



Brain and Visual Perception: The Story of a 25-Year

Collaboration, D. H. Hubel & T. N. Wiesel

Susana Martinez-Conde, PhD

Barrow Neurological Institute

350 W. Thomas Rd.

Phoenix, AZ 85013

Phone: 602-406-3484

Fax: 602-406-4172

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smart@neuralcorrelate.com

<http://neuralcorrelate.com>

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REVIEW OF: D.H. Hubel and T.N. Wiesel. 2004. *Brain and Visual Perception: The Story of a 25-Year Collaboration*. Oxford: Oxford University Press. 729pp. US\$49.50 hbk, ISBN: 0195176189

In 1981, David Hubel and Torsten Wiesel received the Nobel Prize in Physiology or Medicine “for their discoveries concerning information processing in the visual system.” *Brain and Visual Perception* is a collection of 28 selected reprints of their most important articles, complete with both Nobel Lectures and extensive new commentary. The book opens with Hubel and Wiesel’s autobiographies, followed by a comprehensive background to their research, an account of how their collaboration started, and the state of brain science in the late 1950’s and early 1960’s. The 28 reprints are organized in three main sections: “Normal physiology and anatomy”, “Deprivation and development” and “Three Reviews”, followed by an epilogue. Each article has new commentary in the form of a foreword and afterword describing the motivation that led to the research, and the authors’ view from today’s perspective. With the exception of Wiesel’s autobiography, *Brain and Visual Perception* is written in Hubel’s voice. Hubel is true to his promise of writing the stories behind the research, and restoring “some of the juices” to the articles. The reader is treated to an honest portrayal of Hubel and Wiesel’s humanity, their 25-year partnership, the occasional disappointments in their incredibly successful career, the rare oversights (i.e. Hubel and Wiesel surprisingly missed the functional organization of directional selectivity in area MT), and above all, “the fun of doing science”.

Hubel's playful humor makes the book a pleasure to read, and I found myself laughing out loud in several occasions. Hubel and Wiesel's irreverent attitude towards science "with a capital S" was no doubt highly influenced by their mentor Steve Kuffler, who "enforced" an informal research atmosphere, first at the Wilmer Institute, and then in the Neurobiology Department at Harvard Medical School. *Brain and Visual Perception* is extremely well written, as are most of the reprints it contains. Hubel's love and mastery of English also reflects the mentorship of Kuffler, who "liked to be able to read without being interrupted by difficulties in syntax or logic".

One aspect of the book that interested me especially was the (lack of) discussion of the perceptual implications of the research. Hubel explains that their famous reluctance to speculate on matters of perception was driven by the desire to present the bare facts and "let the theoreticians do the speculating". However, this statement seems somewhat in conflict with the book's title! Moreover Hubel and Wiesel did not hesitate to offer theoretical models of the functional architecture of the visual cortex, even when the available evidence was only partial: i.e. the hierarchical organization from center-surround geniculate receptive fields to simple cells, and from simple cells to complex cells, and the "ice-cube model", with orientation columns orthogonal to ocular dominance ones, are just a couple of examples. Moreover Hubel and Wiesel's theoretical models of cortical circuitry have for the most part been proven correct in recent years. So they did not leave every interesting speculation to the theoreticians. Why then the unwillingness to discuss perception? After all, one of their earlier works (the 1965 cat prestriate article) has a full section entitled "Implications for Perception" (in which even the word "awareness" is uttered!). One might guess that subjects such as perception and awareness were not considered scientifically respectable at the time of Hubel and Wiesel's main discoveries. Only recently, and thanks largely to Crick and Koch's efforts, has consciousness become a serious topic of discussion for mainstream neuroscientists.

Having been a postdoc with David Hubel for 5 years, I can attest that reading *Brain and Visual Perception* feels like listening to Hubel himself. While preparing this review I often found myself reliving the countless conversations I had with Hubel, many of which centered on the very stories in the book. If I missed anything in *Brain and Visual Perception*, it was hearing more from Wiesel. Wiesel's autobiography (barely 9 pages) whets your appetite and betrays a slightly different perspective than that of Hubel.

In Wiesel's words, Hubel and Wiesel "approached the visual cortex as explorers of a new world". Advancing through uncharted territory, they were open to anything they might find: through a mixture of naiveté and genius, Hubel and Wiesel discovered the building blocks of visual processing in less than two decades. Hubel describes this effort as a "massive fishing trip", seldom driven by specific hypotheses, and quickly remarks that "the lack of a hypothesis need not necessarily prevent one from catching big fish". This is a classic Hubelian reproach of funding agencies who insist that grant proposals must be hypothesis-driven.

A critical aspect of Hubel and Wiesel's powerful approach was their trailblazing combination of physiological and anatomical techniques. Hubel expresses regret that neuroanatomical methods have fallen out of fashion in contemporary neuroscience: modern awake behaving techniques usually prevent histological processing, and imaging methods generally lack the necessary resolution to determine the microcircuits underlying

functional responses. However, my feeling is that recent imaging developments may foretell the rebirth of functional anatomy. In February, *Nature* published an instantly-classic study by Ohki et al.¹ Using 2-photon microscopy, the authors were able to image, with single-cell resolution, the activity of neuronal populations in the mammalian visual cortex *in vivo*. The functional maps obtained had equivalent precision to those acquired through microelectrode single-cell recordings. Hubel and Wiesel's coupling of physiology and anatomy revolutionized systems neuroscience 40 years ago. The next functional anatomy revolution may be in sight!

In summary, the reprint collection alone would make *Brain and Visual Perception* a must-have in every neuroscientist's library, but the book offers much more: a rare opportunity to peek into the minds of the founders of modern visual neurophysiology.

References

- Ohki, K., Chung, S., Ch'ng, Y. H., Kara, P. & Reid, R. C. 2005. Functional imaging with cellular resolution reveals precise micro-architecture in visual cortex. *Nature* 433: 597-603.