The Influence of Task-Irrelevant Spatial Regularity on Sequence Learning

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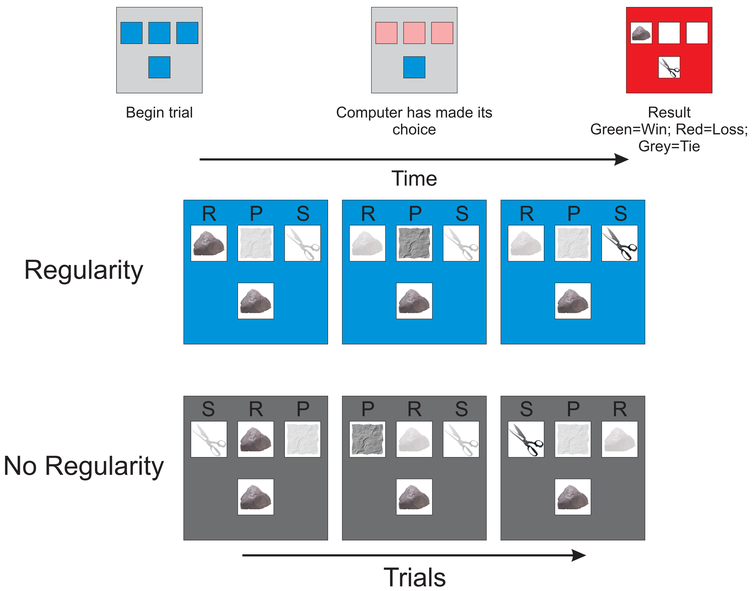
Can task-irrelevant spatial regularities influence sequence learning?

We are proficient at detecting regularities in our environment
- We use these regularities to learn the statistical properties of events
- When event properties change, we update our event representation

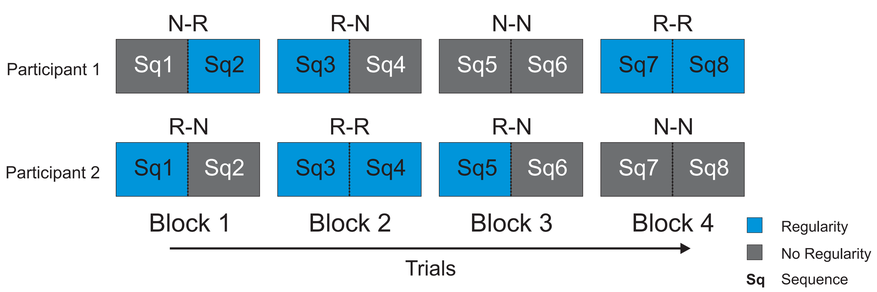
Events can be composed of many redundant features
- Task-irrelevant spatial features have been shown to influence behaviour[1]

We predict that task-irrelevant spatial regularities will:
- Influence participants' ability to detect non-spatial event regularities
- Improve their ability to detect switches in an environment

Measuring sequence learning using Rock-Paper-Scissors



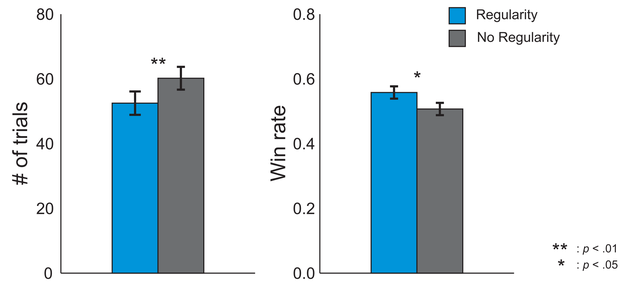
40 undergraduates played Rock-Paper-Scissors against a computer that repeated sequences of 5 plays. Each sequence was presented either with spatial regularity or no spatial regularity.



Participants played 4 blocks of trials. In each block computer played initial sequence, then switched to second sequence once the participant had learned first sequence. Participants played against a block that switched from spatial regularity to spatial regularity (R-R), regularity to no regularity (R-N), no regularity to regularity (N-R), and no regularity to no regularity (N-N).

Redundant spatial regularities improve sequence learning

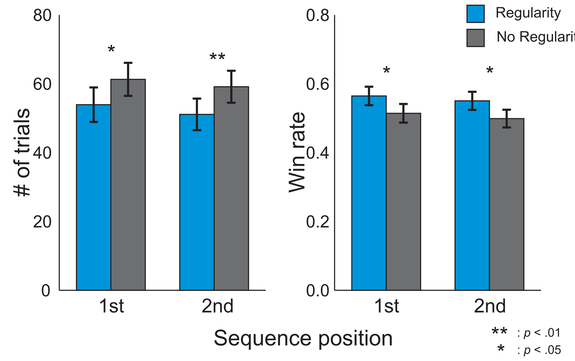
Performance across all blocks



Participants took fewer trials to learn sequences presented with task-irrelevant spatial regularity and experienced higher win rates.

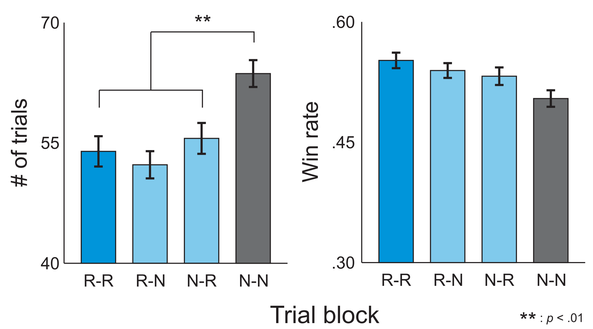
Spatial regularity improves initial sequence learning and switch detection

Performance for sequence position across all blocks



Participants learned initial block sequences and detected switches more rapidly when spatial regularity was present.

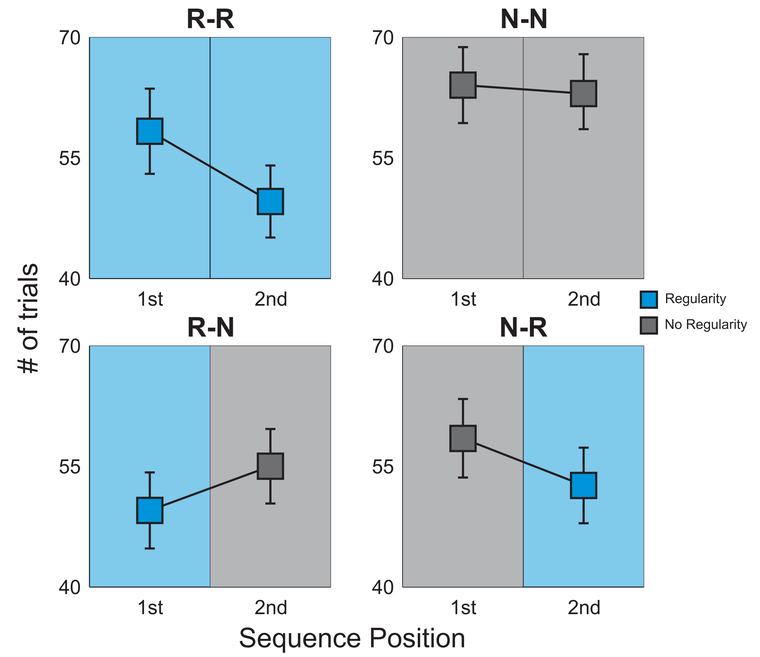
Overall performance in each block



Performance was best in blocks that contained at least one sequence with spatial regularity.

Switch performance improves only when spatial regularity is present

Performance within each block type



Participants learned second block sequence faster than first sequence when second sequence contained spatial regularity.

Task-Irrelevant spatial regularities influence sequence learning and switch detection

Separate behaviours that share neural activation have been found to influence each other if they are done simultaneously[2].

Posterior parietal cortex has been implicated in sequence learning[3] and spatial attention[4]. Redundant spatial regularities during a sequence learning task may increase the firing rate of this region thereby facilitating sequence learning.

Redundant spatial regularities may help patients that have difficulty with detecting environmental changes (**see poster 23.535 - E. Stoettinger)**.

For fMRI work on learning and switching **see poster 36.547 - D. Valadao**.

References
1. Robertson, E.M. & Pascual-Leone, A. (2001). Aspects of sensory guidance in sequence learning. Experimental Brain Research, 137, 336-345.
2. Fias, W., Lauwereyns, J., & Lammertyn, J. (2001). Irrelevant digits affect feature-based attention depending on the overlap of neural circuits. Cognitive Brain Research, 12(3), 415-423.
3. Toni, I., Krams, M., Turner, R., & Passingham, R. E. (1998). The time course of changes during motor sequence learning: A whole-brain fMRI study. NeuroImage, 8(1), 50-61.
4. Silver, M. A., Ress, D., & Heeger, D. J. (2005). Topographic maps of visual spatial attention in human parietal cortex. Journal of Neurophysiology, 94(2), 1358-1371.

Acknowledgements
The authors would like to thank Diana Lam and Katarzyna Gittsovich for their assistance with data collection. This work was supported in part by a NSERC Canada Research Chair and Discovery Grant (J.D.) and a CIHR Operating Grant (B.A. and J.D.).

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