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Gilbert has pioneered research into the mechanisms underlying visual perception and perceptual learning at the level of cortical circuits. To this end, he has studied the role of the brain's visual cortex in analyzing images and in memory. His lab has explored how the circuitry of the brain and the interactions between neuronal ensembles contribute to visual perception.

The Gilbert lab studies the visual cortex, including a series of areas mediating object recognition and perceptual tasks. The job of the visual cortex is to take signals from the retina, group features belonging to objects, and determine their shapes. The lab investigates the mechanism by which this occurs at the level of cortical circuitry. Efforts to map this circuitry have led to a seminal contribution in the field: the discovery of an intricate network of long-range horizontal connections that mediate the assembly of contours and the parsing of visual scenes into objects and background. Using a combination of techniques, Gilbert has found close correspondence between the geometry of these connections, the functional properties of visual cortical neurons, and the perception of visual stimuli.

The lab also studies the way visual experience shapes the strategy by which the cortex analyzes sensory information, a process known as perceptual learning. The group has found that, even in adults, the visual cortex is capable of altering its functional properties and circuitry—a quality known as plasticity. These long-term changes aid in analyzing visual scenes as a result of normal experience and assist recovery from injury. For example, following a retinal lesion that initially silences parts of the visual cortex, the cortex gradually regains its ability to respond to visual stimuli. The lab is studying the synaptic and molecular mechanisms underlying experience-dependent changes in cortical circuits. Understanding adaptive changes in cortical function provides important insights into the mechanism of recovery after brain lesions and neurodegenerative disease, including macular degeneration.

Research in the Gilbert lab suggests each cortical area is an adaptive processor that runs different programs according to the immediate demands of the perceptual task. Object recognition, for example, involves a countercurrent process of feedforward and feedback interactions. The top-down signal conveys information about attentional locus, perceptual task, and object expectation. These results have led to a novel view of cortical processing: Rather than having fixed functional properties, adult neurons are dynamically tuned, changing their specificities with sensory experience and behavioral context. This work is likely relevant to behavioral disorders such as schizophrenia and autism, which have been described as dysfunctions of top-down interactions. Based on these findings, Gilbert's lab now uses computational models to link cortical circuits and the properties of neuronal ensembles to visual perception. They are currently applying their findings on circuit mechanisms of visual perception to the study of animal models of autism.

Gilbert and his colleagues use electrophysiology, imaging, and molecular approaches to understand the mechanisms of adult cortical plasticity. This research includes examining the contribution of different neuronal types and circuit components to experience-dependent changes, the circuitry and synaptic mechanisms underlying the dynamic changes in cortical cells in behaving animals, and using human psychophysics to explore the perceptual consequences of dynamic changes in cortical properties.

EDUCATION

B.A. in biophysics, 1971
Amherst College

M.D., 1977
Harvard Medical School

Ph.D. in neurobiology, 1977
Harvard University

POSTDOC

Harvard Medical School, 1977–1981

POSITIONS

Assistant Professor, 1981–1983
Harvard Medical School

Assistant Professor, 1983–1985
Associate Professor, 1985–1991
Professor, 1991–
The Rockefeller University

AWARDS

W. Alden Spencer Award, 2002

The Rockefeller University Distinguished Teaching Award, 2010

Edward M. Scolnick Prize, 2015

HONORARY SOCIETIES

National Academy of Sciences

American Academy of Arts and Sciences

Fellow, American Association for the Advancement of Science

SELECTED PUBLICATIONS

Astorga, G. et al. Adaptive processing and perceptual learning in visual cortical areas V1 and V4. *PNAS* 119 (42), e2213080119 (2022).

Gilbert, C.D. and Li, W. Top-down influences on visual processing. *Nat. Rev. Neurosci.* 14, 350–363 (2013).

Ramalingam, N. et al. Top-down modulation of lateral interactions in visual cortex. *J. Neurosci.* 33, 1773–1789 (2013).

Gilbert, C.D. and Li, W. Adult visual cortical plasticity. *Neuron* 75, 250–264 (2012).

Yamahachi, H. et al. Rapid axonal sprouting and pruning accompany functional reorganization in primary visual cortex. *Neuron* 64, 719–729 (2009).