

Is there a cost in forming statistical summary representations at multiple spatial scales?

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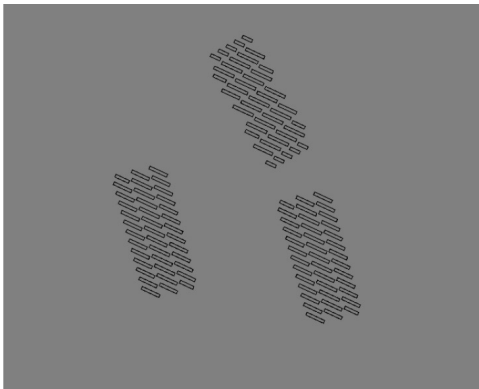
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Background

Visual processing often entails forming statistical summary representations to encode properties of groups of similar objects. It has been debated whether the formation of these representations requires limited capacity resources. We ask for the first time whether the formation of SSRs at multiple spatial scales incurs a cost in visual processing.

Experiment 1

Goal – To determine whether formation of SSRs at multiple spatial scales incurs a cost in visual processing



Stimulus – Several small rectangles were spatially arranged to create three large rectangles. Participants estimated the mean orientation of either the large rectangles (low spatial frequency) or the small rectangles (high spatial frequency).

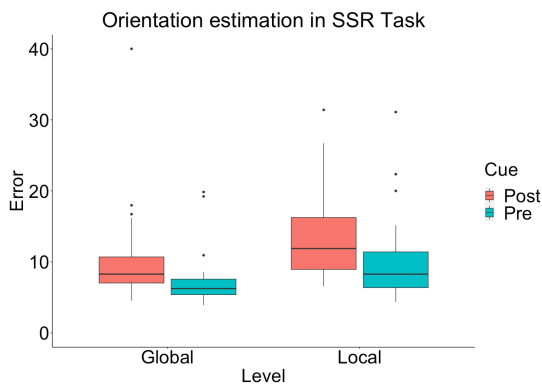
Design – There were two independent variables - Cue (Pre or Post) and Level (Local or Global)

Pre-Cue – The level for which the mean was to be estimated was known prior to stimulus display

Post-Cue – The level for which the mean was to be estimated was known after the stimulus disappeared. Participants had to estimate the mean at two spatial scales but report only one.

Results – There is a cost involved in forming SSRs across multiple spatial scales.

There was a main effect of Cue indicating that more errors were made when participants estimated SSRs at both global and local levels compared to when participants estimated an SSR at only one level



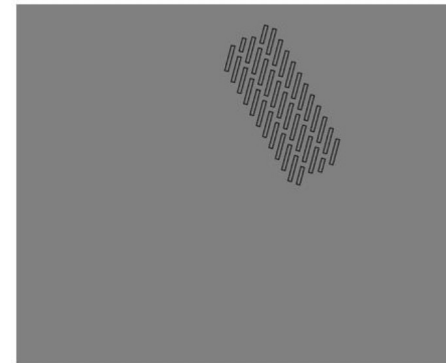
Rationale for Experiment 2 – SSR formation could be thought of as a two part of process –

SSR formation = (Pre-Averaging Processes) + (Averaging)

The cost associated with SSR formation could be arising either during the 'pre-averaging processes' or during 'averaging' or both. We determine the cost associated with the 'Pre-Averaging Processes' in Experiment 2

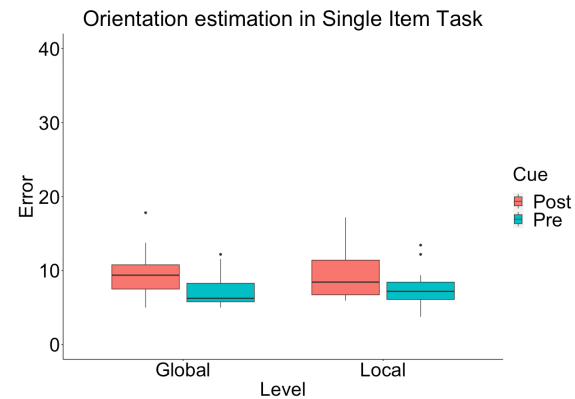
Experiment 2

Goal – The first goal is to determine whether formation of single item representations at multiple spatial scales incurs a cost in visual processing. The second goal is to determine whether there is a cost associated with SSR formation above and beyond the cost associated with the pre-averaging processes



Stimulus – Several small rectangles were spatially arranged to create a single large rectangle. Participants estimated the orientation of either the large rectangle (low spatial frequency) or the small rectangles (high spatial frequency).

Design – The design of Experiment 2 was identical to Experiment 1



Results – There was a main effect of cue indicating there is a cost involved in forming single item representations across multiple spatial scales.

On comparing Experiment 1 and Experiment 2, however, we found that the interaction between experiment and cue was not significant. This suggests that there may not be a cost associated with SSR formation above and beyond the cost associated with the pre-averaging processes.

Conclusion

Even though there is a cost associated with the formation of SSRs at multiple spatial scales, that cost is associated with the pre-averaging part of the process. **The averaging step appears to be cost-free.**

This framework could potentially help resolve the debate regarding whether the formation of SSRs incurs a cost. **The averaging step could have been cost free in studies that found a SSR formation cost and in studies that didn't.** The presence or absence of a cost associated with the pre-averaging processes could have determined the presence or absence of a SSR formation cost in those studies.

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