HUBEL and WIESEL: The Cat Cortex

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Experiments

Striate cortex neurons – stimulated by slits of light

Anesthesia-Induced Cats

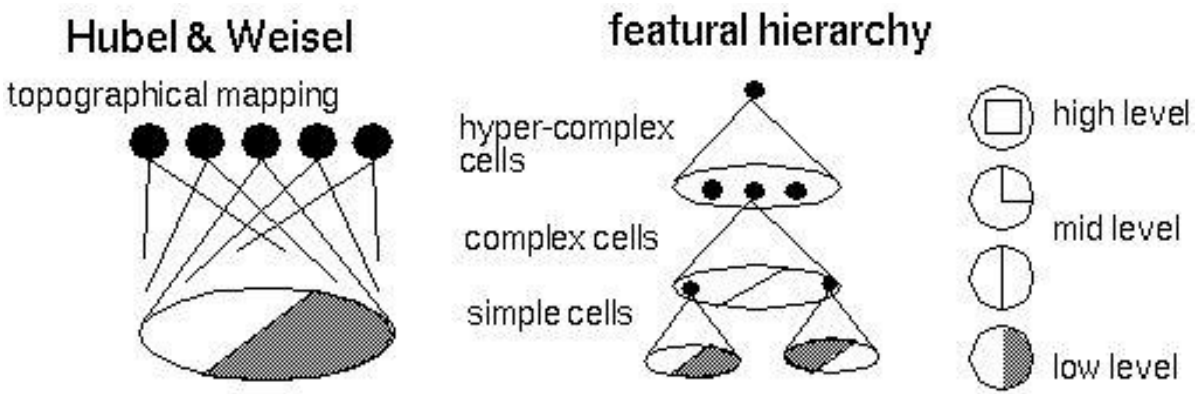
- Studies of receptive field reactions
- Anesthesia was demonstrated to inhibit reactions by dulling or delaying them
- Anesthesia affected motion last; motion persisted in deep anesthesia

Monkeys

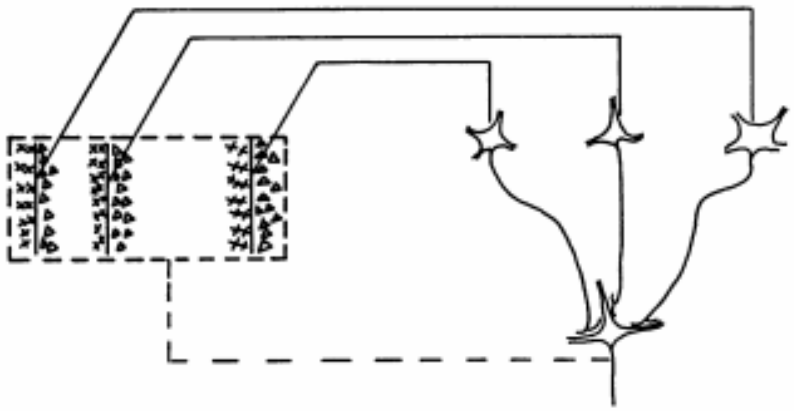
- Expansion of cat findings
- Organization of cortex and layers

Types of Cells

- Simple
  - Cells that reacted to simple light intensities and shapes, especially thin slits of light
  - Determined through specific light triggers
- Complex / Hypercomplex
  - Cells whose firings were produced through a combination of other neurons; react to movement
  - Determined by lack of specific light trigger, not necessarily multiple simple inputs
  - Did not have a specific field of activation that consistently triggered reactions given a specific input shape



Complex Cells



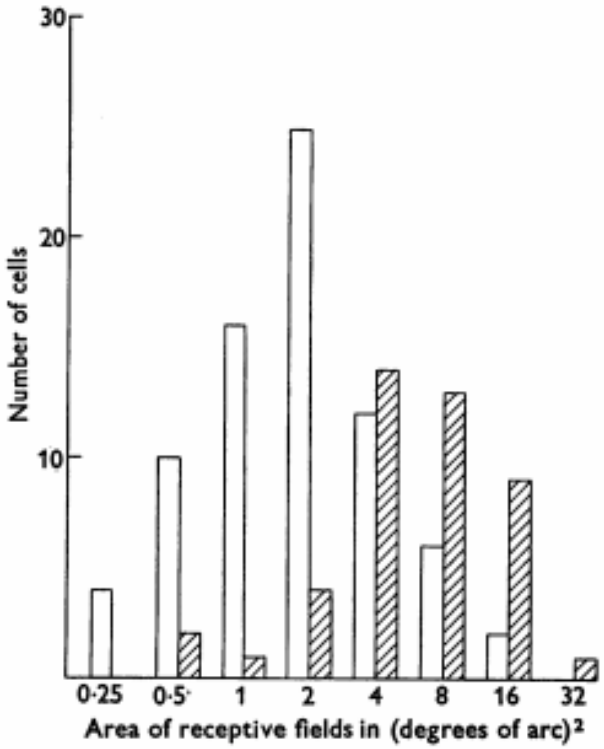
- Complex cells were thought to receive inputs from simple cells
- Simple cells used in inputs would have the same orientation, but different locations on the retina

Properties of Striate Cells & Cats

- Simple fields = same spatial arrangement of regions in in both eyes
  - Part of the early stage of processing
- Complex fields = similar spatial arrangement of regions in both eyes
  - Part of the higher level processing
  - Process movement
- Activations of corresponding regions enhanced one another
- Activations of antagonized regions negated signals

Sequences and Ocular Dominance

- Cells formed sequences, or columns, that corresponded to a specific movement
- Columns of cells had the same axis orientation throughout the sequence
- Both eyes should trigger the same column of cells if they are aligned on an image
  - Focus / Alignment
  - Movement detection



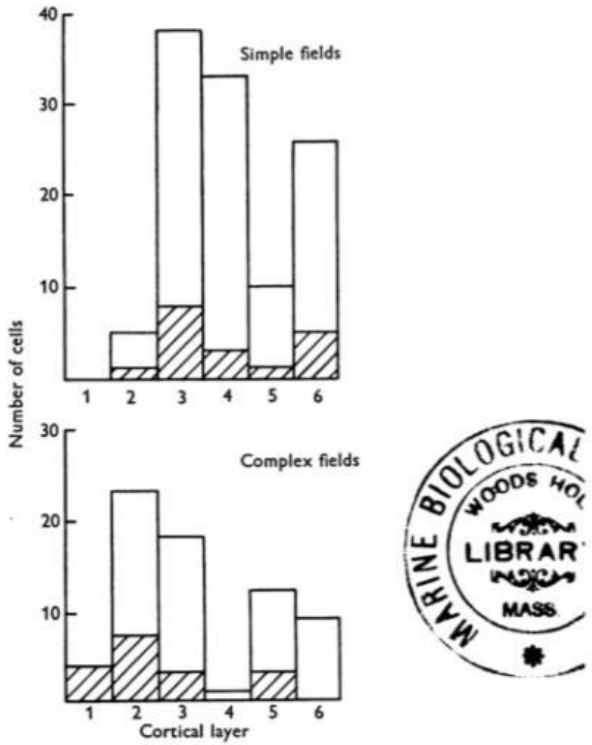
Text-fig. 9. Distribution of 119 cells in the visual cortex with respect to the approximate area of their receptive fields. White columns indicate cells with simple receptive fields; shaded columns, cells with complex fields. Abscissa: area of receptive fields. Ordinate: number of cells.

Types of Complex fields

- The complex fields in cell sequences were split into a number of categories
- Different fields were categorized in the experiment to get a better idea of the kinds of shapes cells would track

TABLE 2. Complex cortical receptive fields

	Text-fig.	No. of cells
(*a*) Activated by slit—non-uniform field	3	11
(*b*) Activated by slit—uniform field	4	39
(*c*) Activated by edge	5–6	14
(*d*) Activated by dark bar	7–8	6
Total number of complex fields		70



Text-fig. 18. Distribution of 179 cells, 113 with simple fields, 66 with complex, among the different cortical layers. All cells were recorded in penetrations in which at least one electrolytic lesion was made and identified; the shaded areas refer to cells marked individually by lesions. Note especially the marked difference in the occurrence, in layer 4, between simple and complex fields.

Cortical Layers & Monkeys

- Distribution of cells throughout the cortex
- Studied in monkeys
- Contour analysis and binocular convergence occur vertically in cortex
- Binocular interactions found not to explain depth perception
- Experiment provided hints for future research to expand on

References

- Receptive Fields of Single Neurons in the Cat's Striate Cortex, H&W
- Receptive Fields, Binocular Interaction and Functional Architecture in the Cat's Visual Cortex, H&W
- Receptive Fields and the Functional Architecture of Monkey Striate Cortex, H&W