The Visual Cortex and Object Recognition

Visual Cortex

The message passes from the retina down the optic nerve to structures in the mid brain and enters the cortex in a relatively small area called the primary visual cortex. Some of the most profound research in the relationship between the perceptual world and the nervous system was carried out by two scientists, David Hubel and Torsten Wiesel, who won a Nobel prize for demonstrating that the cells in a cat’s visual cortex responded to lines of different orientations, and moving in given directions etc. This was profound in that they found this consistent relationship between the firing of cells in this area and stimuli in the visual field. They also found that the cells were organized in the cortex in a very systematic fashion, so that, for example, the message passes through a series of levels that analyze these lines in more and more complex ways, and that cells are lined up within the layers according to the orientation to which they respond. However, the basic problem is that they never found any cells that responded to anything close to even relatively simple objects like faces or hands or chairs or all those things that we perceive as important in our visual world. They had apparently discovered an important step in the visual pathway, which indicates that we break objects up into basic constituent parts at some level, and then eventually we put them back together in such a way that we consciously perceive all the objects that represent our everyday visual experience.

Object Recognition

How then do we actually recognize objects? One theory that might seem logical is that at some later level of analysis, beyond the visual cortex, we have more complex cells that respond to objects like a face and a chair. However, there are a number of reasons why this is almost certainly not the case. First, despite all the research that’s been done since Hubel and Wiesel, these cells have not been identified. Second, despite all the cells we have in our brain, there is no way that we can have one cell for all of the different objects that we see in all possible orientations and at all possible distances. Third, the consequences of damage to a single cell would be devastating. For example, if I somehow destroyed the cell that allowed me to recognize my wife or my mother or my general psychology classroom, I would effectively become blind for those objects. Therefore, it seems much more logical that it is some sort of complex combination of cell firing patterns that accounts for our ability to recognize objects, and this most likely occurs in the association cortex. As you saw in the film during the last section, damage to this area can destroy a person’s ability to identify complex objects. But the details of how such a process works are still a mystery to neuroscientists (see figure 1).
Figure 1. R. Hall “Then A Miracle Happens” Theory of Object Recognition