BIASED AVERAGE POSITION ESTIMATES IN LINE AND BAR GRAPHS: UNDERESTIMATION, OVERESTIMATION, AND PERCEPTUAL PULL

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Bias

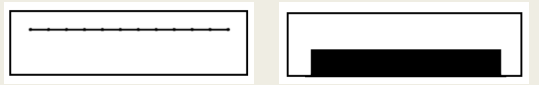
- Bias in position channel
- Position is believed to be the most precise way to encode information
- Data encoded in position is assumed to be perceived in an unbiased manner

Experient Setup

- Two types of data series

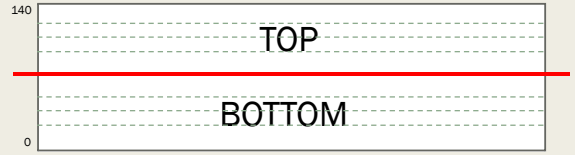
Line Bar

- Uniform or Noisy



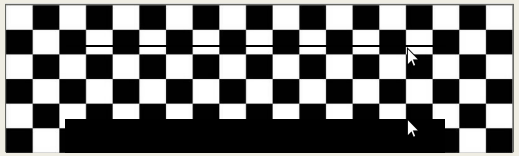
Experient Setup

- Display Frame and Display Types



9.6 x 2.8 in
538 x 140 pixels

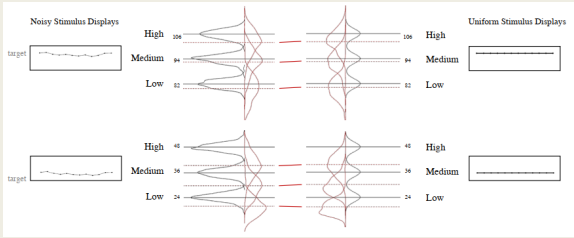
Experient Procedures



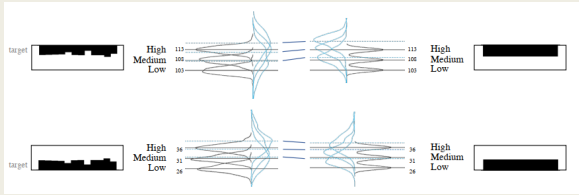
Experient 1

- How accurately people can perceive average position of a single line or single set of bars in a graph?
- Establish a baseline for later experiments
- 576 trials, 288 trials for each line and bar position estimate, with half of trails for each condition displaying noisy and uniform data.

Experient 1 Results



Experient 1 Results



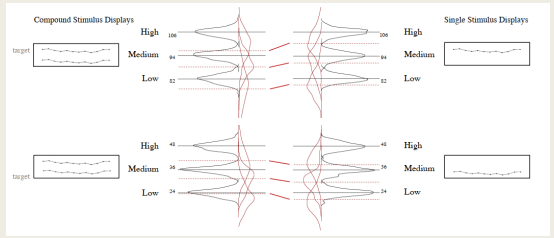
Experient 1 Results

- Underestimation of Lines
  - *regardless appeared top or bottom, although more underestimation at the bottom*
  - *not depend on whether the line was noisy or uniform, although estimations of uniform data are more accurate and precise*
  - *not an artifact of poor average strategies (not averaging only high points and low points)*
  - *initial probe position affects error but not bias*
- Overestimation of Bars
  - *same results as the lines'*

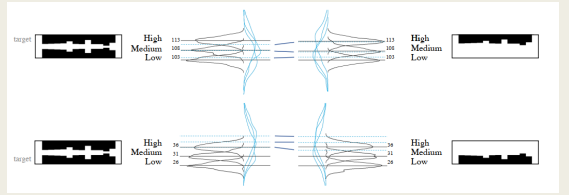
Experient 2

- How this bias affected by the presence of an additional data series?
  - *two lines ("compound line-line")*
  - *two bars ("compound bar-bar")*
- 240 trials, 120 trials for each line and bar average position estimation condition.
- 144 control trials (experiment 1) were replicated.

Experient 2 Results



Experient 2 Results



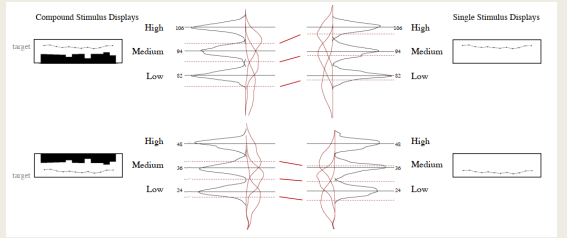
"Perceptual Pull"

- Underestimation of top line was exaggerated
- Underestimation of bottom line was reduced
- Overestimation of top bar was reduced
- Overestimation of bottom bar was exaggerated

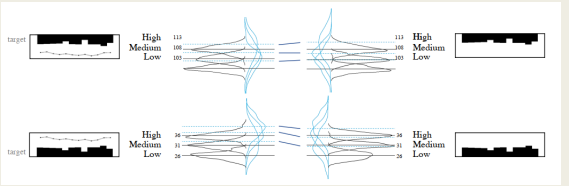
Experient 3

- What determines the extent of perceptual pull? (Data-series? Perceptual similarity?)
  - *"compound line-bar", "compound bar-line"*
- Experiment 1 and 2 results were replicated.

Experient 3 Results



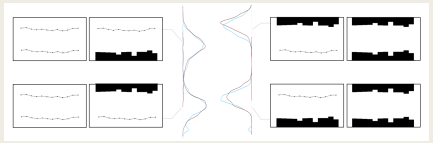
Experient 3 Results



Experient 3 Results

- The effect of perceptual pull occurs across graphed data series types.

- Strength of pulling across data series types?



  - *Extent of perceptual pull does not depend on data series type*

Conclusions and General Guideline

1. Underestimation of lines and overestimation of bars
2. "Perceptual Pull":

   - presence of an irrelevant line or set of bars in the same display pulled average position of estimations of a target line or set of bars toward the position of this irrelevant data series.
3. Perceptual pull is not dependent on graphed data series type.

1. Using bars to display data
2. Avoiding plotting two series in the same display

Critique

- Strengths
  - *An area few have studied*
  - *Carefully designed experiments, considered potential causes and issues*
  - *Well planned future works*

- Weaknesses/Limitations
  - *Short observation time (500ms)*
  - *Small experimental population*

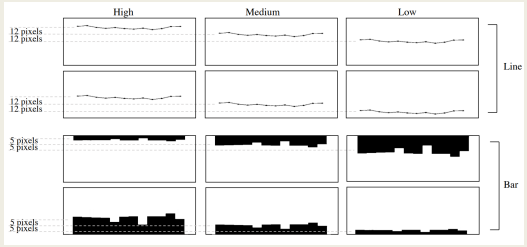
THANK YOU

Limitations

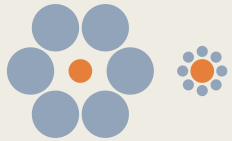
- Asymmetrical Biases
- Aspect Ratio
- Figure-Ground Encoding
- Take Beyond Averaging
- Reporting Mechanisms
- Complex Real-World Stimuli
- Untested Encodings

Experient Setup

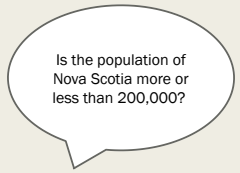
- Three Mean Values (for each top and bottom section)



Bias



Ebbinghaus Illusion
(perceptual)



Anchoring Effect
(cognitive)