

General introduction

The standard framework to study vision is typically, either implicitly or explicitly, both hierarchical and feedforward.

However, such frameworks can break down when elements are presented in context, as they are in everyday life.

In order to truly understand low-level vision, we must also understand high-level processing. The two are inseparable.

Crowding and context

In crowding, peripheral object discrimination is hindered by the presence of nearby elements (Bouma, 1970).

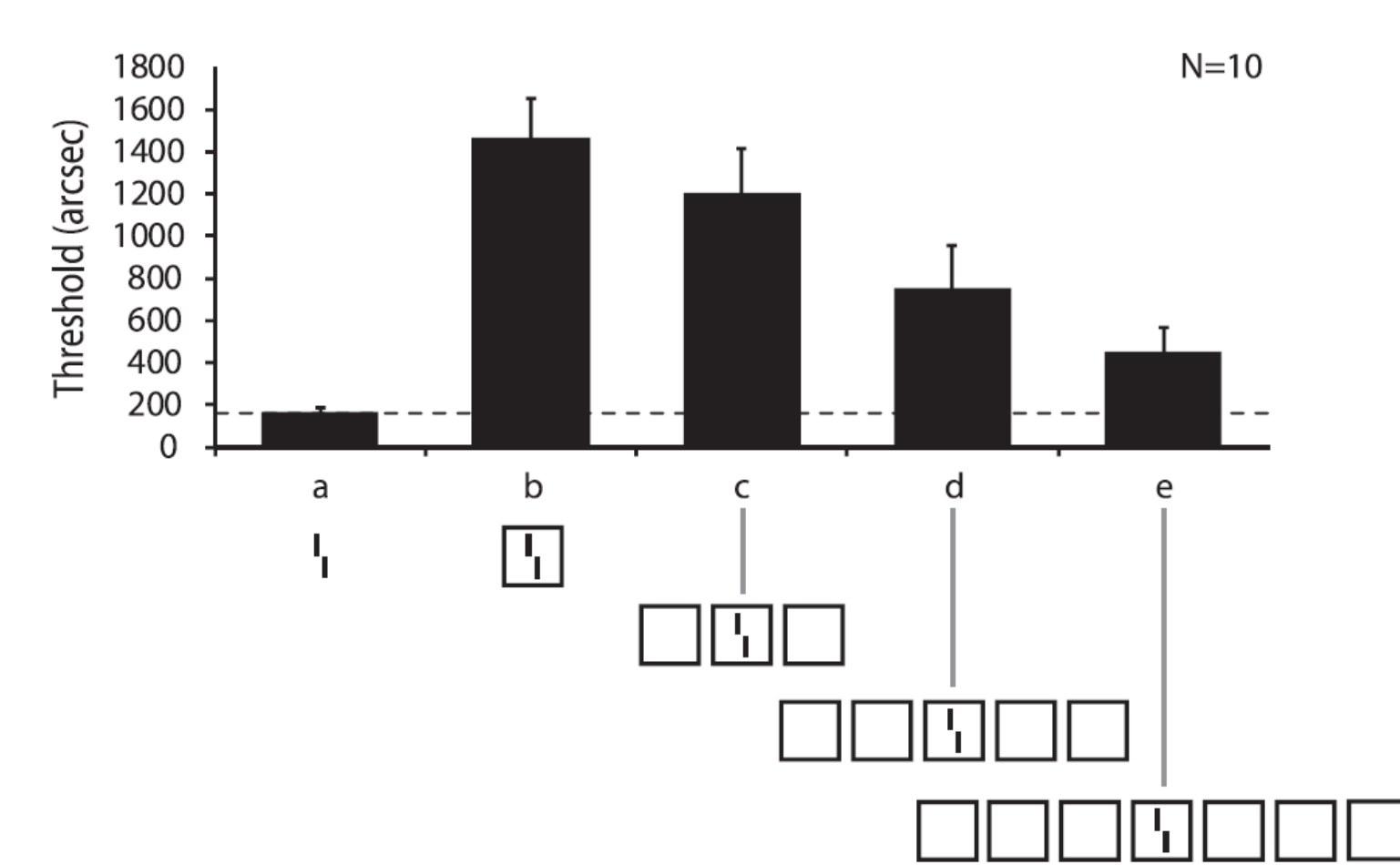


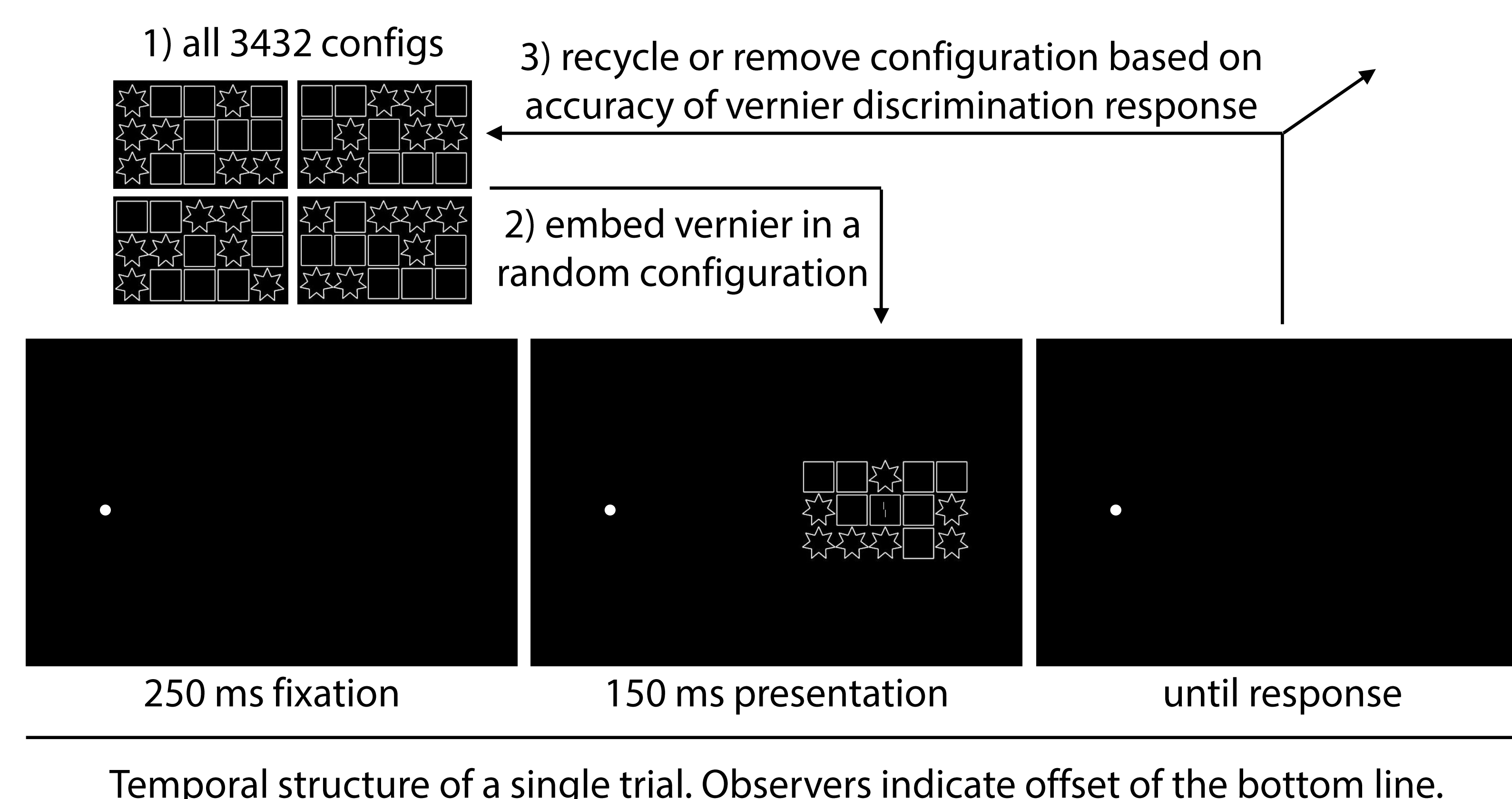
Figure adapted from Manassi, et al. (2013)

In this way, embedding a Vernier in a square hinders discrimination. However, if we add contextual squares, this deficit is ameliorated. Elements outside Bouma's window affect crowding.

Methods: logic & design

Previous studies have explored the effect of relatively few experimenter-selected configurations on crowding. Here, we employed a *bottom-up, theory-agnostic* approach.

We presented all possible 3x5 arrays with equal of squares and stars to measure their effect on Vernier discrimination



Methods: experimental layout

Experiment 1

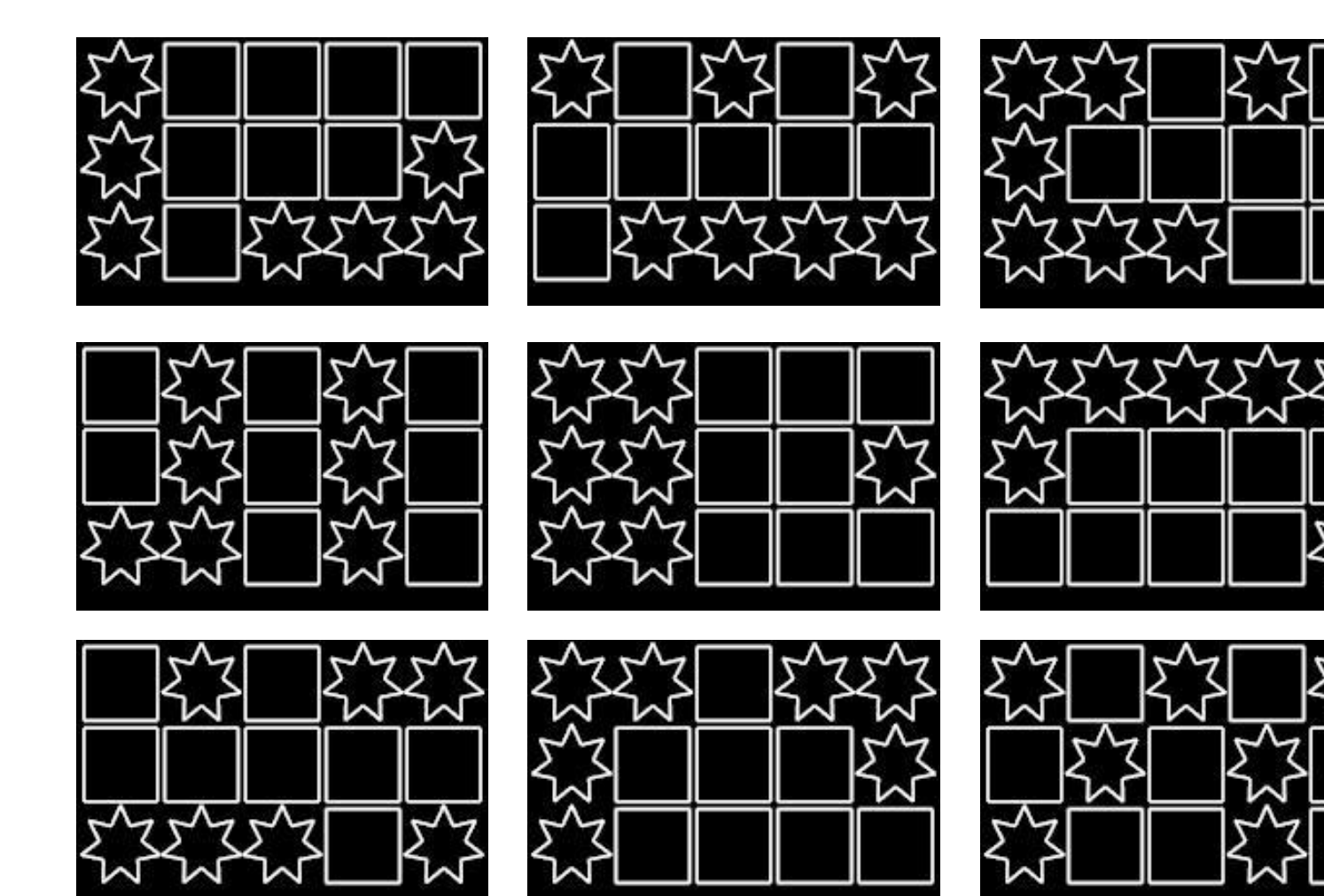
- N = 6, eight sessions each
- Phase 1: Obtain 75% thresh before each session begins
- Phase 2: 429 configs/session
- Configs removed after one incorrect or six correct discrimination responses

Experiment 2

- N = 6, eight sessions each
- Phase 1: Obtain 70% thresh before each session begins
- Phase 2: 429 configs/session
- Configs removed after two correct or seven incorrect discrimination responses

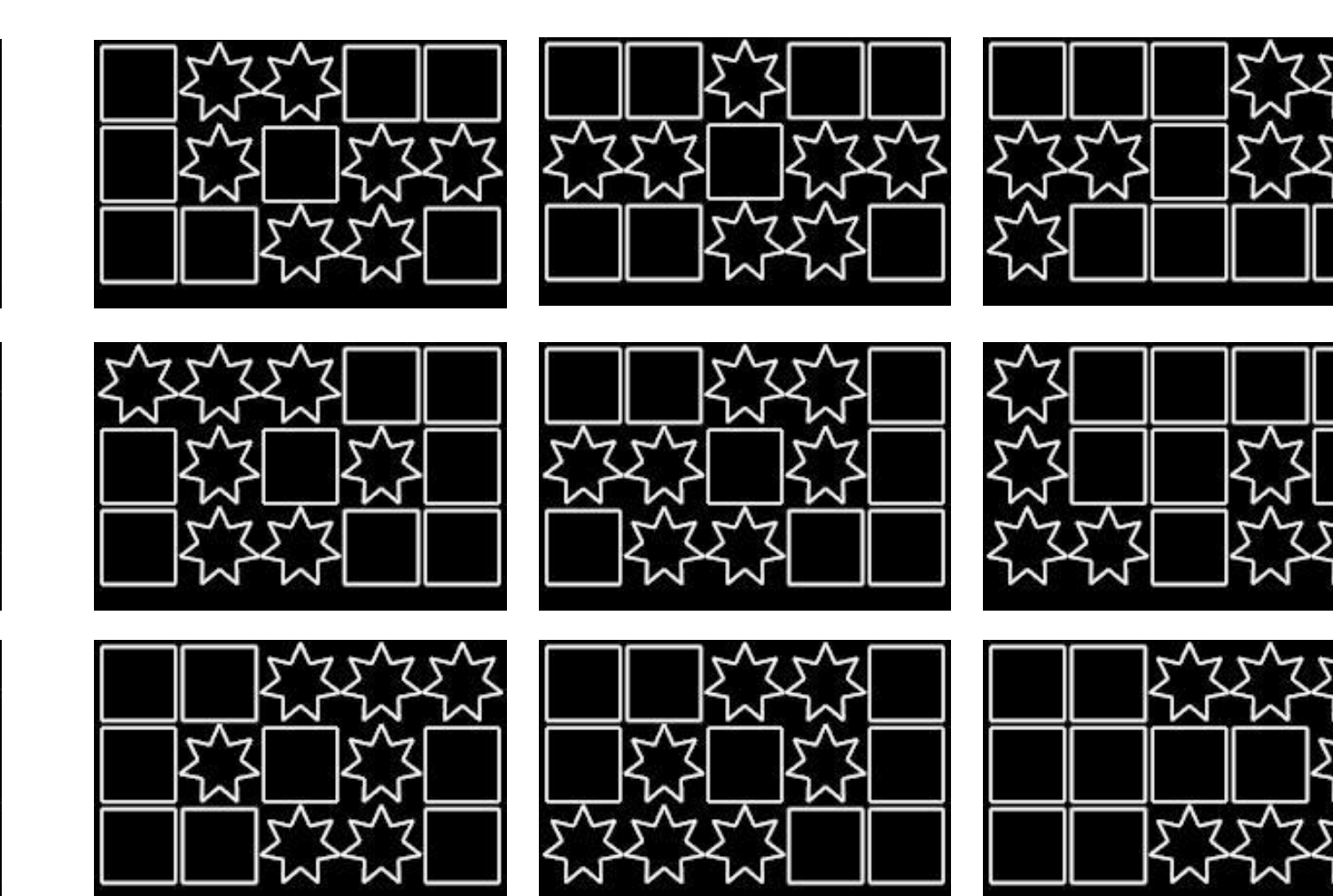
Results: sample configurations

Experiment 1: top 200



Based on average correct responses

Experiment 2: bottom 200

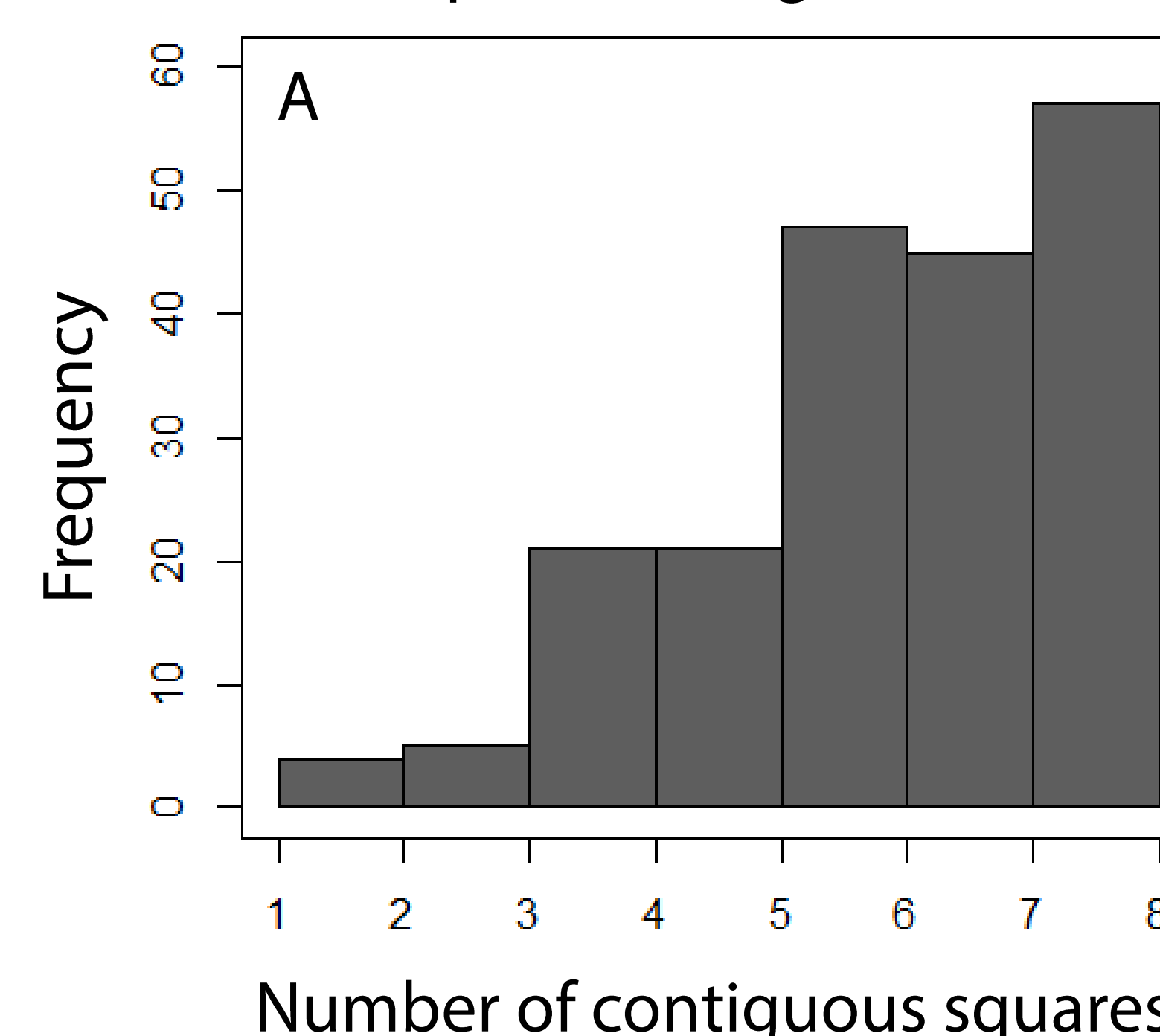


Based on average incorrect responses

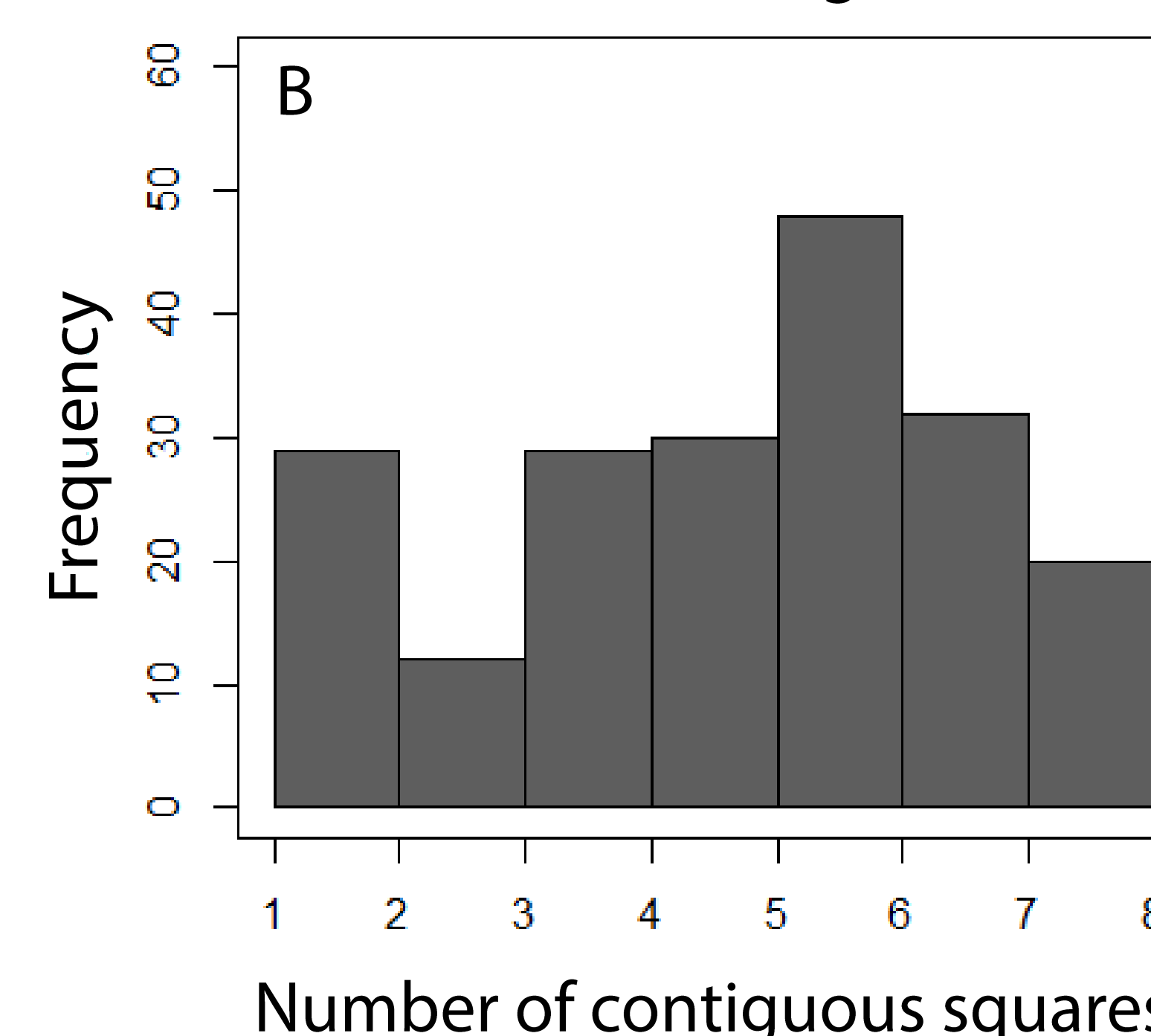
Results: analysis of contiguous squares

Experiment 1: Keep configurations after correct responses

Top 200 configurations

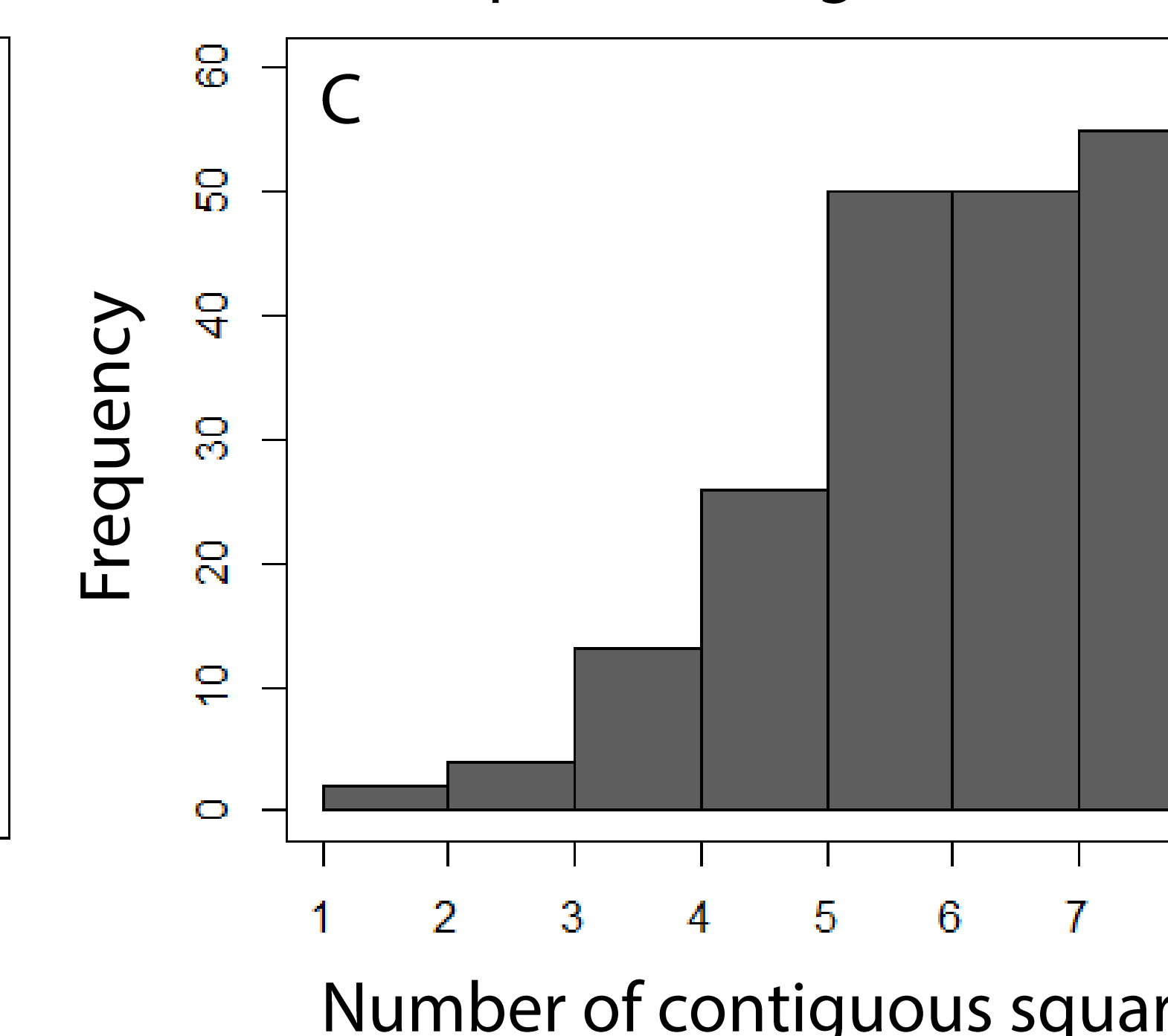


Bottom 200 configurations

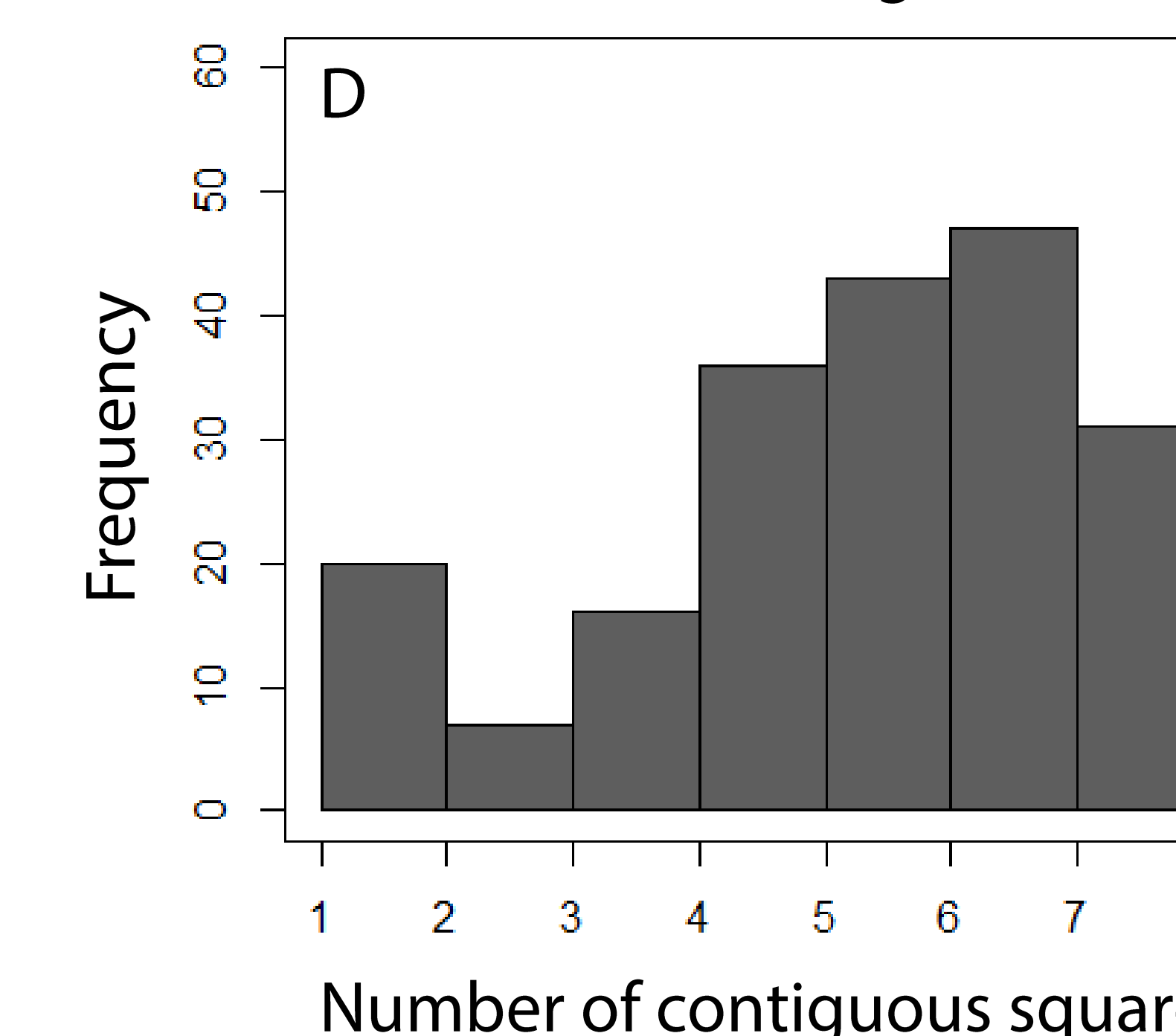


Experiment 2: Keep configurations after incorrect responses

Top 200 configurations



Bottom 200 configurations



Histograms of the number of square elements non-diagonally connected to the central square. **Panels A and B**: Experiment 1, where configurations resulting in correct Vernier discrimination responses were repeated. **Panels C and D**: Experiment 2, where configurations resulting in incorrect Vernier discrimination responses were repeated. Top and bottom 200 configurations are quantified using the mean number of presentations across observers before removal. In experiment 1, the top configurations are those repeated most often (i.e., those leading to the highest number of correct responses). In experiment 2, the top configurations are those repeated least often (i.e., those leading to the fewest incorrect responses)

Conclusions

The number of contiguous square elements in the surrounding configural context is a strong predictor of Vernier discrimination performance.

We posit that such configurations encourage separate grouping of the target and flanking elements.

When the target groups separately from the flankers, performance improves (as in, e.g., Manassi et al, 2013).

References

1. Bouma, H. (1970). Interaction effects in parafoveal letter recognition. *Nature*, 226, 177-178.
2. Manassi, M., Sayim, B., & Herzog, M. H. (2013). When crowding of crowding leads to uncrowding. *Journal of Vision*, 13, 1-10.

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