

Neuronal mechanisms for perceptual organization

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A fundamental task of vision is to group the image elements that belong to one object and to segregate them from other objects and the background. I will discuss a conceptual framework that explains how perceptual grouping is implemented in the visual cortex. According to this framework, two mechanisms are responsible for perceptual grouping: base-grouping and incremental grouping. Base-groupings are coded by single neurons tuned to multiple features, like the combination of a color and an orientation. They are computed rapidly because they reflect the selectivity of feedforward connections that propagate information from lower to higher areas of the visual cortex. However, not all conceivable feature combinations are coded by dedicated neurons. Therefore, a second, flexible form of grouping is required that is called incremental grouping.

Incremental grouping takes more time than base-grouping because it relies on horizontal connections between neurons in the same area and feedback connections that propagate information from higher to lower areas. These connections spread an enhanced response to all the neurons that code image elements that belong to the same perceptual object. This response enhancement acts as a label that tags those neurons that respond to image elements to be bound in perception. The enhancement of neuronal activity during incremental grouping has a correlate in psychology because attention is directed to precisely those features that are labeled by the enhanced neuronal response. I will show data indicating that feedforward and feedback processing rely on different receptors for glutamate and on processing in different cortical layers.