The Perceptual Proxies of Visual Comparison

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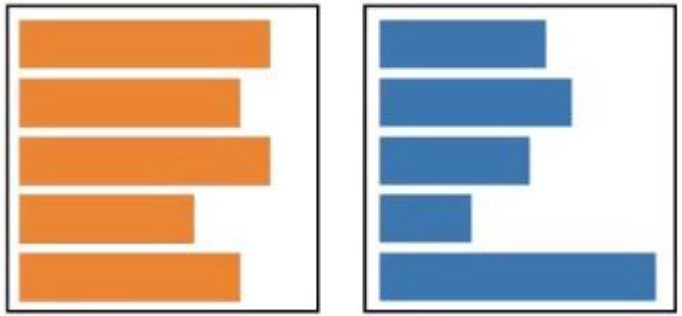
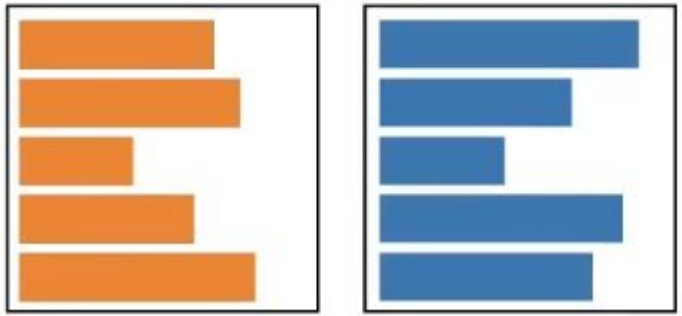
Visual comparison

Bigger Mean?



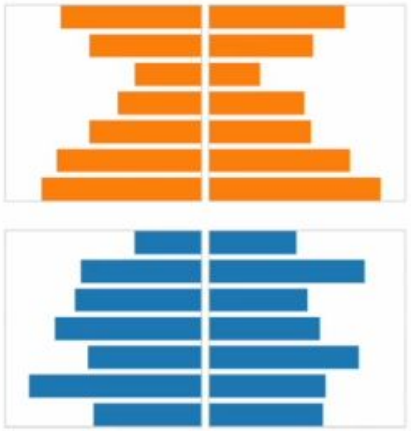
Bigger Range?



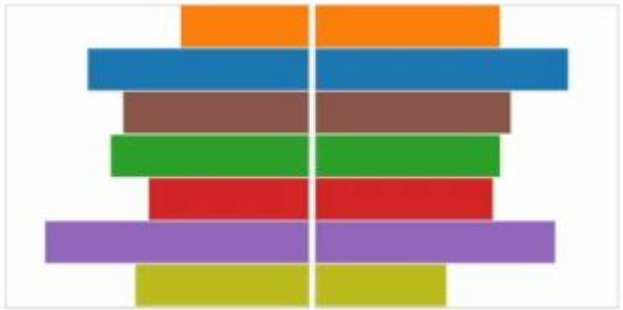
A bit of History

Examine the precision of comparison tasks with different arrangements

Max Correlation



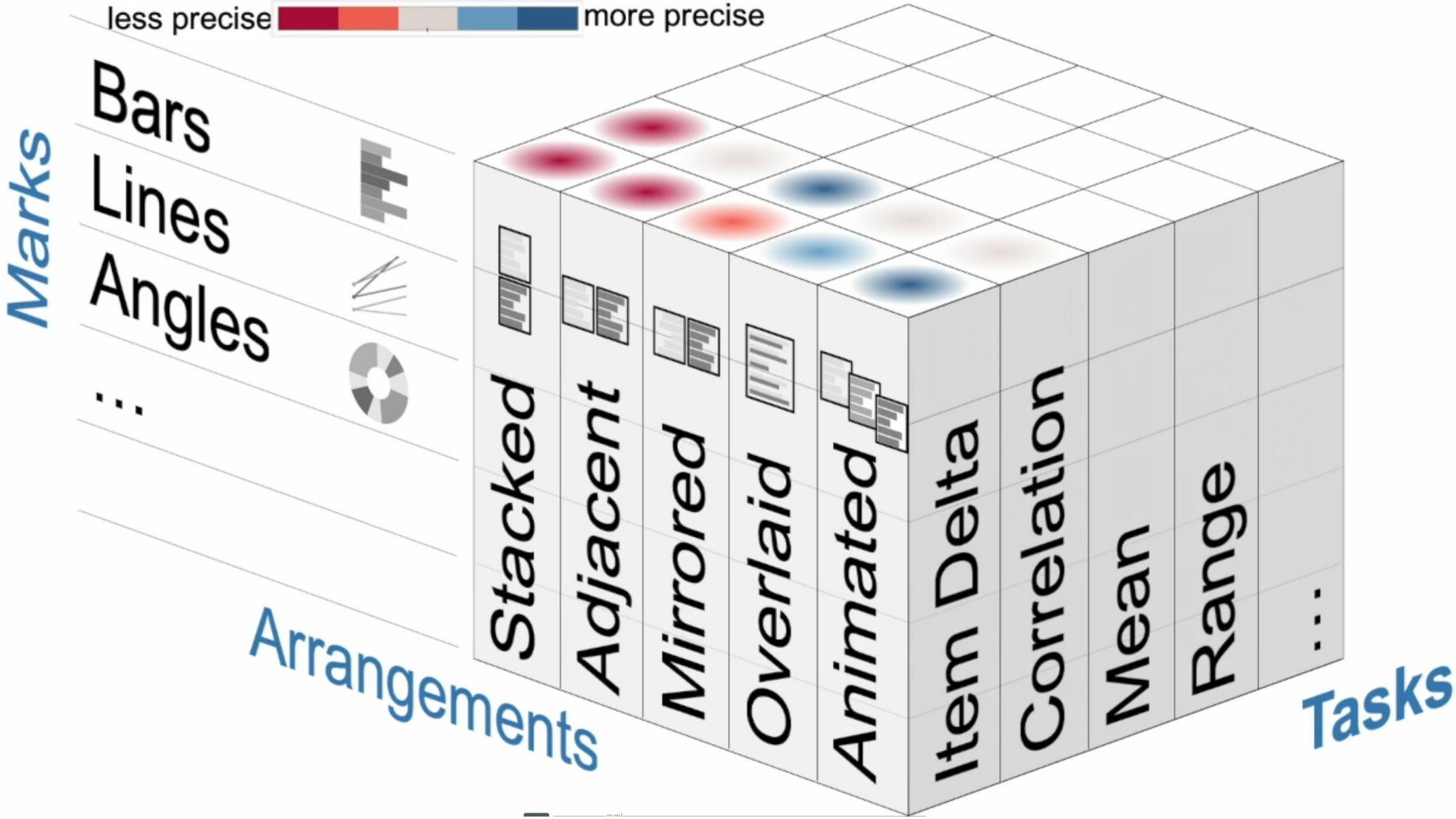
Max Delta



Arrangements

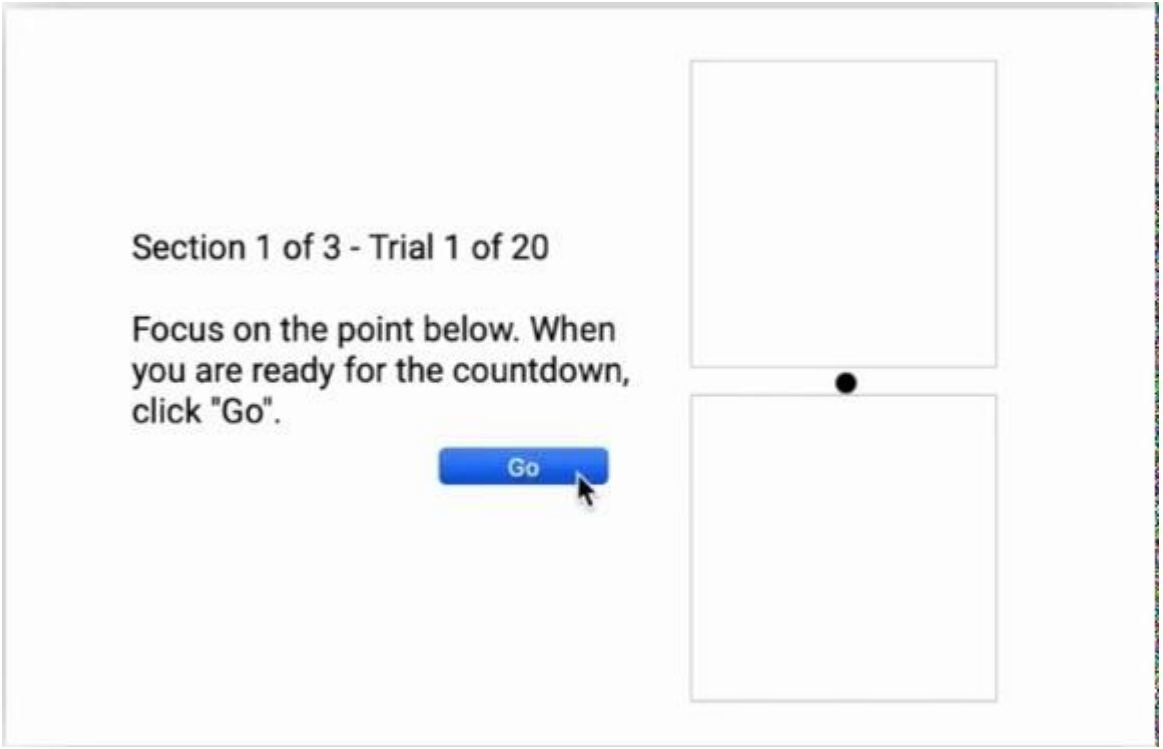
Dimensions

- 2 comparison tasks
- 3 marks
- 5 arrangements


less precise
more precise
Marks
Bars
Lines
Angles
...
Arrangements
Stacked
Adjacent
Mirrored
Overlaid
Animated
Item Delta
Correlation
Mean
Range
...
Tasks

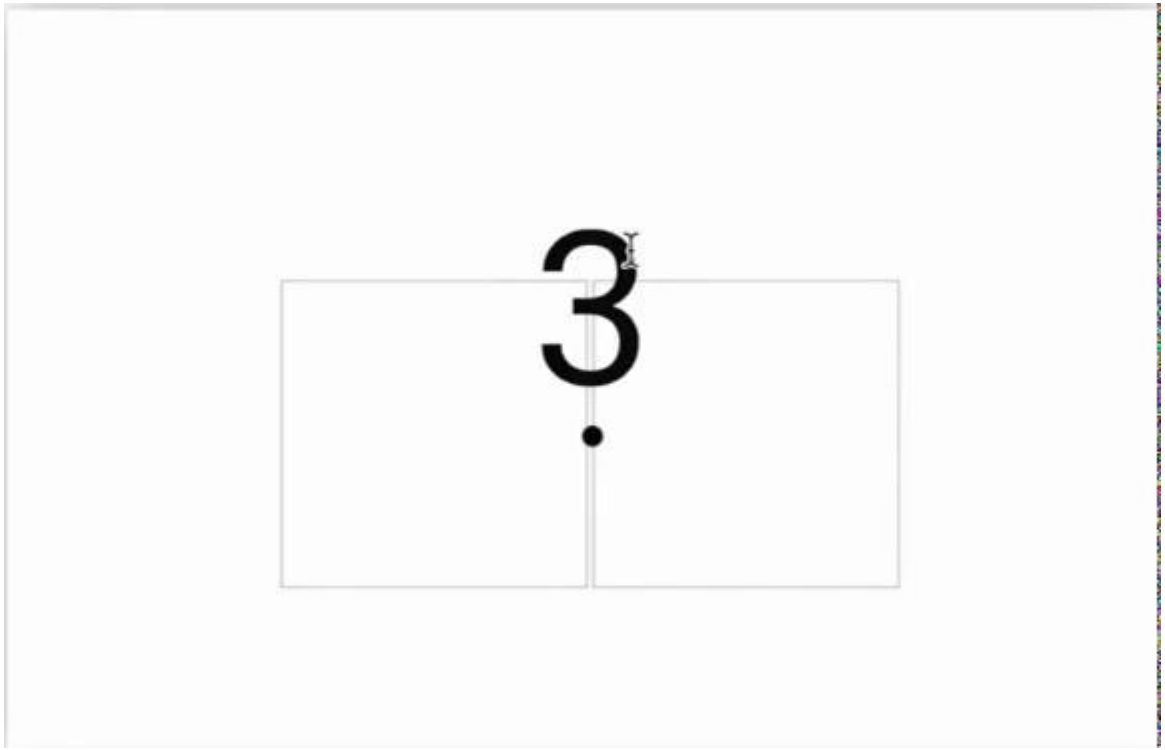
2 more tasks to experiment with

- **Max Mean**
- Max Range



2 more tasks to experiment with

- Max Mean
- **Max Range**



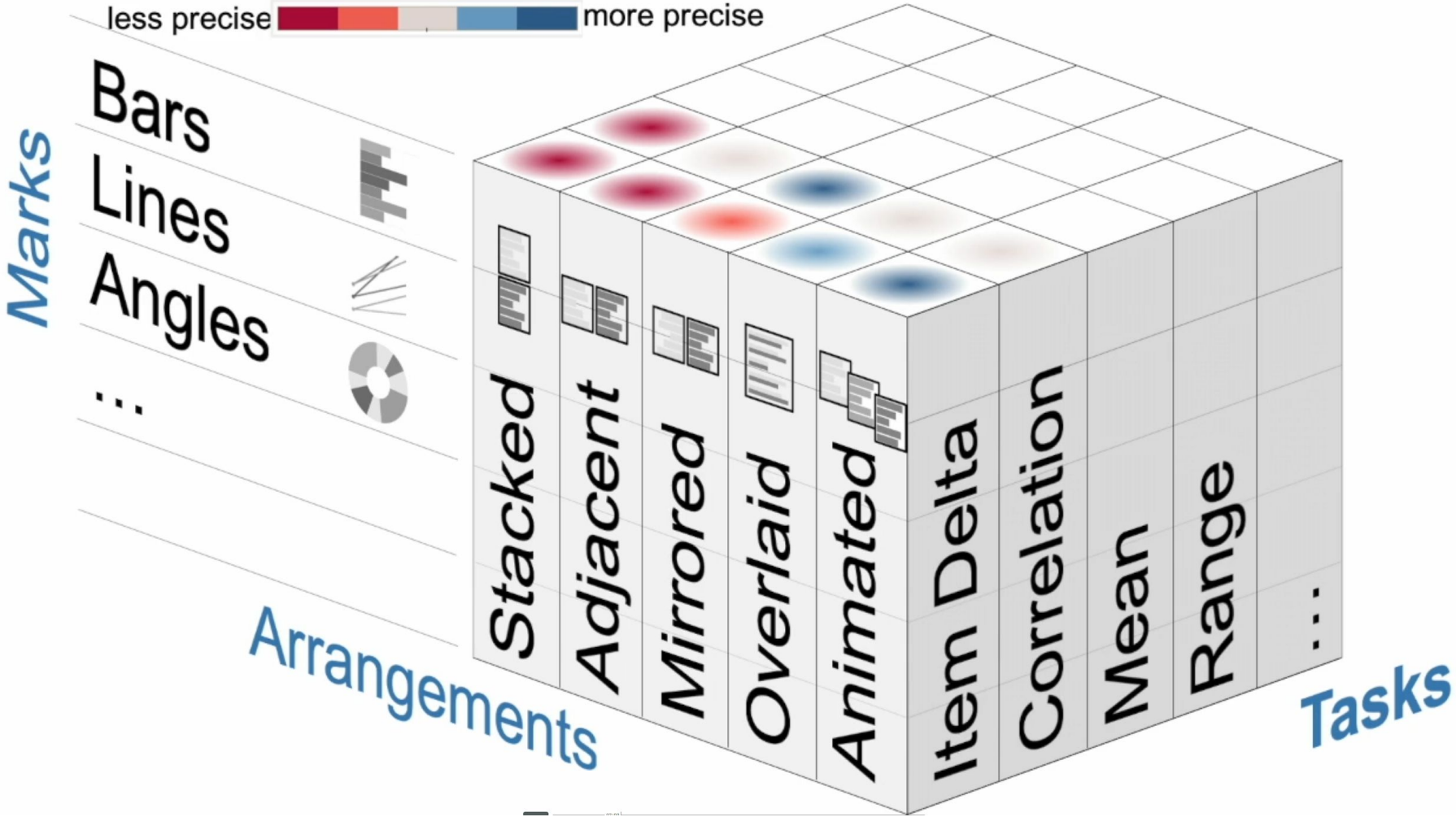
How to increase difficulty?

Staircase procedure

Which set in each pair has a bigger mean?

Easy

Hard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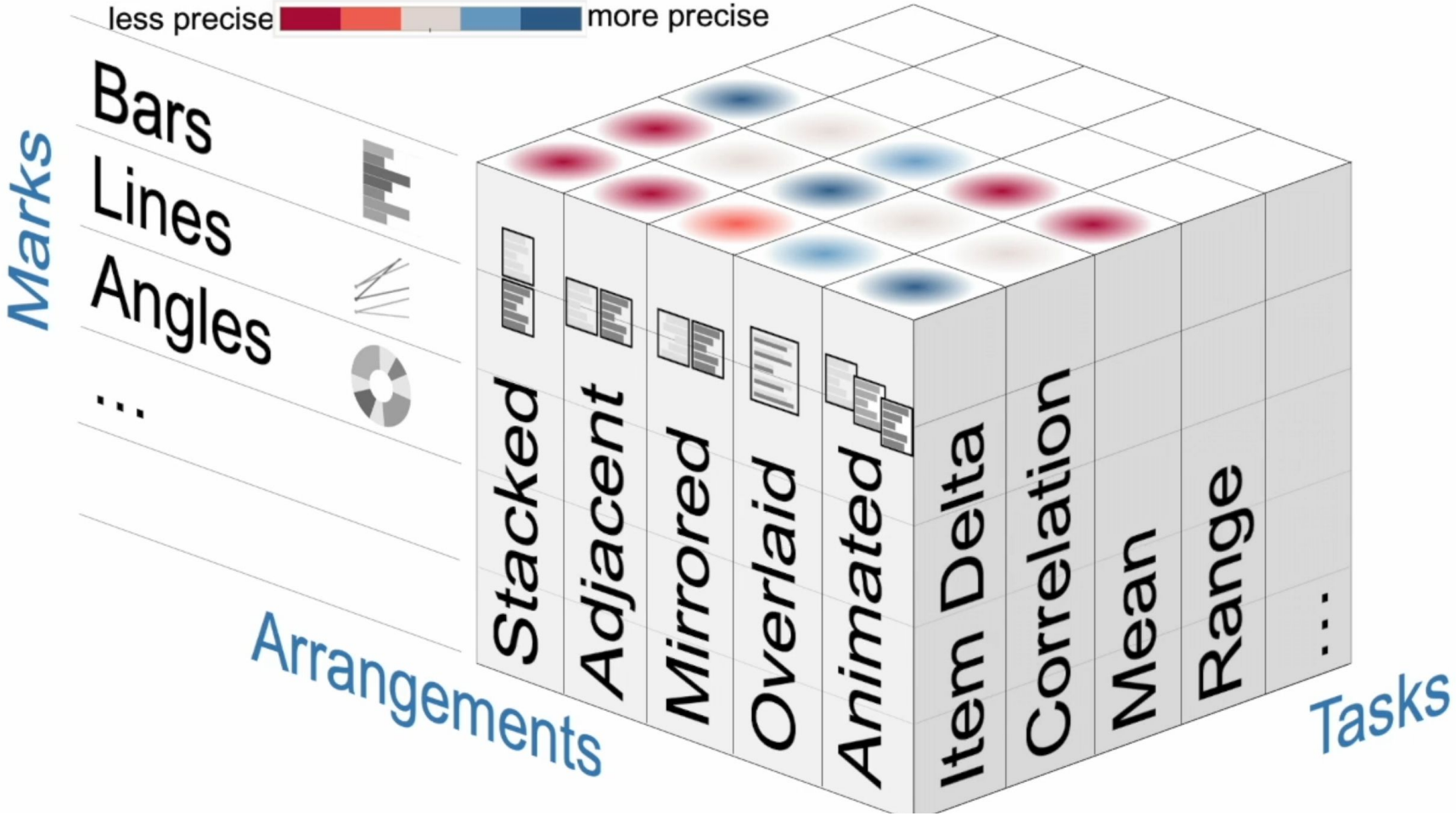
...
Tasks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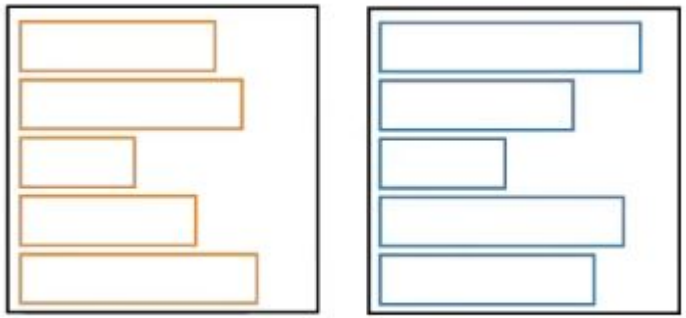
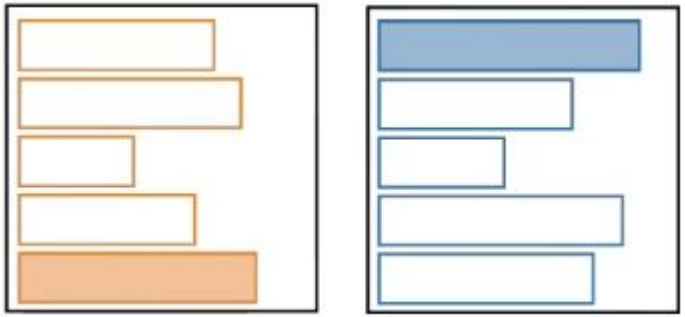
Tasks

What is visually compared?

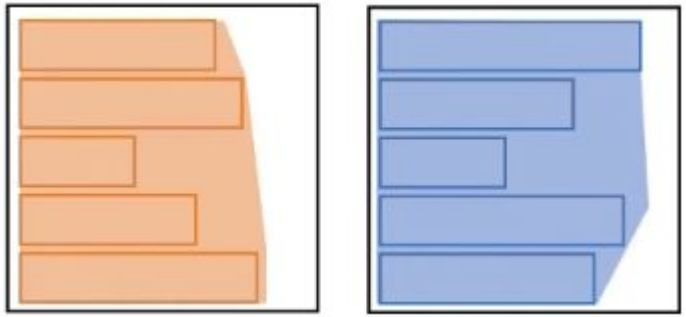


What steps do our brain do in order to reach for a conclusion?

What is visually compared?



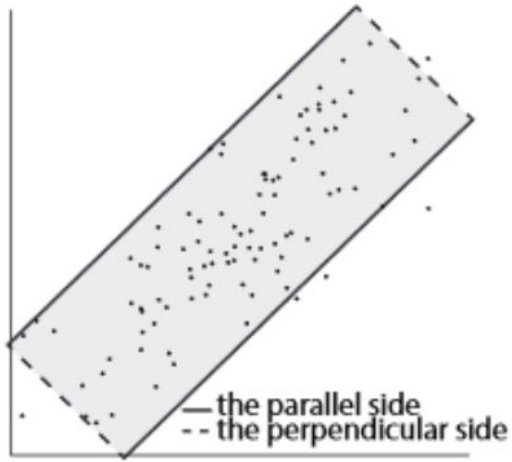
What is visually compared?



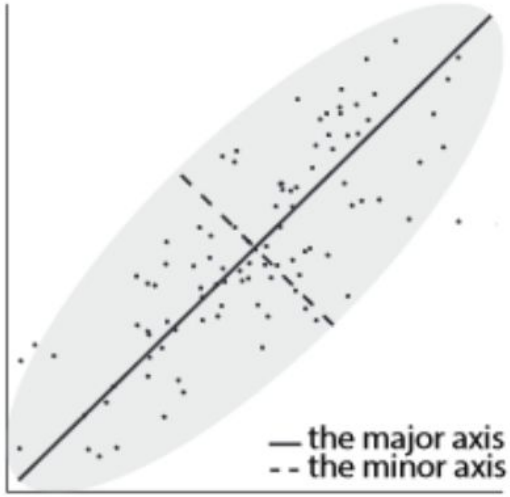
Proxies for scatter plots

What does your brain do to know the correlation between two factors in a scatterplot?

Bounding Box



Prediction Ellipse



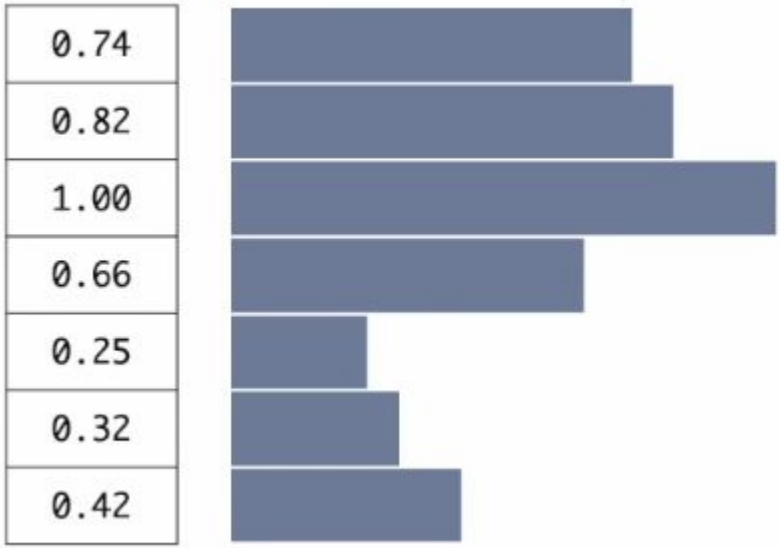
Proxies for bar charts

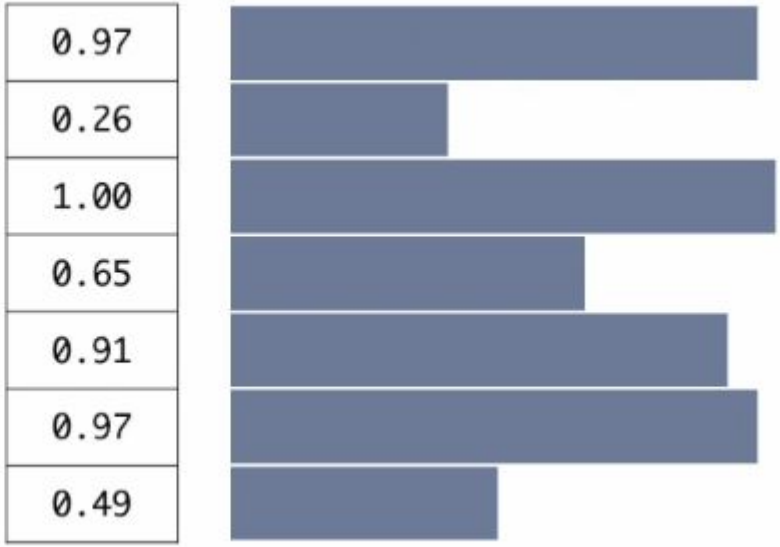
- Different from scatterplot
- Allows for different tasks like comparing mean and comparing range instead of only one task
- Different tasks map to different proxies

Proxy bots

- Not computer vision systems
- Only know how to do one thing
- Simple algorithms

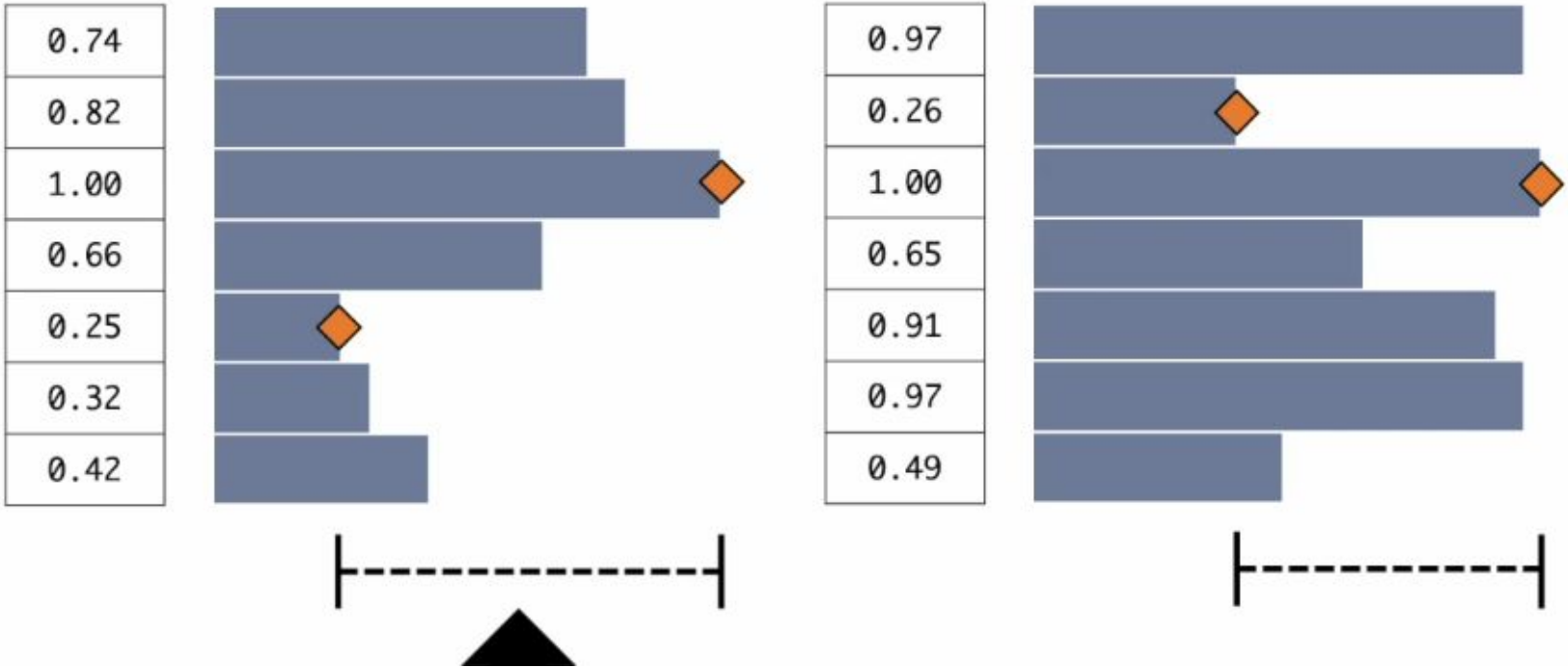
What do these proxy bots do?



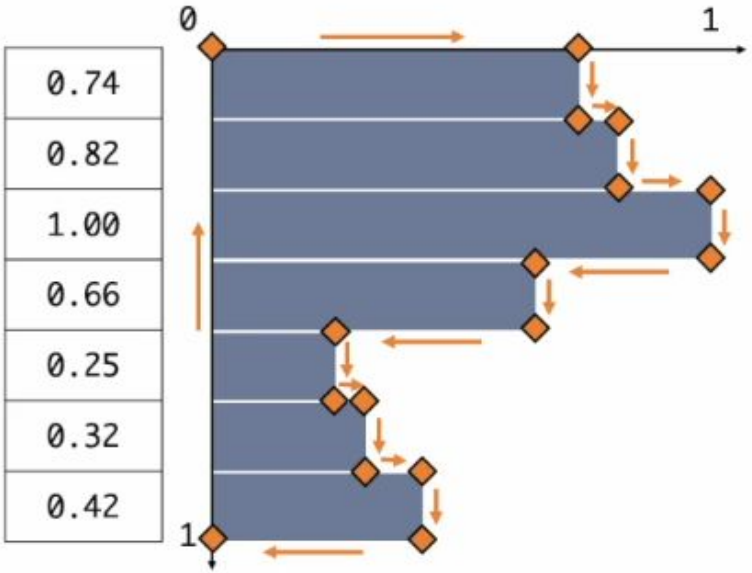


Example: Top-Item proxy bot

Example: Range proxy bot

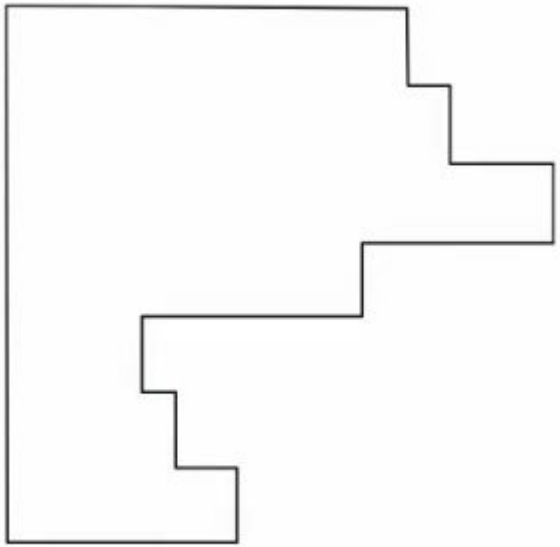


Example: Convex hull proxy bot

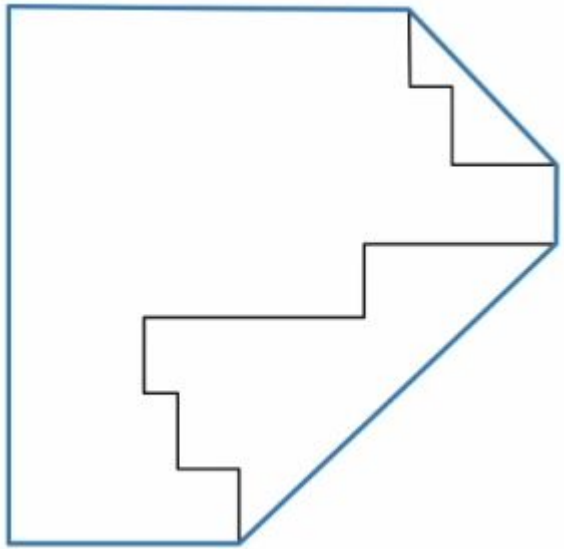


1. (0.00, 0.00)
2. (0.74, 0.00)
3. (0.74, 0.14)
4. (0.82, 0.14)
5. (0.82, 0.28)
6. (1.00, 0.28)
7. (1.00, 0.43)
8. (0.66, 0.43)
9. (0.66, 0.57)
10. (0.25, 0.57)
11. (0.25, 0.71)
12. (0.32, 0.71)
13. (0.32, 0.86)
14. (0.42, 0.86)
15. (0.42, 1.00)
16. (0.00, 1.00)

Example: Convex hull proxy bot

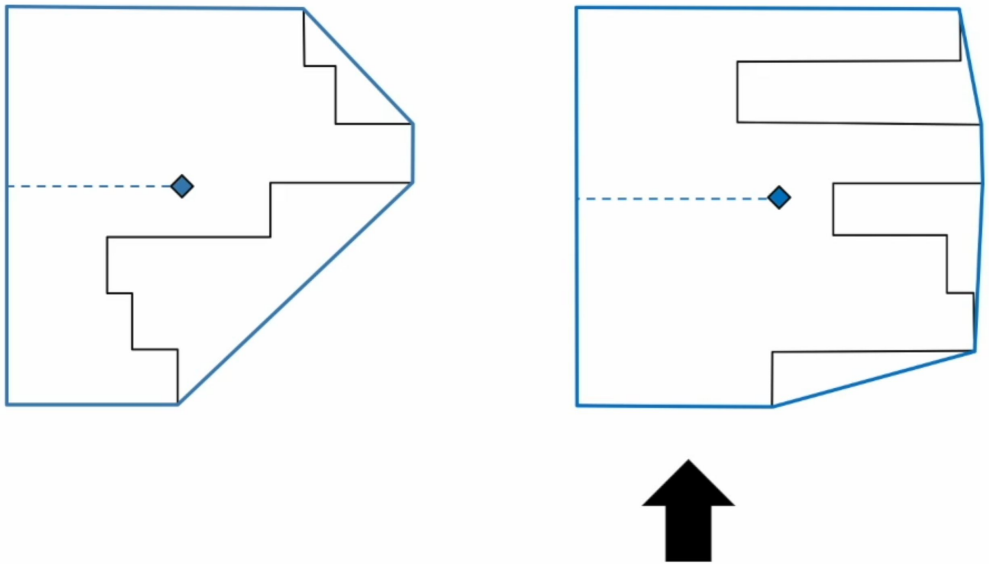


Example: Convex hull proxy bot



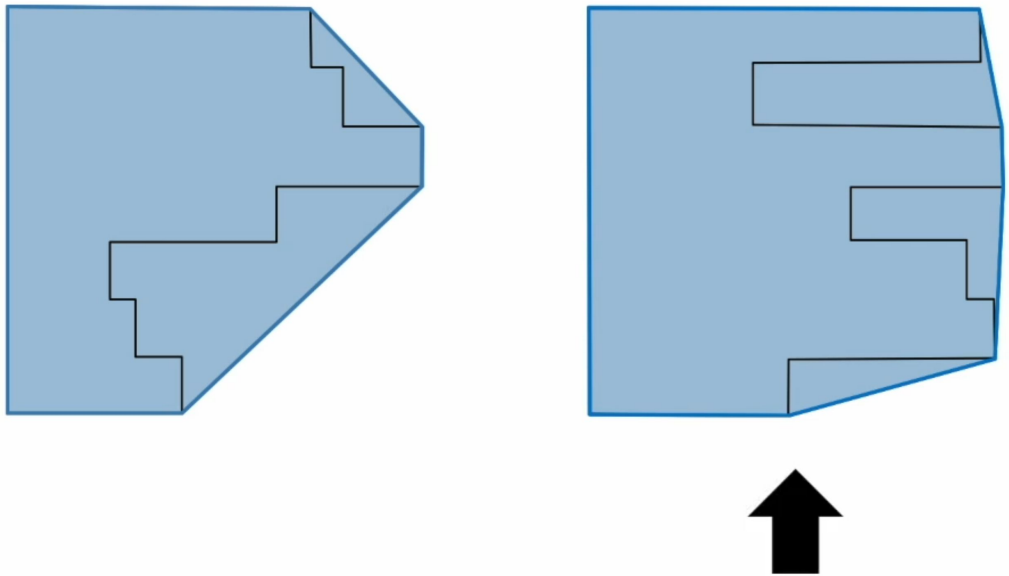
Example: Convex hull proxy bot

Which have a centroid farther to the right?

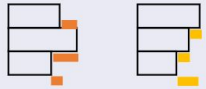
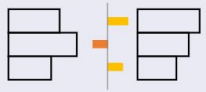
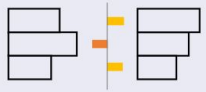
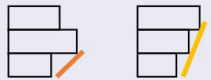


Convex hull proxy bot

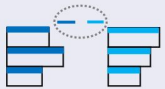
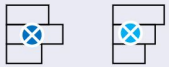
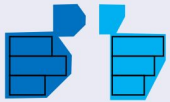
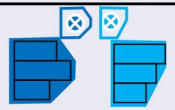
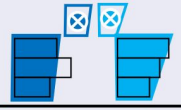
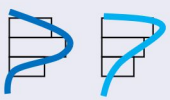
Which have a larger area?



Focal proxies

Focal Proxies			
	Range*		Extracts all pairwise deltas within a set, chooses set with the longest pairwise length difference.
	Biggest Mover Pair (Abs)		Between charts, finds largest delta between item pairs (a1-b1, a2-b2…), picks chart with largest positive delta.
	Biggest Mover Pair (Rel)		Same as Biggest Mover Pairwise, but scaled relative to the smaller item within the pair.
	Biggest First Item		Compare top items, picks chart with larger top item.
	Biggest Middle Item		Compare middle items, picks chart with larger middle item.
	Slope Min to Max		Finds each chart's min/max, computes slope between them. Picks the chart with the least-vertical slope.

Global proxies

Global Proxies		
Mean*		Extracts lengths of bars of each set, computes ensembles, chooses chart with longer ensemble.
Centroid		Picks chart with largest centroid of the bar areas (along just relevant x axis).
Hull Area		Calculates convex hull of chart, picks chart with bigger hull area.
Hull Centroid		Calculates convex hulls, picks larger centroid (along relevant dimension only).
Trap Area		Draws trapezoids between each chart's top and bottom bars, picks bigger area.
Trap Centroid		Draws trapezoids between each chart's top and bottom bars, picks trapezoid with larger centroid.
Symmetry Bias		Calculates skew (i.e. symmetry) of each set, chooses which chart is less skewed (i.e. more symmetric).

What to do with the proxy bots?

We need to answer two questions

1. Which proxies are accurate for each task (useful)?
2. Which proxies are used by humans for each task (used)?

1. **Which proxies are useful?**

% correct

2. **Which proxies are used?**

% agreed

Results

- Global visual features are better candidates for the MAXMEAN comparisons
- Focal visual features are better candidates for MAXRANGE compar-isons.
- People tend to make decisions consistent with using the most useful visual features

Strengths

- Novel idea which is to build proxy bots and use these bots to understand what humans do to for specific visualization tasks
- Provided clear examples of what proxy bots are and clear examples of tasks and arrangements
- Were generous to provide a video for their paper
- Did not shy away from mentioning their failed attempts in proving a correlation of two tasks
- Used visualizations in their paper to make it easier for readers to comprehend
- Clearly mentioned their limitations and caveats in the paper

Weaknesses

- Were discouraged of establishing a correlation between arrangements with tasks after conducting two extra tasks only
- Did not show clearly on which basis did they categorize proxy bots into two categories (item based and set-based)
- Looks like they had 2 unrelated contributions

Future work

- How can different datasets affect what proxy the user uses
- Example: “In a visualization with two charts with one large item outlier, the single item outlier might capture attention provoke a focal comparison.”

References

- https://vimeo.com/371939151
- https://vimeo.com/360050277

Thank you