

Finding useful functions– part 1

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Our brains have innate structure tailored by evolutionary processes over a long period of time. This structure performs functions that contribute to our behavior in ways that somewhere along the line probably helped individuals to survive, or at least didn't hurt.

Many of those functions are not fully determined by genetics alone. There is an innate framework, but details are filled in by processes of conditioning and association, and to some degree the framework itself is mutable if environmental conditions differ sufficiently from those for which it evolved. There are few sharp lines between innate and acquired neural function.

Feature discrimination in the early visual system is sometimes called innate. Certainly it is innate that the cells grow into layers of tissue appropriate for performing useful feature discriminations. However, it seems the specific connections and weights to implement particular discriminations get filled in by adaptation to correlations in the ensemble of signals flowing from the retina. For example, we can change the distribution of particular detectors dramatically by raising a cat in an abnormal visual environment. It seems cells are not so much genetically determined to perform specific discriminations, as that they acquire discrimination functions appropriate to the signals they encounter in their genetically determined position in the network.

There are places where neural projections bring together signals originating from corresponding points in the left and right eyes. This allows merging both images to fill in details missing from one or the other, estimating depth from discrepancies in the two images, and so on. There is genetic direction to cause axonal projections carrying signals from one eye to grow toward the normally expected locations of the corresponding signal paths from the other. But (from experiments on *Xenopus* frogs) if one eye is surgically rotated before the connections are formed, so that the locations of correlated signals are altered, we see the projections grow first toward the normal target location, then veer off sharply to connect with the very different cells now in position to be correlated.

Many topographic maps can be found in the brain, so that for example neighboring sections of neural tissue are excited by stimuli from adjacent sections of skin. One might imagine a fixed wiring scheme under genetic control to hook up these maps, but when we surgically swap small patches of skin the connections change to preserve the mapping. It takes some time, but after a while we find that the moved sensors now activate sections of the remote neural map that correspond