Ventral temporal cortex

Visual categorization is thought to occur in the human ventral temporal cortex (VTC), but how this categorization is achieved is still largely unknown.

The ventral part of the temporal cortices appear to be involved in high-level visual processing of complex stimuli such as faces (fusiform gyrus) and scenes (parahippocampal gyrus). Anterior parts of this ventral stream for visual processing are involved in object perception and recognition.

Representations of visual objects in the human brain have been shown to be organized by several principles, including whether those objects tend to be viewed centrally or peripherally in the visual field. However, it remains unclear how regions that process objects that are viewed centrally, like words and faces, are organized relative to one another. Here, invasive and non-invasive neuroimaging suggests there is a mosaic of regions in ventral temporal cortex that respond selectively to either words or faces. These regions display differences in the strength and timing of their responses, both within and between brain hemispheres, suggesting they play different roles in perception. These results illuminate extended, bilateral, and dynamic brain pathways that support face perception and reading [1)].

In a review, Grill-Spector et al., considered the computations and representations that are necessary for categorization and examine how the microanatomical and macroanatomical layout of the VTC might optimize them to achieve rapid and flexible visual categorization.

They proposed that efficient categorization is achieved by organizing representations in a nested spatial hierarchy in the VTC. This spatial hierarchy serves as a neural infrastructure for the representational hierarchy of visual information in the VTC and thereby enables flexible access to category information at several levels of abstraction [2)].

The representation of objects in ventral temporal cortex is relatively resilient to transformations in the stimuli. There is emerging recognition that ventral temporal object representations are forged via interactions among a broader network of regions that receive independent inputs about a stimulus.

Lee et al., tested whether ventral temporal representations are causally modulated by disrupting processing in distal associative areas. They used transcranial direct current stimulation (tDCS) to stimulate left parietal areas and functional Magnetic Resonance Imaging (fMRI) to measure object-related neural responses in the ventral stream. They find that representational geometries and category discriminability within ventral temporal cortex, as well as functional connectivity between ventral temporal and parietal areas, are enhanced by anodal compared to cathodal stimulation of left parietal associative cortex. These results demonstrate that ventral temporal representations can be causally modulated by processing distal to the ventral stream [3)].

1)

Boring MJ, Silson EH, Ward MJ, Richardson RM, Fiez JA, Baker CI, Ghuman AS. Multiple adjoining word- and face-selective regions in ventral temporal cortex exhibit distinct dynamics. J Neurosci. 2021 Jun 7:JN-RM-3234-20. doi: 10.1523/JNEUROSCI.3234-20.2021. Epub ahead of print. PMID: 34099511.
2)

Grill-Spector K, Weiner KS. The functional architecture of the ventral temporal cortex and its role in categorization. Nat Rev Neurosci. 2014 Aug;15(8):536-48. doi: 10.1038/nrn3747. Epub 2014 Jun 25. Review. PubMed PMID: 24962370; PubMed Central PMCID: PMC4143420.
3)

Lee D, Mahon BZ, Almeida J. Action at a distance on object-related ventral temporal representations. Cortex. 2019 Mar 4;117:157-167. doi: 10.1016/j.cortex.2019.02.018. [Epub ahead of print] PubMed PMID: 30981039.