Object recognition

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# Probing the brain's visual catalogue

Every day, people open their eyes to a world comprising countless visual features and their brains are able to effortlessly recognize different faces, animals, objects and places in a split second. Over the past two decades, neuroscientists have discovered regions of the primate visual cortex that are dedicated to processing specific types of objects, such as the face patch system for faces, the parahippocampal place area for places and the extrastriate body area for body parts. However, it is not clear whether every single type of object is processed by a specialized brain area, or how cortical regions are organized and coordinated in the primate brain to give rise to object recognition.

In their study, Bao et al. explored how visual objects are represented in the primate brain, focusing on areas of the inferotemporal cortex without known specialization. Specifically, the authors combined functional magnetic resonance imaging (fMRI), microstimulation, electrophysiology and deep neural networks to investigate the functional organization of the macaque inferotemporal cortex. They discovered four distinct networks within the inferotemporal cortex that project objects onto specific axes that describe the most important features in a low-dimensional object space. Similar to the face patch system, these networks repeat three times along the cortical hierarchy (corresponding to different stages of view invariance required for object recognition). This map of object space was consistent across individual subjects.

These findings offer a unified view of the cortical organization of object recognition networks, and demonstrate that face- and body-selective regions are part of a larger cortical catalogue of object space. This low-dimensional abstraction of object space is consistent with representations learned by a range of task-optimized deep neural networks, which suggests that the functional clustering in the inferotemporal cortex might be optimized for object recognition.

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The study by Bao et al. is impressive in its use of multiple advanced techniques to unravel the complexities of the inferotemporal cortex at different scales. The use of fMRI enabled the authors to identify and locate several previously unknown networks in the inferotemporal cortex. The connectivity between these regions was in turn revealed by directly manipulating neural activity using microstimulation. Informed by these results, electrophysiological recordings further characterized the neural response properties of these areas. Finally, the comparison with trained artificial neural networks provided insights into the functional role of these response properties across multiple regions. These techniques complemented each other, and enabled the authors to comprehensively map out the functional organization of the cortex. Thus, this study contributes to the understanding of the neural mechanisms that underlie object recognition and demonstrates the power of multiscale methodology for future neuroscientific research.

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**Competing interests**
The author declares no competing interests.

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