Visual Search Through Displays of Data

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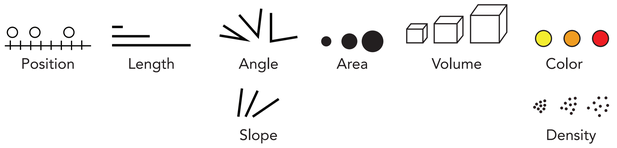
VISUAL REPRESENTATIONS IN GRAPHS

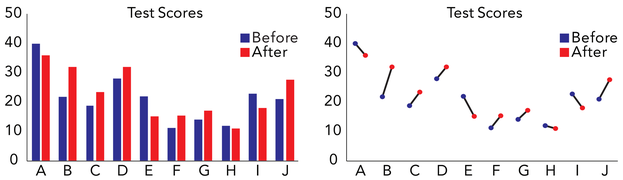
Most Precise **Least Precise**



The ranking above is a **seminal** result[1] in data visualization.
However: precision = ratio judgment of two values

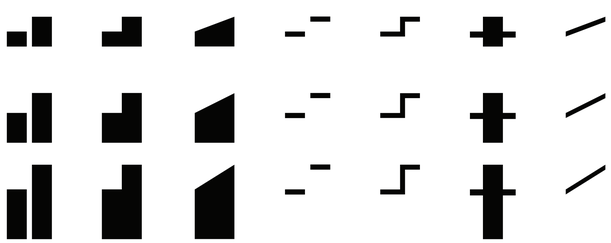
Is that really what's important in data visualization?
We think trends, patterns, and relations are most vital.

Question:
How can we most efficiently perceive **relations** in large data sets?

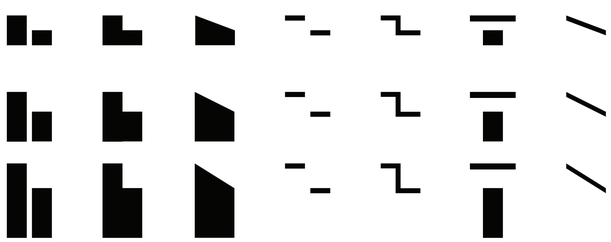


OUR DATA REPRESENTATIONS

Increasing Relation

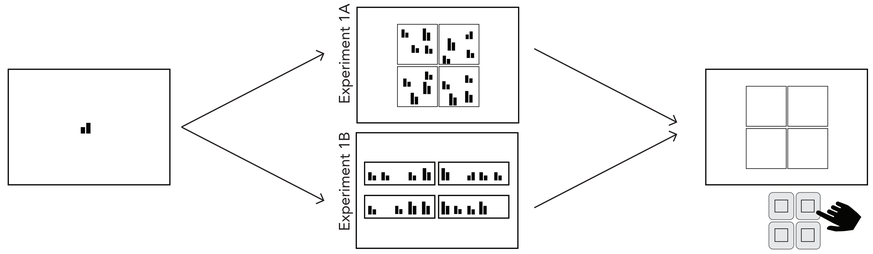


Decreasing Relation



Separated Bars | Adjacent Bars | Area Graph | Unconnected Dashes | Connected Dashes | Benchmark Graph | Slope Graph

EXPERIMENTS 1A & 1B: VISUAL SEARCH

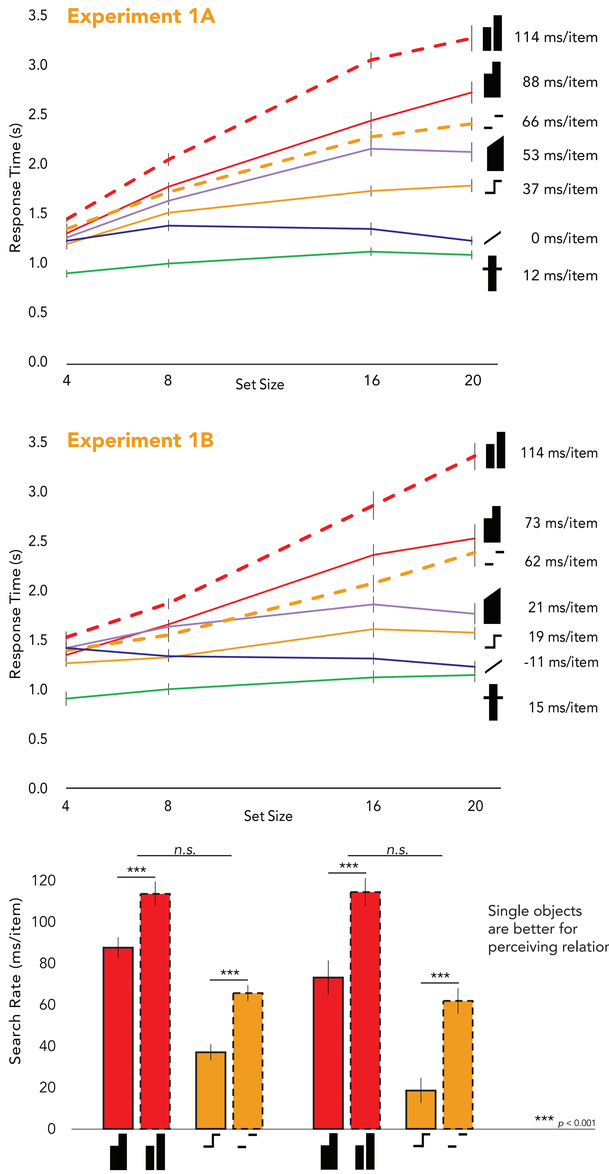


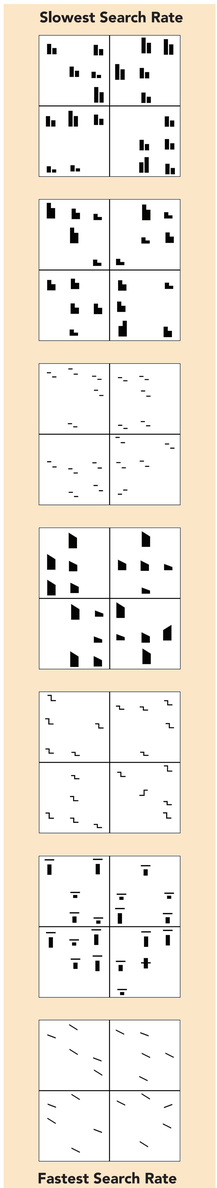
Target Relation Preview
Until Response

Test Display
Until Response

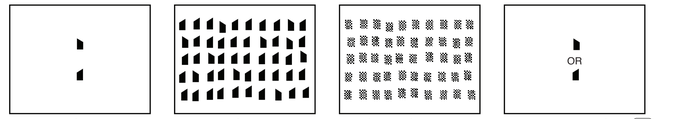
Response Display
Until Response

EXPERIMENTS 1A & 1B: RESULTS





EXPERIMENT 2: ENSEMBLE CODING



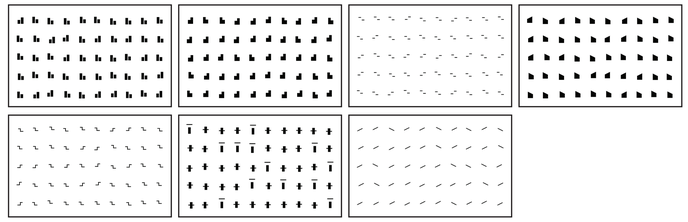
Target Relation Preview
Until Response

Test Display
(Ratio staircased to 75% accuracy)
200 ms

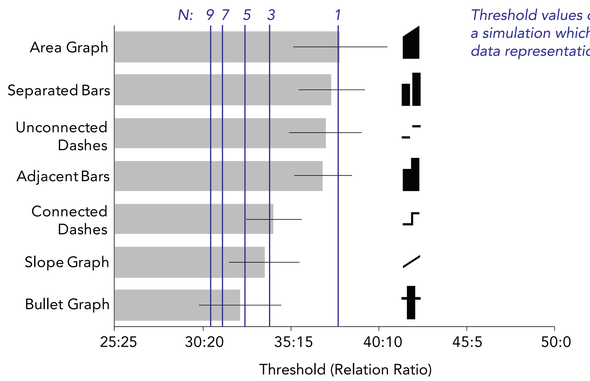
Mask Display
200 ms

Response Display
Until Response

EXPERIMENT 2: SAMPLE DISPLAYS



EXPERIMENT 2: RESULTS



Threshold values obtained from a simulation which sampled N data representations per trial.

CONCLUSIONS

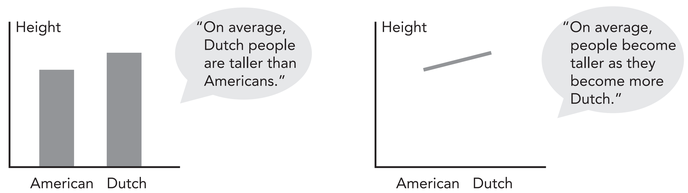
Precision for ratios =\= Efficiency for visual search & ensemble coding

It is easier to perceive data relations when represented by a **single object**.

Despite their common use, our results show that bar graphs and dot plots are the **worst** data representations for processing relations between data points, and result in strikingly **serial** processing.

Slope graphs, benchmark graphs, and connected scatterplots should be used whenever possible.

However, slope graphs can mislead conceptually[2]:



REFERENCES

[1] Cleveland, W. S., & McGill, R. (1985). Graphical perception and graphical methods for analyzing scientific data. *Science, 229*(4716), 828-833.
[2] Zacks, J., & Tversky, B. (1999). Bars and lines: A study of graphic communication. *Memory and Cognition, 27*, 1073-1079.

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