

Revealing interactive mechanism underlying brain activity in the visual cortex using a voxel-wise background connectivity analysis



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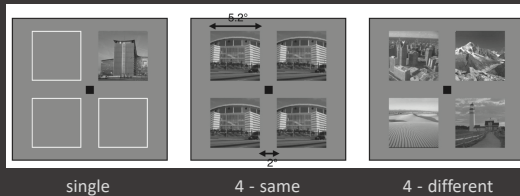


Background

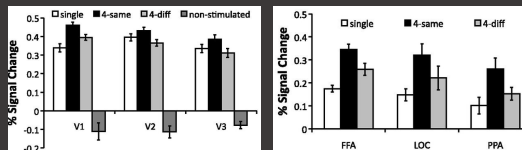
• Redundancy Gain

Enhanced neural activity to a stimulus in retinotopic areas when identical stimuli appear far away in different visual quadrants

• Experimental Condition



• Results



- Enhanced brain activity in retinotopic areas despite small receptive fields
- The redundancy gain likely reflects feedback from higher visual areas

Shim et al., 2013

Research Goal

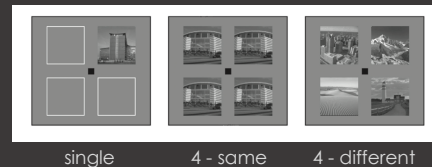
Investigating whether feedback activity from higher visual areas modulates the activation of the early visual cortex

REFERENCE

- Shim, W. M., Jiang, Y. V., & Kanwisher, N. (2013). Redundancy gains in retinotopic cortex. *Journal of Neurophysiology*, 110, 2227-2235.
- Al-Aidroos, N., Said, C. P., & Turk-Browne, N. B. (2012). Top-down attention switches coupling between low-level and high-level areas of human visual cortex. *Proceedings of the National Academy of Sciences*, 109, 14675-14680.

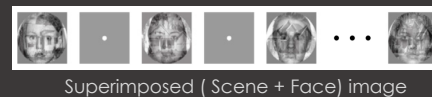
Method

1st Phase Redundancy Gain



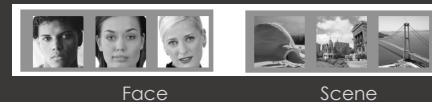
"Focusing on a central fixation and pressing a button whenever the brightness of the fixation changes"

2nd Phase Functional Connectivity



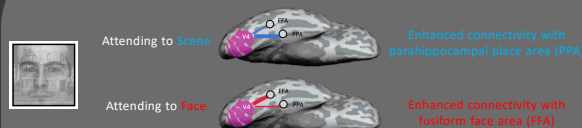
"Attending to a scene (face) image and pressing a button whenever the same scene (face) image appears consecutively"

3rd Phase Scene/Face Localizer

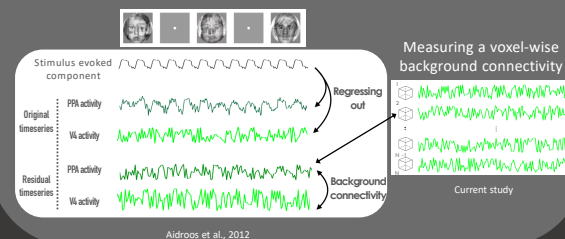


"Categorizing images" Face : Female / Male Scene : Interior / Exterior

Background Connectivity Analysis



Measuring changes in functional connectivity that is independent of stimulus-evoked responses and instead depend on the current goal

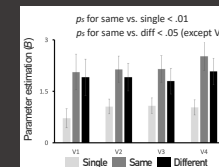


Aidroos et al., 2012

Results

The redundancy gain

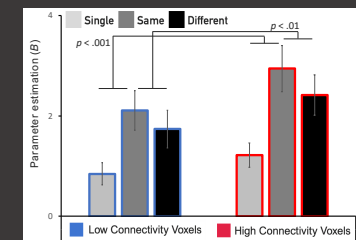
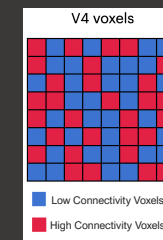
$n = 16$



Successfully replicated the previous redundancy gain effect.

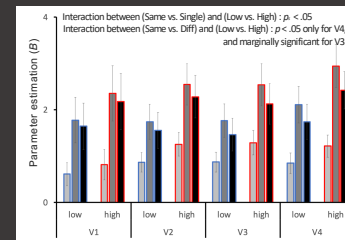
Except V1, responses to the distant, redundant stimuli were enhanced compared to a single stimulus and distant, different stimuli in the visual cortex.

Linking functional connectivity to the redundancy gain effect



In V4, for both low and high connectivity voxels, neural activation for the 'same' condition increased compared to the 'single' and 'different' conditions.

Crucially, the amount of the redundancy gain was greater for high connectivity voxels than low connectivity voxels.



Overall, the amount of redundancy gain was modulated by the strength of functional connectivity between the early visual cortex and PPA

Conclusion

The current study provides direct evidence showing that higher visual areas feed global representation back to low-level visual areas and modulate their activation by using the novel voxel-wise background connectivity analysis.