Face perception

Facial perception is an individual's understanding and interpretation of the face. Here, perception implies the presence of consciousness and hence excludes automated facial recognition systems.

The area within the fusiform gyrus, is heavily involved in face perception but only to any generic within-category identification that is shown to be one of the functions of the fusiform gyrus.

The human amygdala and hippocampus are critically involved in various processes in face perception. However, it remains unclear how task demands or evaluative contexts modulate processes underlying face perception. Cao et al. from West Virginia University employed two task instructions when participants viewed the same faces and recorded single-neuron activity from the human amygdala and hippocampus. They comprehensively analyzed task modulation for three key aspects of face processing and we found that neurons in the amygdala and hippocampus (1) encoded high-level social traits such as perceived facial trustworthiness and dominance and this response was modulated by task instructions; (2) encoded low-level facial features and demonstrated region-based feature coding, which was not modulated by task instructions; and (3) encoded fixations on salient face parts such as the eyes and mouth, which was not modulated by task instructions. Together, these results provide a comprehensive survey of task modulation of neural processes underlying face perception at the single-neuron level in the human amygdala and hippocampus. Significance Statement The human amygdala and hippocampus play important roles in face perception, but it remains unclear how task demands or evaluative contexts modulate neural face processing, especially at the single-neuron level in the human brain. In this study, we comprehensively analyzed how task instruction modulates key aspects of face processing, including low-level facial features such as face shape and texture, social trait judgment of faces such as trustworthiness and dominance, as well as neural correlates of eye movement when viewing faces. This comprehensive survey of task modulation of face processing reveals both flexible and invariant neuronal processes in the human brain [1)].

Prevailing theories suggest that cortical regions responsible for face perception operate in a serial, feed-forward fashion.

Kadipasaoglu et al. utilize invasive human electrophysiology to evaluate serial models of face-processing via measurements of cortical activation, functional connectivity, and cortico-cortical evoked potentials.

They find that task-dependent changes in functional connectivity between face-selective regions in the inferior occipital (f-IOG) and fusiform gyrus (f-FG) are bidirectional, not feed-forward, and emerge following feed-forward input from early visual cortex (EVC) to both of these regions. Cortico-cortical evoked potentials similarly reveal independent signal propagations between EVC and both f-IOG and f-FG. These findings are incompatible with serial models, and support a parallel, distributed network underpinning face perception in humans [2)].

Neuroscientists have long debated whether some regions of the human brain are exclusively engaged in a single specific mental process. Consistent with this view, fMRI has revealed cortical regions that respond selectively to certain stimulus classes such as faces. However, results from multivoxel pattern analyses (MVPA) challenge this view by demonstrating that category-selective regions often contain information about “nonpreferred” stimulus dimensions. But is this nonpreferred information causally relevant to behavior? Here we report a rare opportunity to test this question in a neurosurgical patient implanted for clinical reasons with strips of electrodes along his fusiform gyri. Broadband gamma electrocorticographic responses in multiple adjacent electrodes showed strong selectivity for faces in a region corresponding to the fusiform face area (FFA), and preferential responses to color in a nearby site, replicating earlier reports. To test the causal role of these regions in the perception of nonpreferred dimensions, we then electrically stimulated individual sites while the patient viewed various objects. When stimulated in the FFA, the patient reported seeing an illusory face (or “facephene”), independent of the object viewed. Similarly, stimulation of color-preferring sites produced illusory “rainbows.” Crucially, the patient reported no change in the object viewed, apart from the facephenes and rainbows apparently superimposed on them. The functional and anatomical specificity of these effects indicate that some cortical regions are exclusively causally engaged in a single specific mental process, and prompt caution about the widespread assumption that any information scientists can decode from the brain is causally relevant to behavior [3].

1)
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