Coding of Visual Image of Objects in the Temporal Cortex

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The anterior part of the inferotemporal cortex (AIT) is the final or, at least, near-final stage of the visual pathway concerning object recognition. Lesions in the AIT impair monkey's ability to recognize shapes and patterns without disturbing visual acuity. Most AIT neurons selectively respond to particular visual images. Except for a class of neurons selective to biologically significant stimuli such as faces and hands, the stimulus features essential to activate AIT neurons are "moderately complex"—neither as simple as slits, edges or spots, nor as complex as particular objects. How can the AIT neurons code objects more complex than their selectivities? How are the stimulus selectivities of AIT neurons generated?

An essential step towards answering these questions is to learn how cells with similar or different selectivities are spatially arranged in the AIT. Previous studies have failed to show any progressive change in complexity of stimulus selectivity over the AIT surface, but instead have suggested that stimulus features are processed rather locally. Kang Cheng, Keiji Tanaka and I have recently obtained evidence that adjacent AIT neurons show similar or related selectivity. They are selective to limited and overlapped ranges of the stimulus feature spectrum, although the optimal feature or the degree of tuning are often slightly different among adjacent neurons. Crosscorrelation analysis indicates that neighboring neurons are functionally connected. The results suggest that the AIT may have a modular organization. All neurons within a module may respond to shapes and patterns which belong to the same "category", but they are differentially activated by a particular stimulus in the category because of the difference in tuning to fine parameters. Activity patterns across a neuronal population within a module may thus be capable of representing complex stimulus features which single neurons cannot specify.