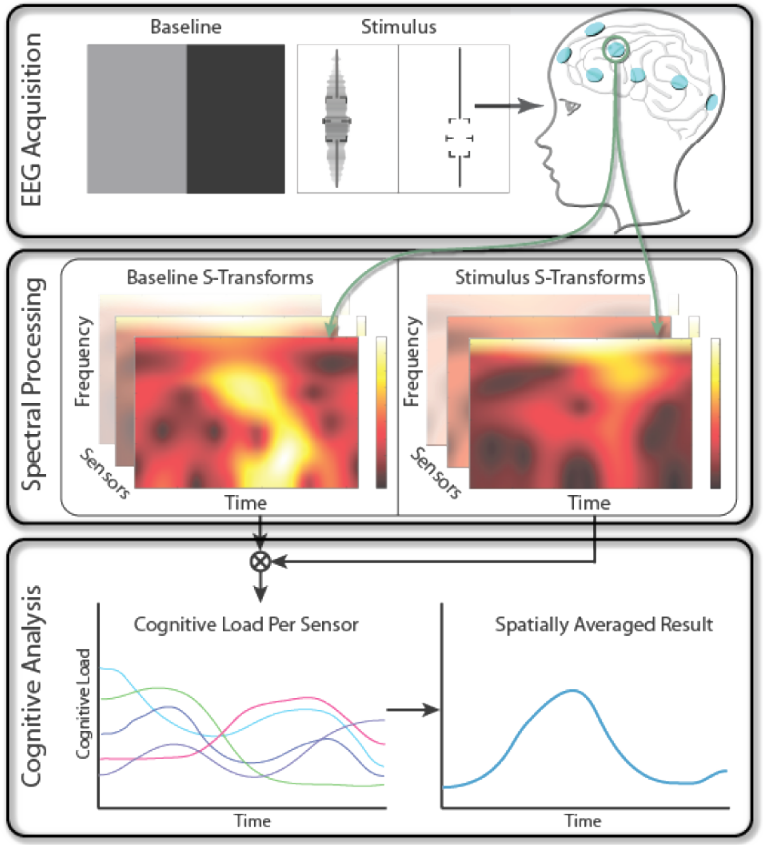
Abstract

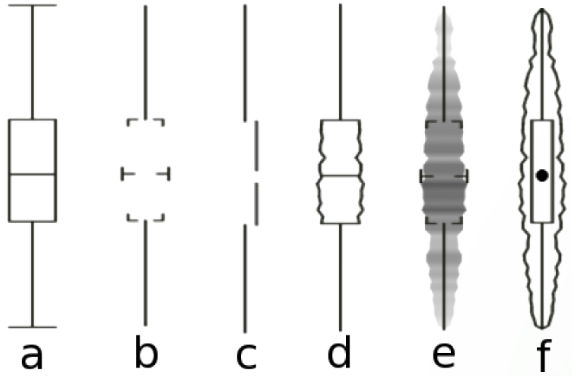
Effectively evaluating visualization techniques is a difficult task often assessed through feedback from user studies and expert evaluations. This work presents an alternative approach to visualization evaluation in which brain activity is passively recorded using electroencephalography (EEG). These measurements are used to compare different visualization techniques in terms of the burden they place on a viewer's cognitive resources. In this paper, EEG signals and response times are recorded while users interpret different representations of data distributions. This information is processed to provide insight into the cognitive load imposed on the viewer. This paper describes the design of the user study performed, the extraction of cognitive load measures from EEG data, and how those measures are used to quantitatively evaluate the effectiveness of visualizations.

Categories and Subject Descriptors (according to ACM CCS): I.3.3 [Computer Graphics]: General—Human Factors, Evaluation, Electroencephalography

Erik W. Anderson, Kristin C. Potter, Laura E. Matzen, Jason F. Shepherd, Gilbert Preston, Cláudio T. Silva (2011). A User Study of Visualization Effectiveness Using EEG and Cognitive Load. Comput. Graph. Forum 30(3): 791-800.

Experiment Design

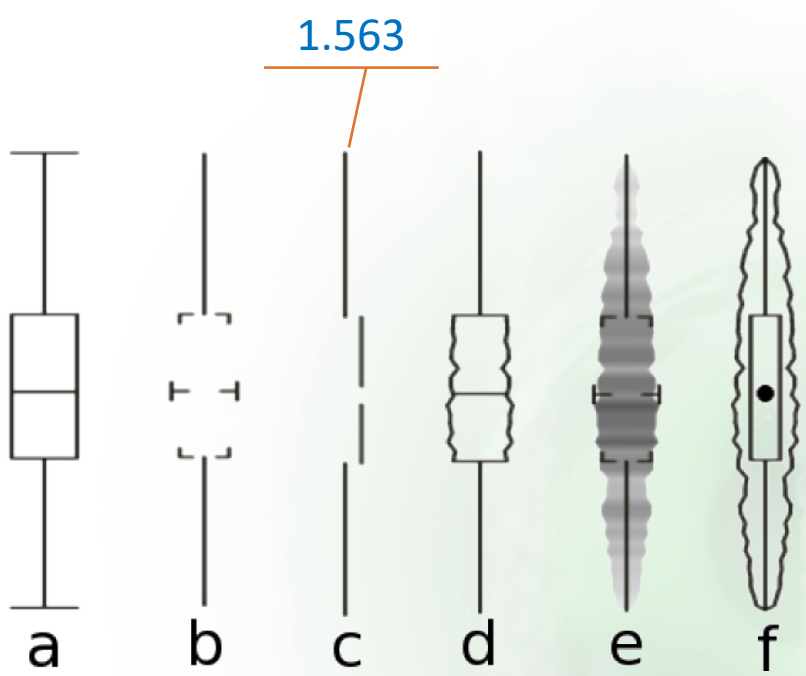




- Asked *participants* to *choose the box plot* with the largest range from a set
- *Varied* representations
- Measured *cognitive load* from *EEG brain waves*

Experimental Results

The *simplest box plot* is the *hardest to interpret*



Tufte's Principles of Graphical Design

- Above all else *show the data*
- *Maximize* the *data-ink ratio*, within reason
- Erase *non-data-ink*, within reason
- Erase *redundant* data-ink
- *Revise* and *edit*

References

- Edward Tufte (1983), *The Visual Display of Quantitative Information*, Graphics Press, Cheshire CT.
- Erik W. Anderson, Kristin C. Potter, Laura E. Matzen, Jason F. Shepherd, Gilbert Preston, Cláudio T. Silva (2011). *A User Study of Visualization Effectiveness Using EEG and Cognitive Load*. Comput. Graph. Forum 30(3): 791-800.

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