



Wanna Practice?

# Learning to Detect Patterns in 2x2 Graphs

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Poster

## Introduction

Prior studies on 2x2 graph comprehension had participants either "think aloud"<sup>(1,2)</sup> or provide written descriptions<sup>(3)</sup> about 2x2 main effects and interaction effects. Those methods privilege declarative knowledge (what can be stated). Here, we measured perceptual learning in 2x2 graph-pattern-detection using a trial-and-error task that does not require declarative knowledge.

## Methods

**Participants:** 58 students from an introductory psychology course completed the experiment.

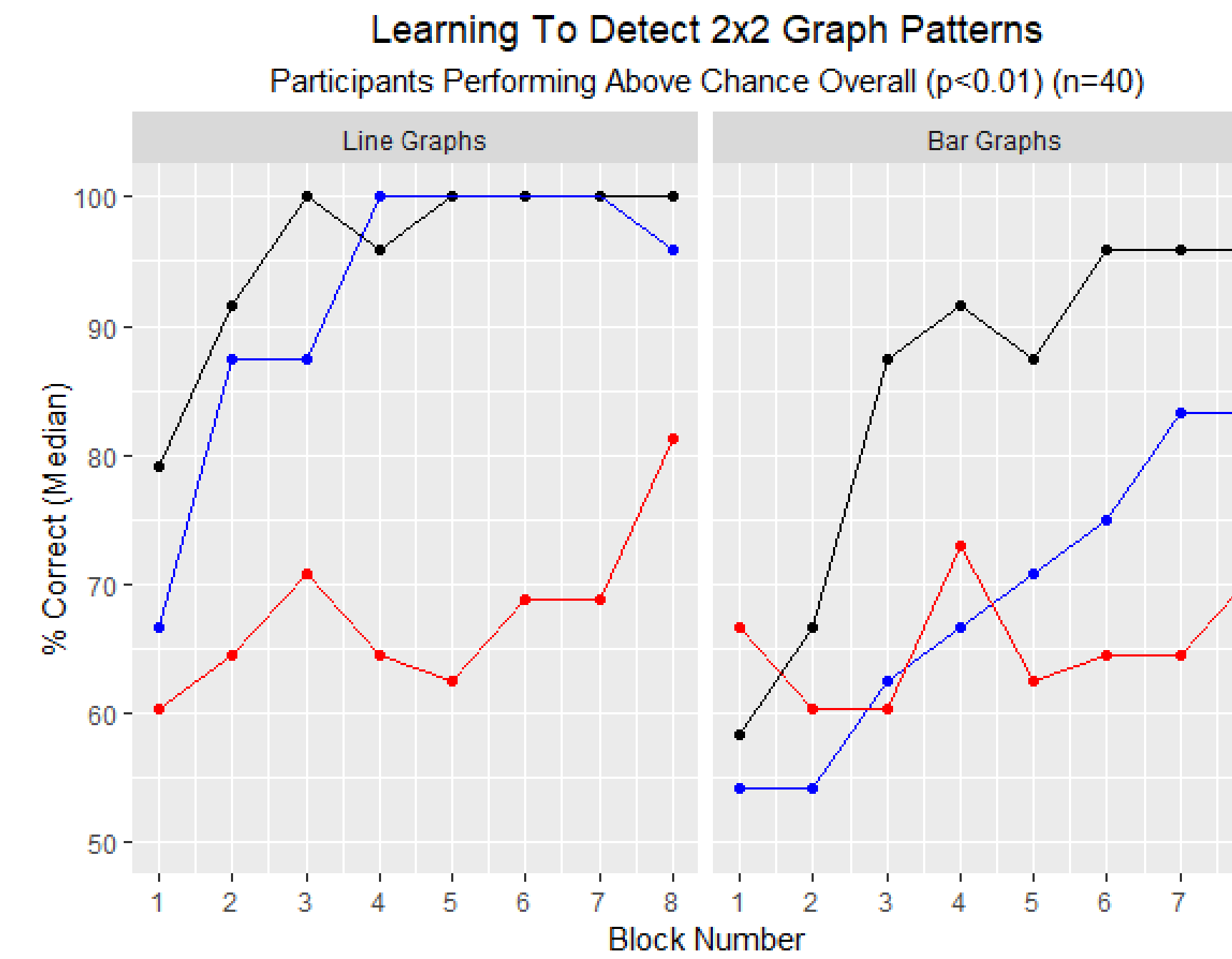
**Stimuli:** The eight possible 2x2 graph patterns, shown as either line graphs or bar graphs.

Pattern #	Factor A <i>L/R Diff</i>	Factor B <i>Color Diff</i>	Interaction <i>Slope Diff</i>	Line Graph	Bar Graph
1	n.s.	n.s.	n.s.		
2	SIG	n.s.	n.s.		
3	n.s.	SIG	n.s.		
4	n.s.	n.s.	SIG		
5	SIG	SIG	n.s.		
6	SIG	n.s.	SIG		
7	n.s.	SIG	SIG		
8	SIG	SIG	SIG		

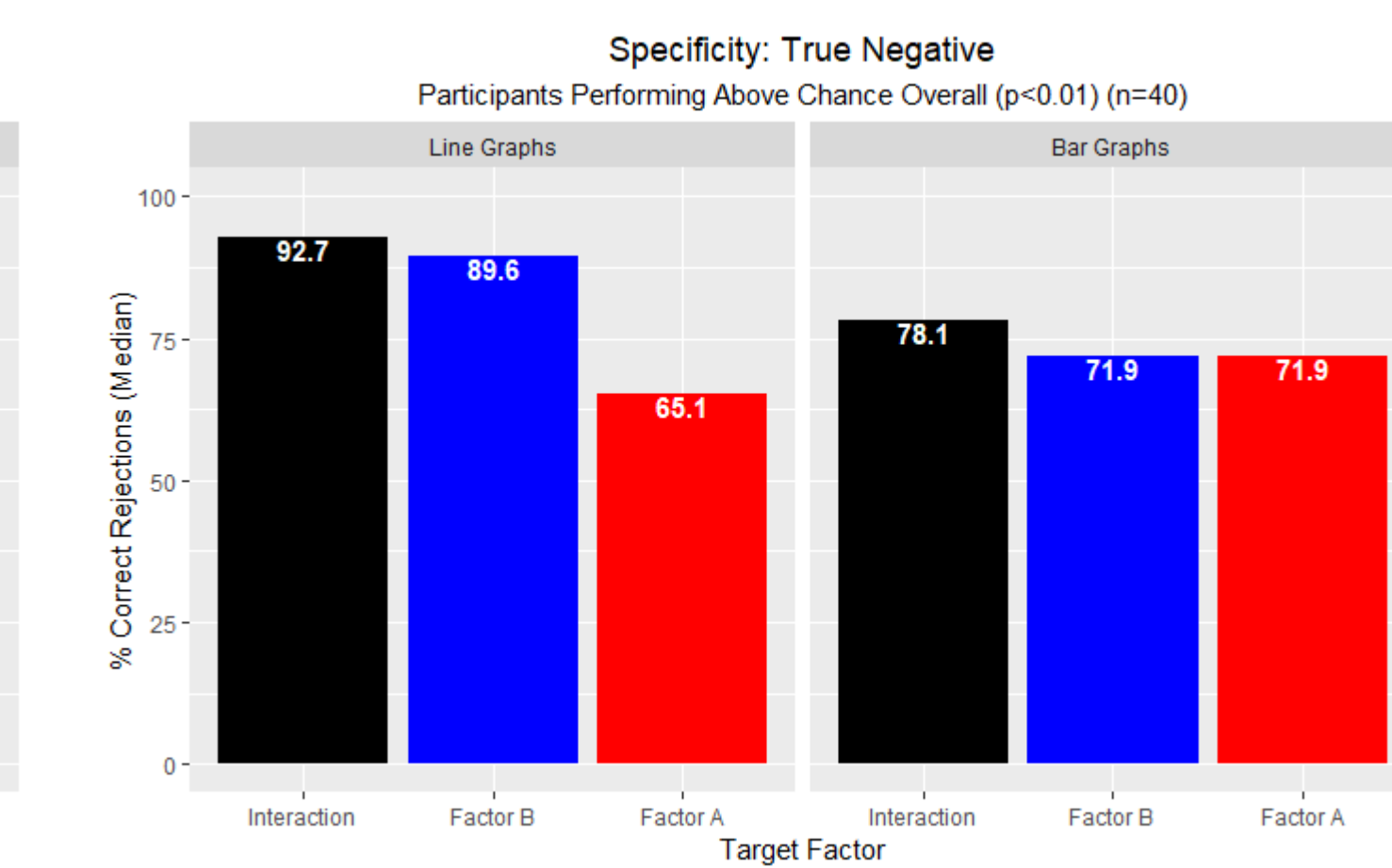
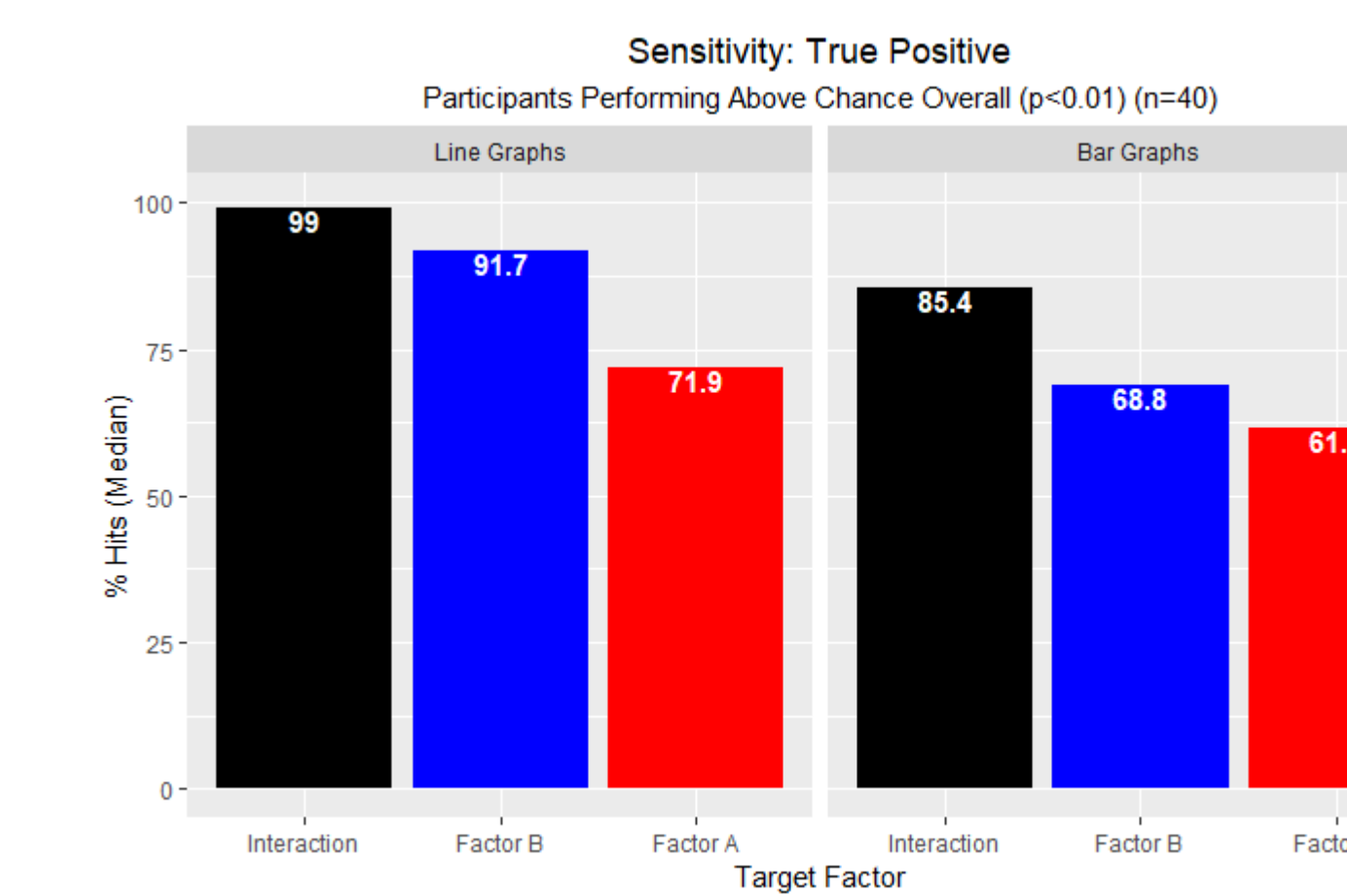
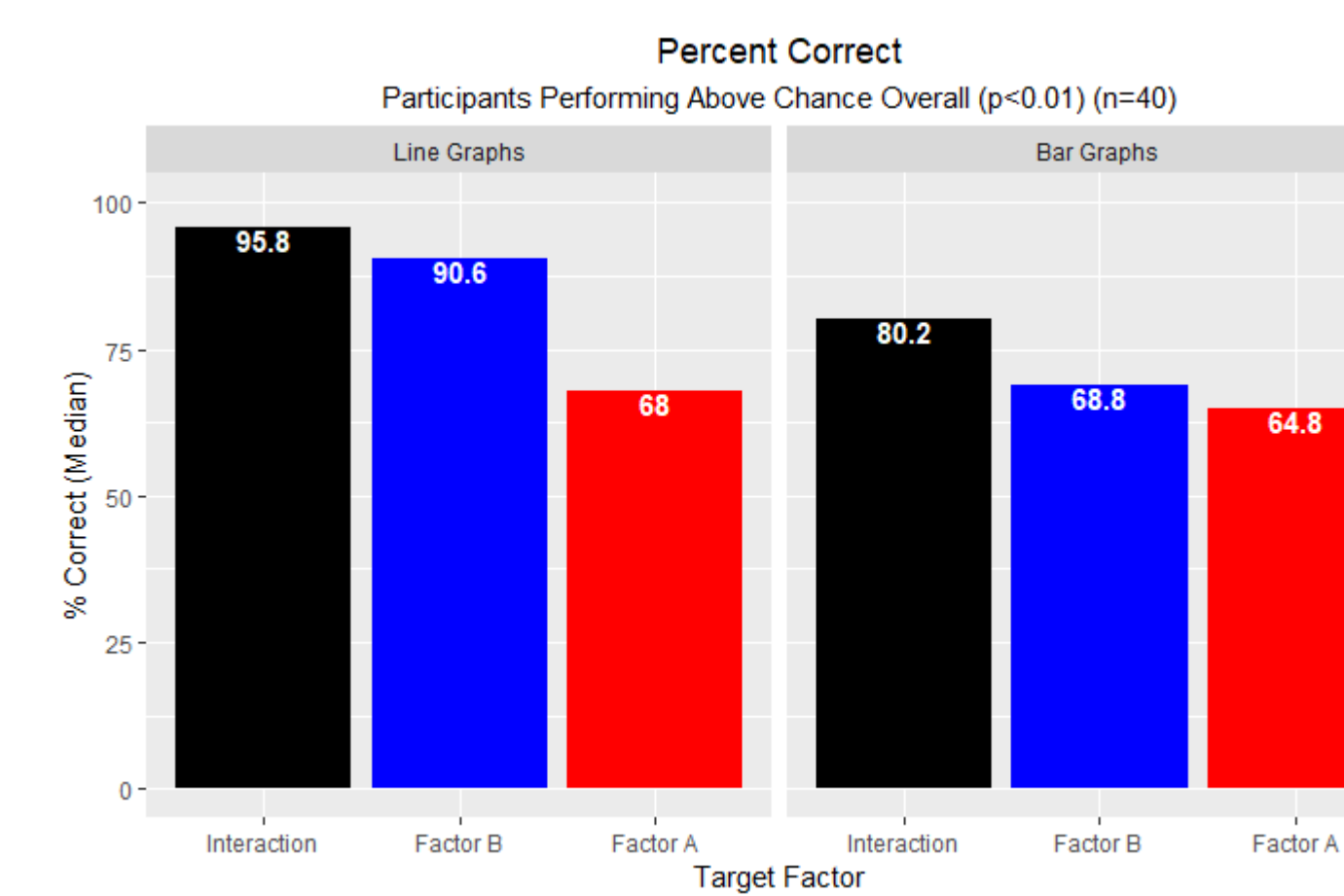
**Task:** Subjects classified 192 graphs into two initially unknown categories, *Category "N"* vs *Category "Y"*; these mapped to n.s. vs sig effects in one of 3 randomly assigned target factors.

**Research Design:** 3x2 → *Target Factor* ("A", "B", "Interaction") by *Graph Type* (Line versus Bar).

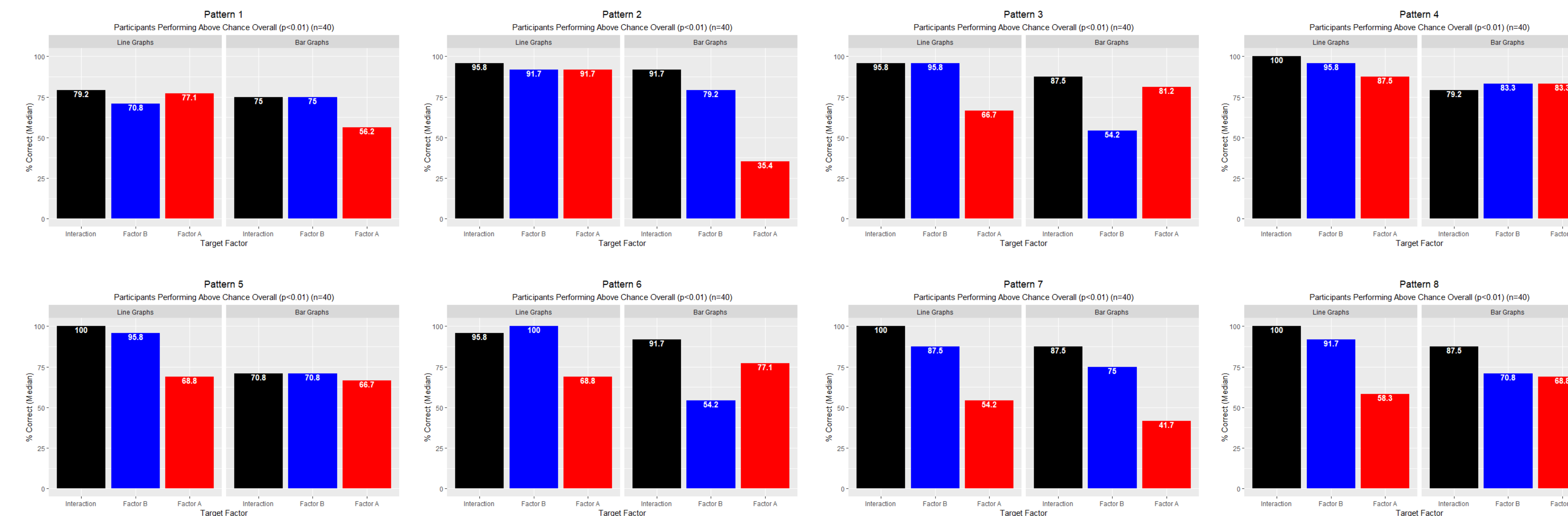
## Results



- Line-graph superiority effect for Factor B, and for Interaction effects (each p<0.001).
- Interaction-learning significantly exceeded Factor-A learning (p=0.009).
- Factor A generated 12 of the 18 subjects (p=0.003) who failed to perform above chance.
- Overall, sensitivity significantly exceeded specificity (median 90.1% vs 85.9%) (p=0.014).
- Pattern 8 performance > Pattern 1 performance (median 87.5% vs 75%) (p=0.033).



## Pattern Analysis



## Discussion

Our findings suggest significant biases in **ensemble perception** -the ability to extract summary statistical information from groups of similar objects<sup>(4)</sup>. Notably, flipping a significant main effect from Factor A to Factor B while also switching the **data visualization** from bar graphs to line graphs improved the median percent correct from 64.8% to 90.6%. Regarding **statistics education**, our pattern analysis suggests a need for students to practice identifying *null effects* in 2x2 graphs.

## References

- (1) PMID: 23516801; (2) PMID: 26579052; (3) PMID: 25164403; (4) PMID: 28892638.