Challenges of Graph Judgment: Top-Down and Bottom-Up Influences

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Abstract

Informal judgment of graphs can be swayed by both top-down expectations and bottom-up perceptual factors. Participants judged whether an event in the middle of a time-series graph affected later data points. Participants' beliefs about the proportion of graphs with such an effect had large impact on a signal detection measure of bias. In contrast, the autocorrelation of the time-series – which controlled perceptual features – primarily affected discriminability. These results highlight the importance of formal statistical algorithms to corroborate informal graph judgment.

Introduction

Interrupted time series graphs are common in A-B designs, and more generally in any situation where something new (an interruption) is thought to cause a change

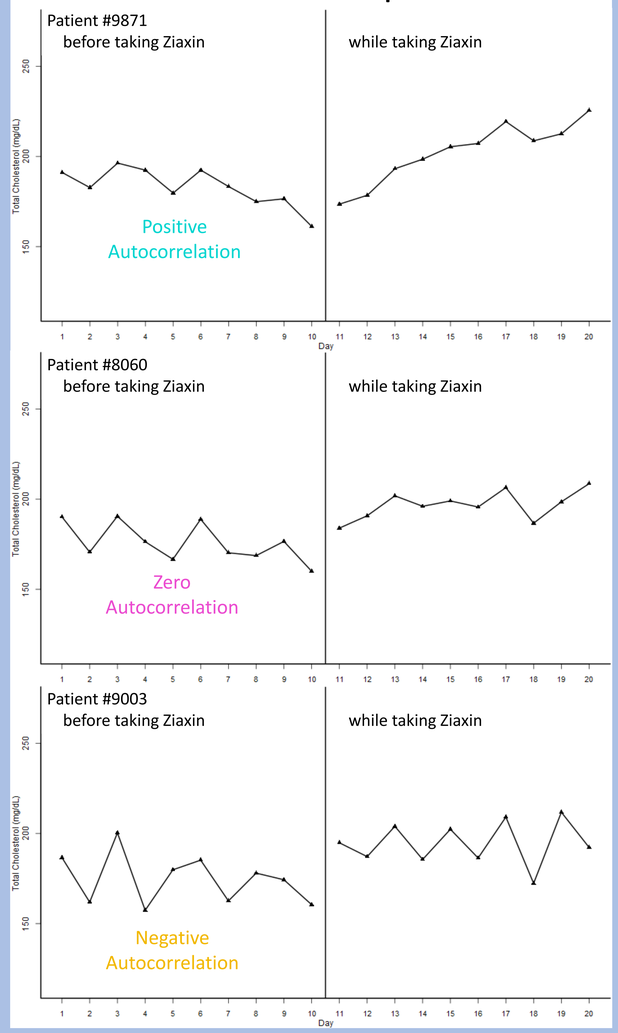
- Top-down influences could include **belief perseverance**
  - People may interpret ambiguous or missing feedback as confirming previous beliefs[1]
- Bottom-up influences include perceptual features of the graph
  - A major source of such features is **autocorrelation** (error in earlier time points affects later time points)
  - Positive autocorrelation
    - E.g., hot days followed by hot days, and cold by cold
    - Leads to smoother line patterns
    - Previous evidence of impaired graph judgment[2,3]
  - Negative autocorrelation
    - E.g., low sleep nights followed by long sleep nights, & vice-versa
    - Leads to jagged, reversing patterns

Could belief perseverance and autocorrelation affect informal graph judgment in distinct ways?

Method

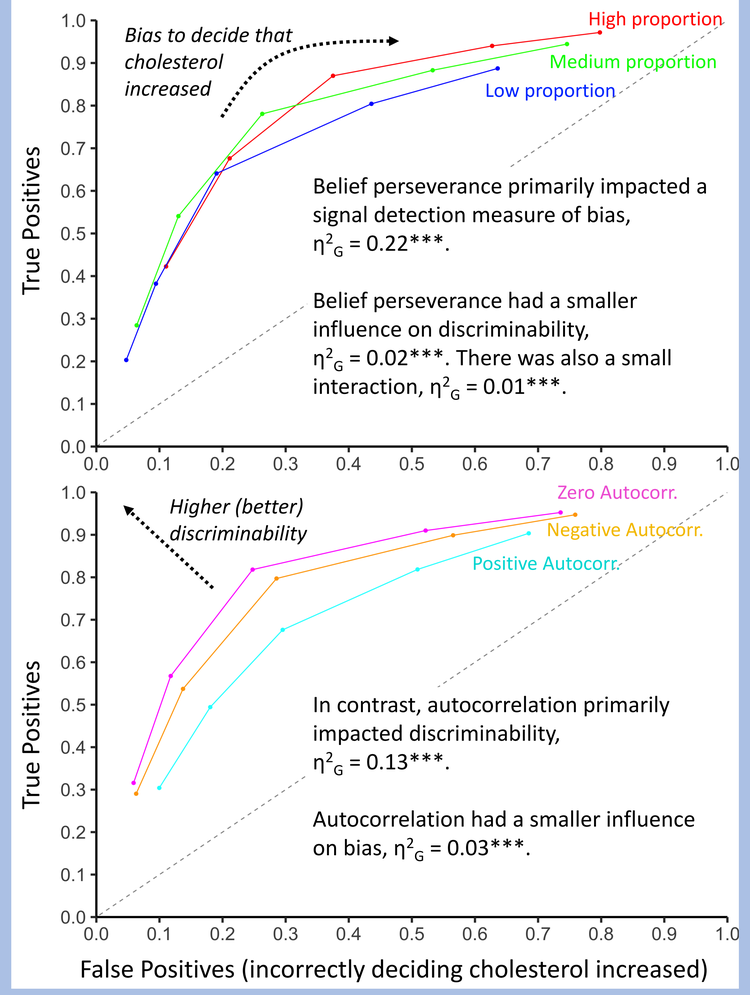
- Subjects (n=91) judged 378 interrupted time-series graphs
- Graphs showed cholesterol level before and after made-up drug (e.g., Ziaxin) was started
- Participants judged whether cholesterol increased after drug-start using a 6-point scale
- For each drug, the first 18 trials (practice trials) had feedback and were manipulated to influence **belief perseverance**. Three conditions:
  - **High proportion** (89% had cholesterol increase)
  - **Medium proportion** (50%)
  - **Low proportion** (11%)
- In critical trials, no feedback was given, and all proportions were 50%
- Population a**utocorrelation** was manipulated through an AR1 generating model:
  - **positive** (+.75), **zero** (0), or **negative** (-.75).
- Half of trials had a cholesterol increase (population intercept higher during drug phase)

Stimuli Examples

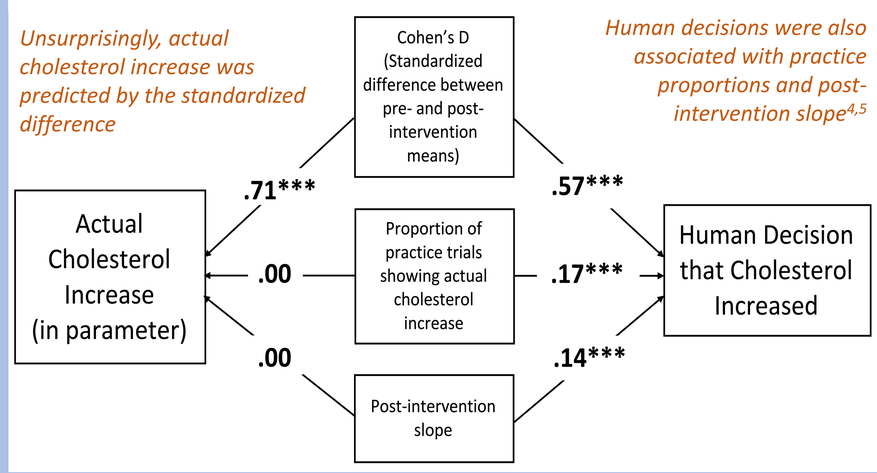


Definitely No Increase (Wager 3)	Probably No Increase (Wager 2)	Guess No Increase (Wager 1)	Guess An Increase (Wager 1)	Probably An Increase (Wager 2)	Definitely An Increase (Wager 3)

ROC Results



Lens Model Results



Additional Experiments

- Ruled out the simple explanation that autocorrelation effects were due to variance and extended effects to two-tailed decisions

Discussion

- Common characteristics of informal time-series graph judgments impacted decisions in different ways
- We recommend corroborating informal graph judgments with formal statistical models[6], particularly those designed for short time-series[7,8]

References

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