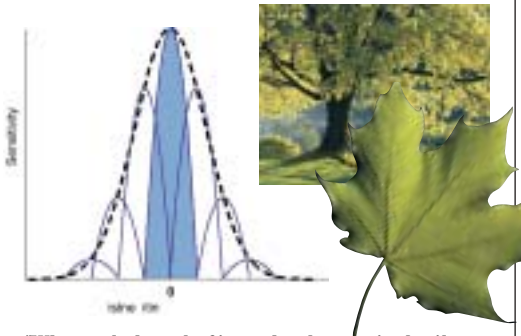
Bart Farell, Ph.D.

Object Recognition

"Seeing the world in three-dimensions is a difficult problem and the human brain uses a number of strategies to solve it."

We see our three-dimensional world through two-dimensional images, one on each retina. Our brains use these images to perform two major tasks: (1) identifying the objects that produce these images and (2) locating these objects in the three-dimensional space that surrounds us.

Based at the Institute for Sensory Research at Syracuse University, Dr. Bart Farell is learning how the brain accomplishes these tasks. The color, form, size, and other features of an object are processed by separate visual pathways. Dr. Farell's goal is to determine how each pathway contributes to our ability to recognize objects and how the brain integrates these features to produce an accurate three-dimensional representation of these objects. This knowledge will increase our understanding of object and space perception and may lead to therapies for reading disabilities, amblyopia (lazy eye), strabismus (turned eye), and other disorders.



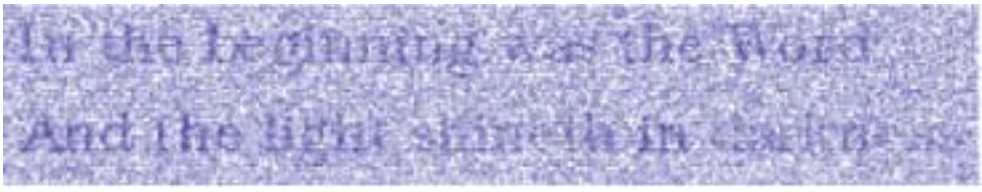
"When we look at a leaf in our hand, we see its details more clearly than we see the details of a much larger tree 50 feet away. We can detect small differences in depth on this leaf better than we can detect equally small differences in depth on the tree. In other words, a difference in depth must be much larger on the distant tree than on the leaf for us to detect it.

Theories of depth perception tell us why this happens. Predictions of one theory are shown by the bell-shaped curves on the graph. Our depth sensitivity is highest where our eyes are focused (in blue) and falls off at nearer or farther distances (to the left and right of center) where our eyes are not focused."

Normal human vision is stereoscopic. We have a binocular, or two-eyed, perception of depth that depends on the subtle differences between the two retinal images. To uncover the basic mechanisms of our stereoscopic vision, Dr. Farell is asking (1) what stimulus units the brain uses to compare the retinal images, (2) how the brain decides how much value to assign a given binocular difference between the images, and (3) how various stimulus characteristics influence the brain's judgments of depth. In addition, he is studying how binocular processes interact with monocular perspective visual information which, unlike stereoscopic vision, is monocular.

Dr. Farell is also studying how we recognize simple two-dimensional objects, such as the letter "A." He has already shown that the brain identifies words by first identifying its parts—letters—rather than by identifying words as whole units. He has shown that even letters have independent parts, or features, which the brain must detect before identifying the letters. He suspects that the properties of these features, once identified, may be involved in recognition of other stimuli as well.

Dr. Farell's object-recognition research should help us understand why our visual system is built as it is and how our visual system performs its everyday tasks. This knowledge should lead to therapies for conditions that deprive people of their ability to carry out these tasks.



Which line is easier to read? The answer—the top line—shows that we read words letter-by-letter, not by whole words. Each letter in the top line has the same contrast energy as does each word in the bottom line. The letters in long words have less contrast, making them harder to read.

A stimulus pattern designed to test whether different pathways of our visual system "see" different size objects. Pathways that respond to different sizes will "see" only the center or the surrounding ring.

Dr. Farell receives research funding from the National Eye Institute. He collaborates with CVR's Dr. Robert Barlow and scientists at New York University and Smith-Kettlewell Eye Research Institute in San Francisco. He is a member of the Visual Sciences Society, Association for Research in Vision and Ophthalmology, and Optical Society of America.

He has authored or co-authored chapters in four textbooks. His research is published in *Nature*; *Journal of Vision*; *Journal of Experimental Psychology: Human Perception & Performance*; *Journal of the Optical Society of America A: Optics, Image Science, & Vision*; *Vision Research*; *Perception*; *Psychological Bulletin*; and *Spatial Vision*. Dr. Farell reviews manuscripts for many of these journals as well.