Memory compression using statistical regularities requires explicit awareness

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Visual Working Memory

Visual working memory (VWM) is the system responsible for actively storing visual information essential for cognitive tasks

The capacity of VWM is known to be limited to about 3-4 objects on average and is a stable individual trait that exhibits robust correlations with measures of intellectual ability

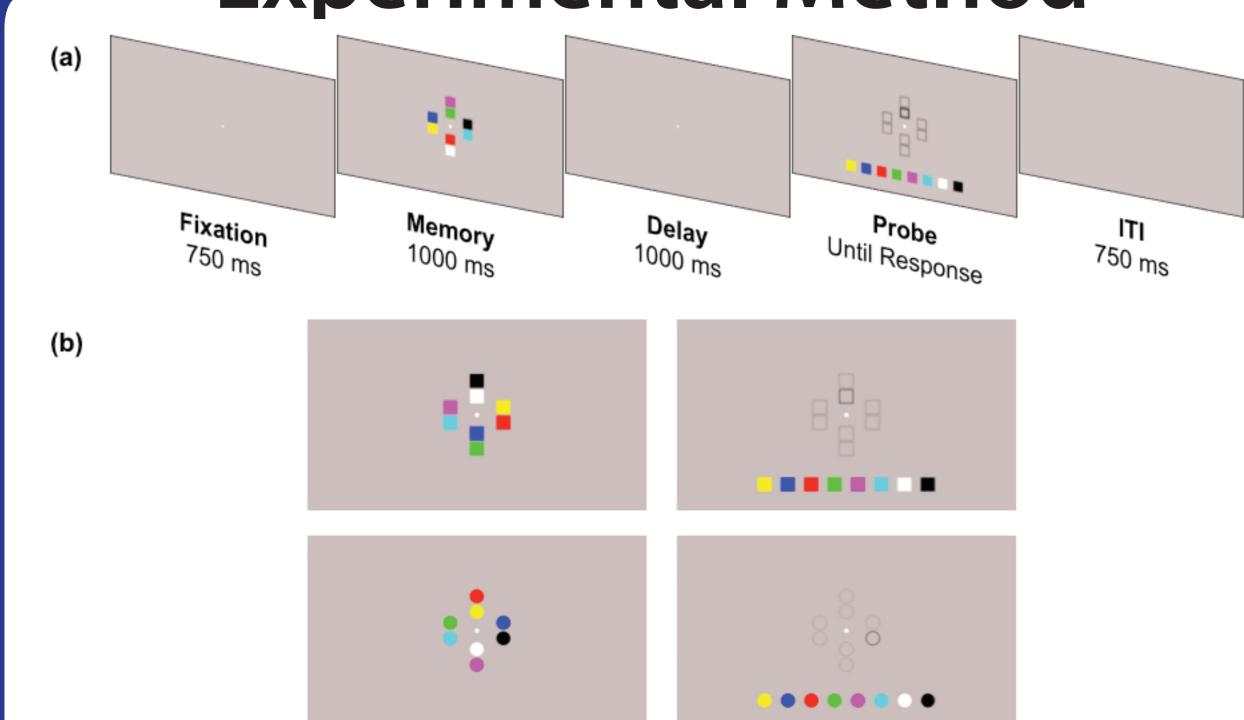
> Can visual working memory capacity be increased with regular or repeated displays?

Brady et al. (2009) found including statistical regularities can yield robust increases in the number of items stored in VWM

This was thought to be a product of visual statistical learning, the process by which observers can learn subtle statistical relationships automatically without awareness of those regularities

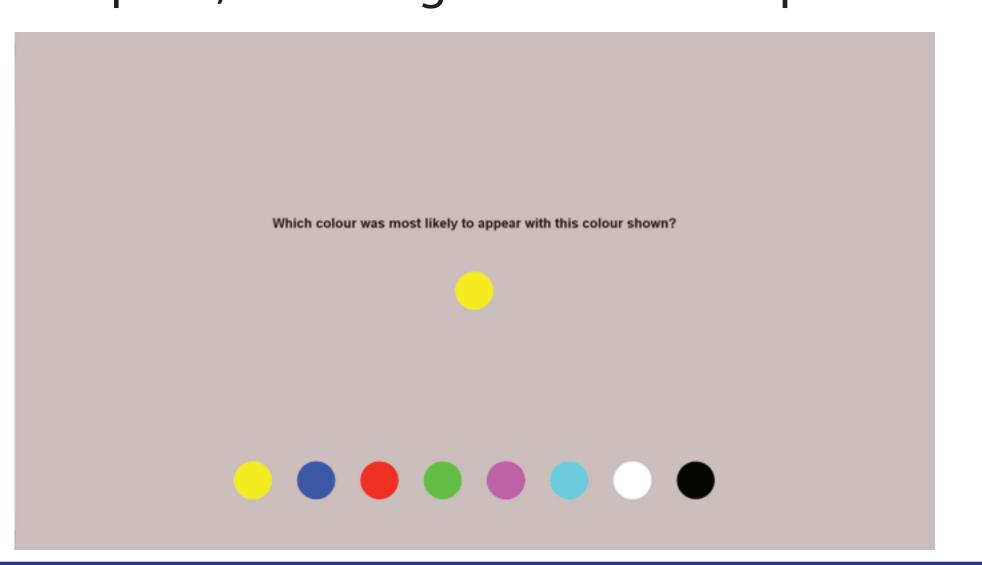
But previous studies showing repeated displays (Logie, Brockmole, & Vandenbroucke, 2009; Olson & Jiang, 2004) found no improvement in change detection, unless the to-be-changed item was held constant

Experimental Method



Two conditions:

All colours randomly distributed in the display Patterned Each observer assigned four high-probability pairs, the rest given a uniform probability.



Overall Performance

Regularities were removed in the last block of the patterned condition.

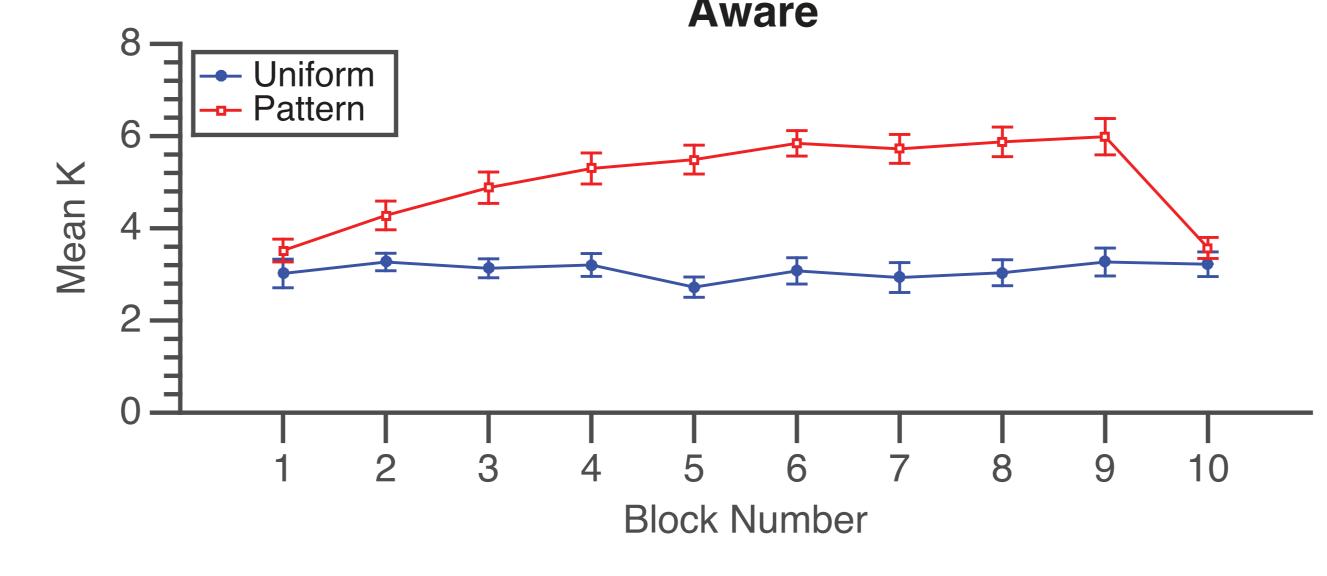
2 3 4 5 6 7 8 9 10

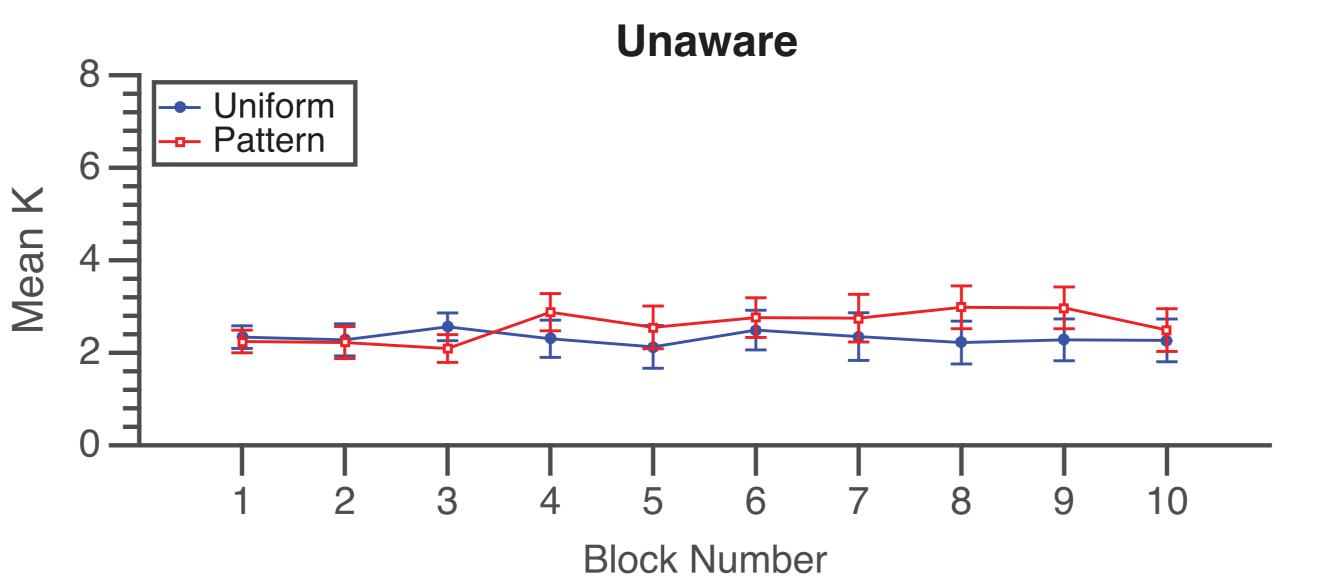
Block Number

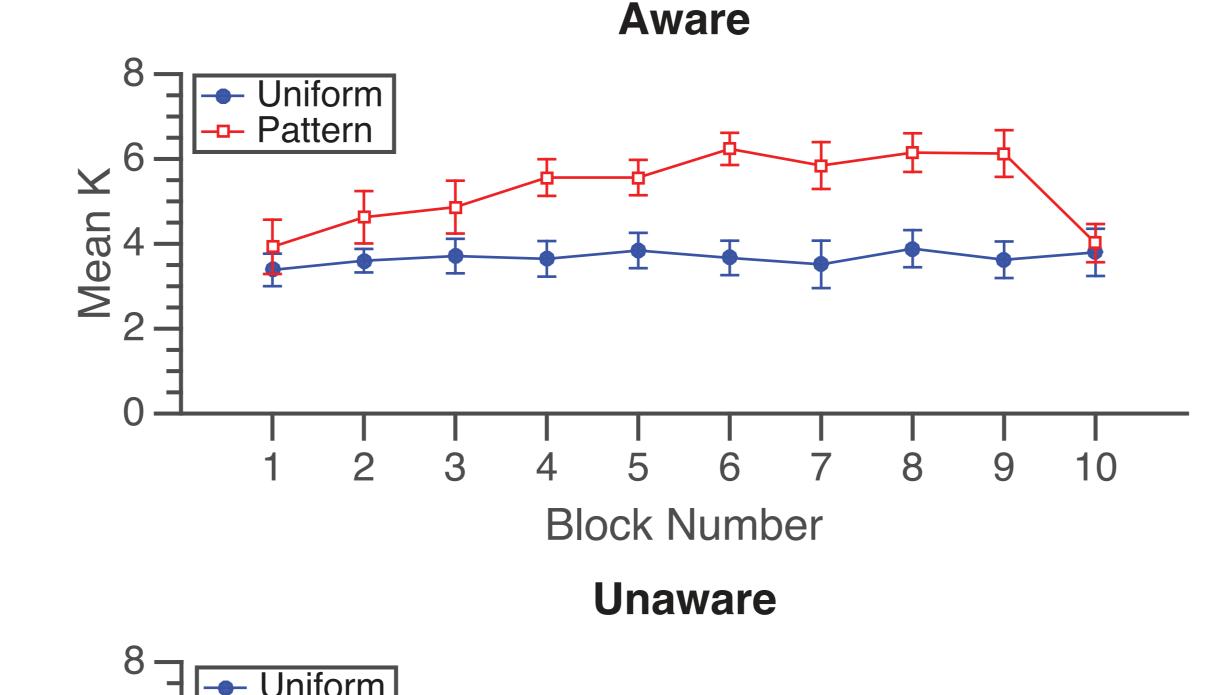
Uniform

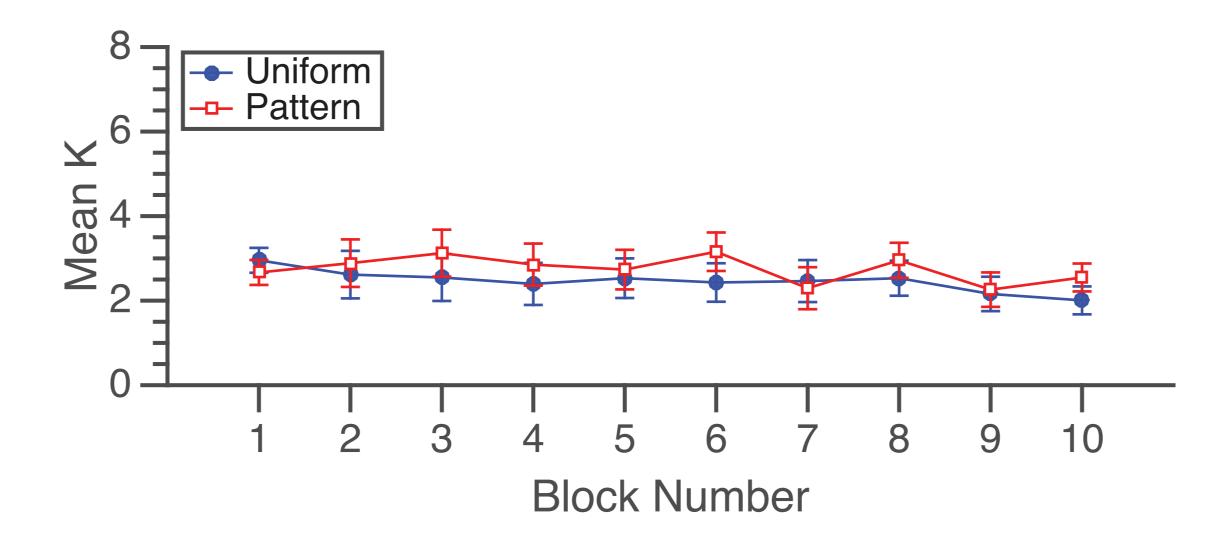
Awareness

Participants considered 'aware' if correctly identified all high-probability color pairings





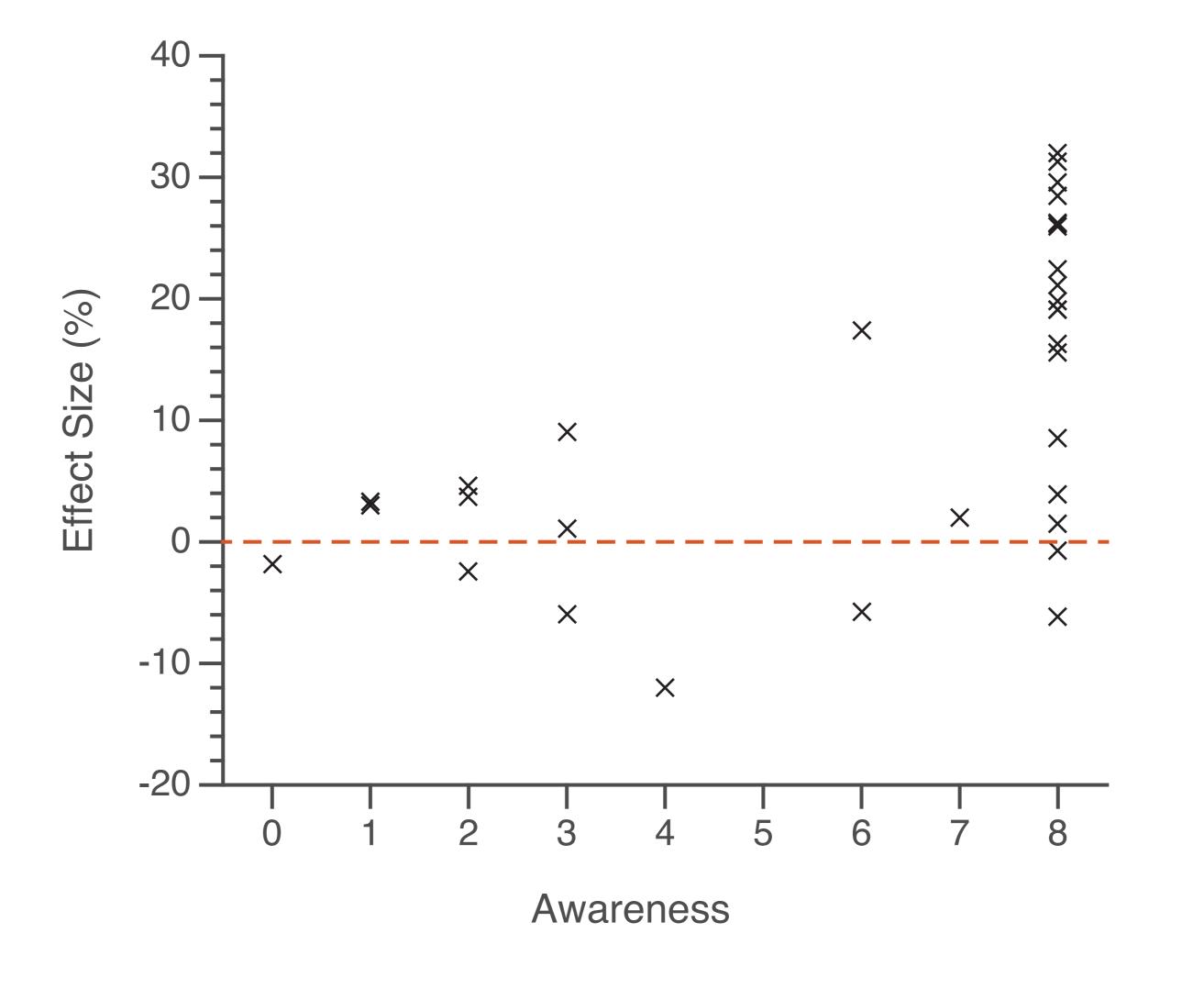


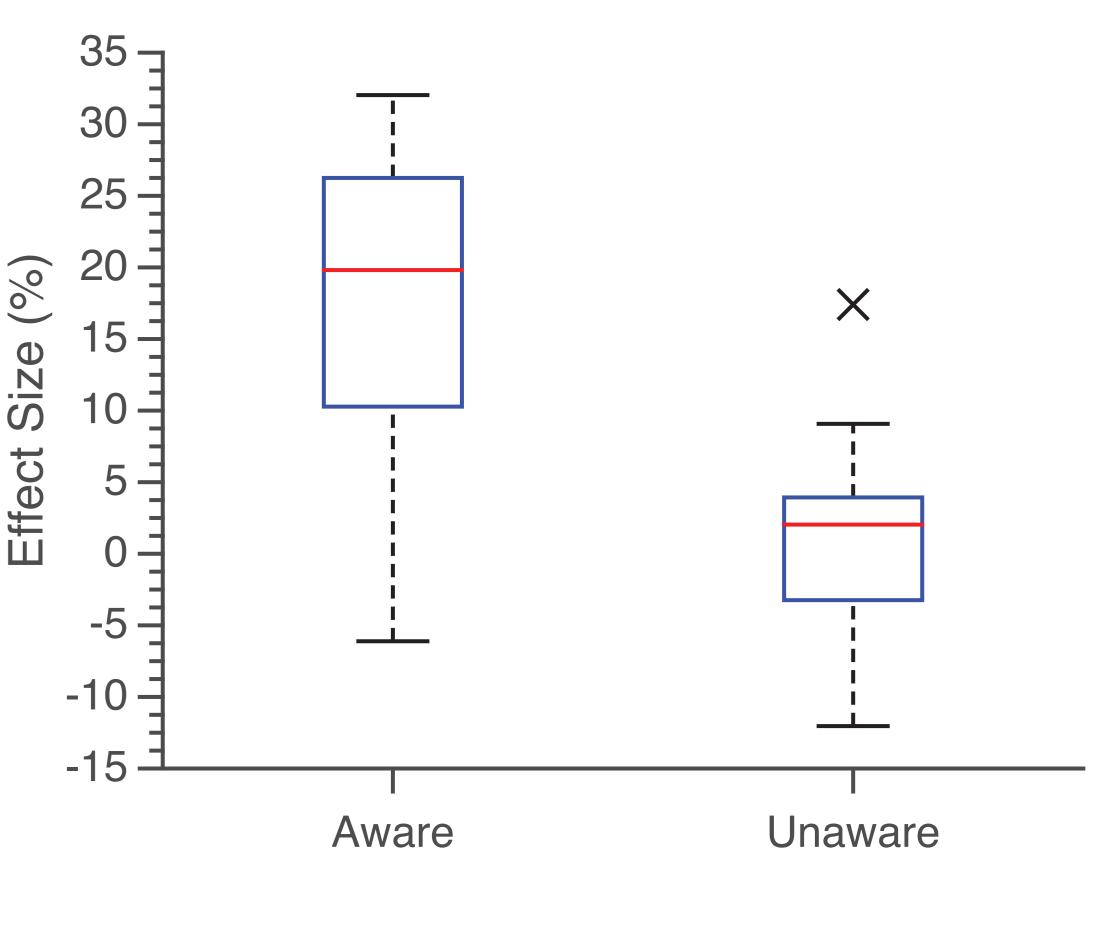


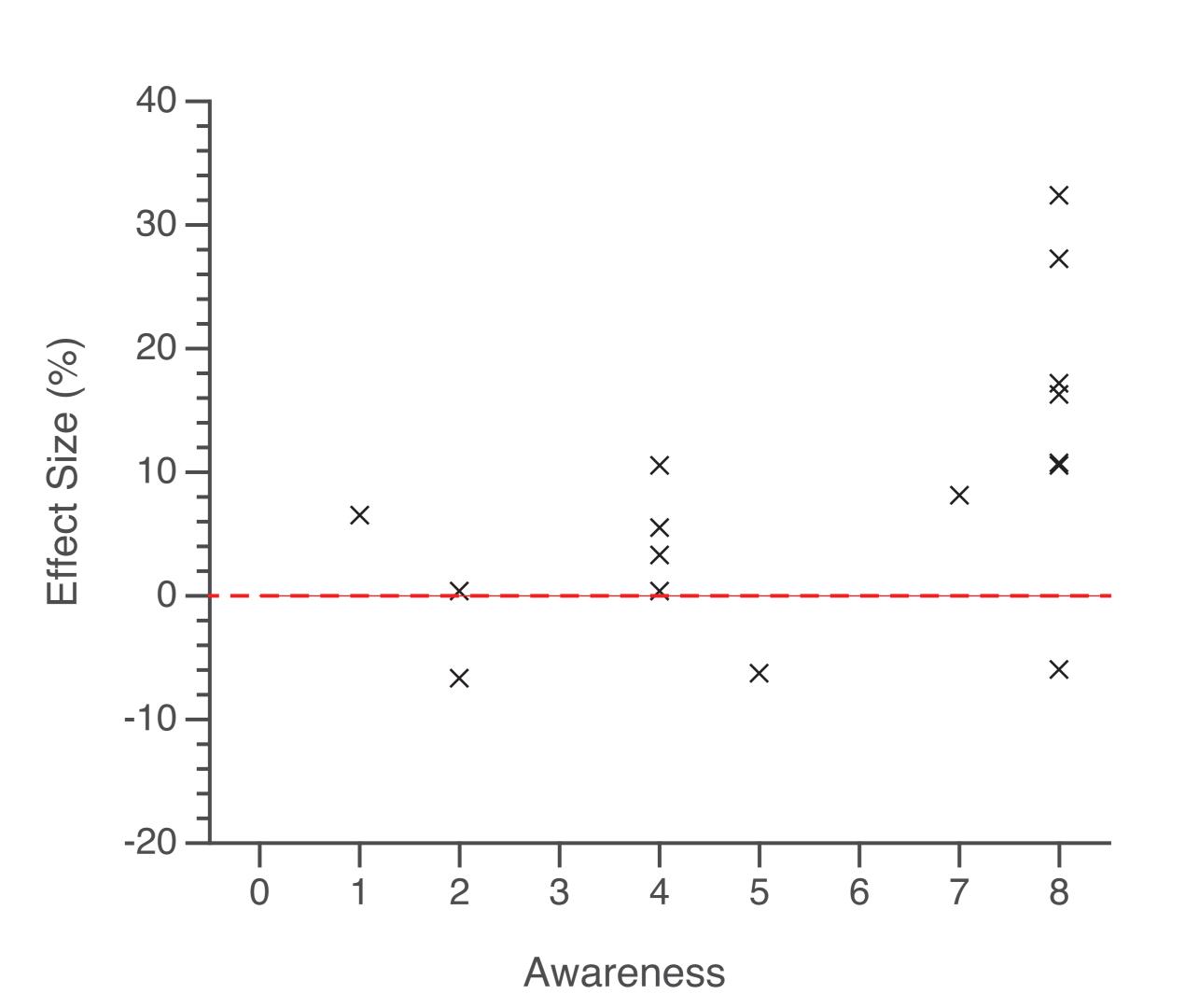
Effect Size

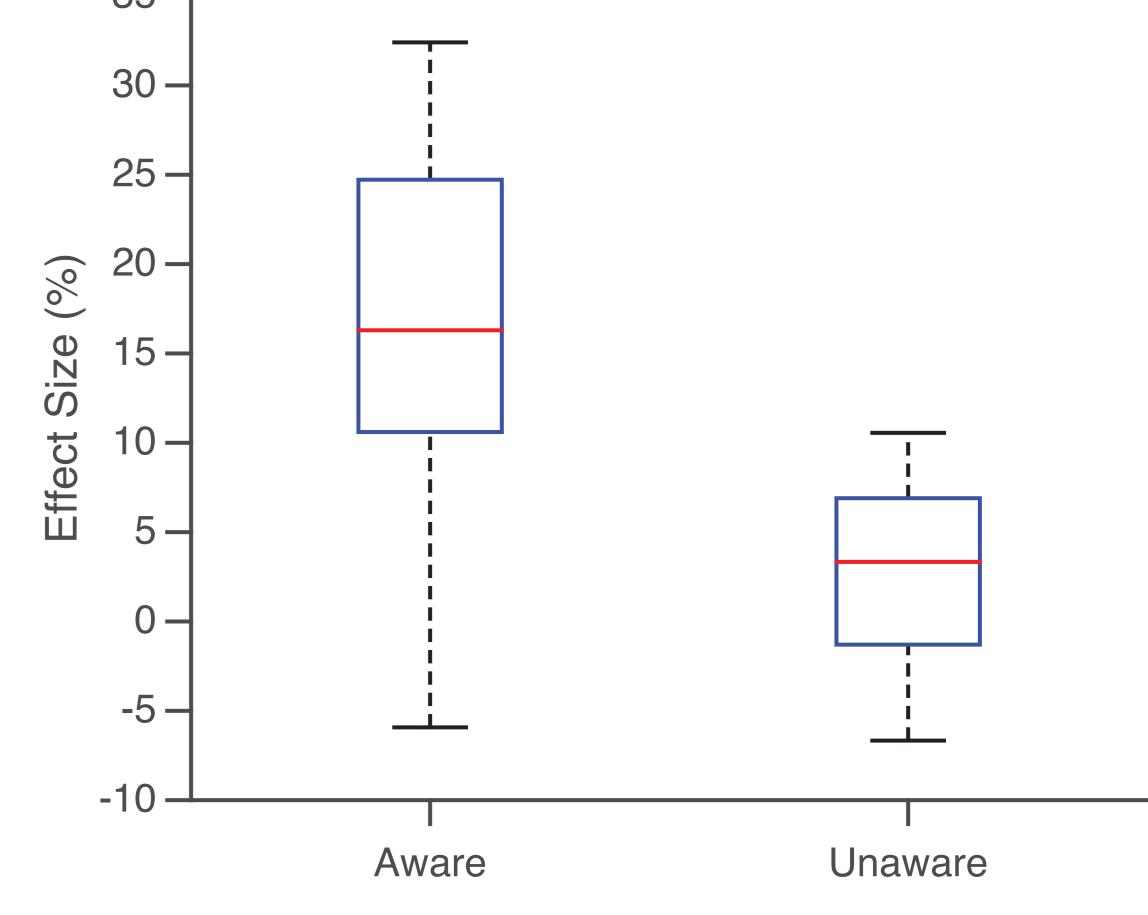
Effect size was measured by taking the difference between the average performance of the first 9 blocks, and the last block of the patterned condition.

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References

to Form More Efficient Memory Representations. Journal of Experimental Psychology: General, 138(4), 487–502. * Logie, R. H., Brockmole, J. R., & Vandenbroucke, A. R. E. (2009). Bound feature combinations in visual short-term memory are fragile but influence long-term learning. Visual Cognition, 17(1–2), 160–179 * Olson, I. R., & Jiang, Y. (2004). Visual short-term memory is not improved by training. Memory & Cognition, 32(8)

Conclusions

Block Number

Performance significantly improves in the patterned condition, but not the uniform condition.

Observers who are aware of the statistical regularities show the learning effect in the patterned condition, whereas unaware observers do not show any difference between pattern and uniform conditions.

Aware observers show a large effect size compared to unaware observers. It appears that explicit awareness drives the memory compression effect.