UC San Diego NEWS RELEASE University Archives. RSS 6020

A new field of research called cognitive neuroscience provides new insights into the mind

November 7, 1988

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CONVERGENCE OF BIOLOGY AND COGNITIVE SCIENCE PROVIDES NEW INSIGHTS INTO THE MIND, UCSD RESEARCHERS SAY

Why do red apples look red to us both in broad daylight and dusk? The wavelengths of light reflected from the apples and received by our eyes vary dramatically, yet our minds continue to perceive the apples as red.

The phenomenon is called color constancy, and an explanation for it is central to understanding how the brain produces what we call our mind.

"The physical description of color and the psychological description of color perception are at two different levels," University of California, San Diego researchers write in the November 4 issue of Science, a special issue devoted to neuroscience research. "The link between them is at the heart of the problem of relating brain to cognition."

In the past, discoveries at the level of nerve cells "and explanations at the cognitive level were so distant that they often seemed of merely academic significance to the other," report UCSD philosopher Patricia S. Churchland and computational neuroscientist Terrence J. Sejnowski.

However, "the development of new techniques for studying large-scale brain activity, together with insights from computational modeling and a better understanding of cognitive processes, have opened the door for collaborative research that could lead to major advances in our understanding of ourselves," they write. The field arising from this convergence is called cognitive neuroscience.

Color constancy is one example of a problem that is yielding to this new interaction between biology and psychology, the researchers note. Insights from artists, psychophysicists and theorists have shown that perceiving a constant color "depends on being able to compute the intrinsic reflectance of a surface independently of the incident light."

Neurobiologists, in turn, have located neurons in an area of the brain's visual cortex that can perform this computation. And other researchers have observed that when the human brain suffers damage to this area, the result is a total loss of color perception.

Although the puzzle of color vision is beginning to yield at many levels, better techniques and models will be needed to determine the biological basis of more complex psychological activities such as reasoning and language, Churchland and Sejnowski note.

New noninvasive techniques such as regional blood flow analysis using positron emission tomography (PET) and magnetic resonance imaging (MRI) are already allowing researchers to measure "the large scale pattern of what is happening where and when" in the human brain.

Also crucial is the development of neural network computer models that mimic the workings of the brain.

Since vast numbers of computer models are possible, the researchers note, experimental findings on the nature of the brain are indispensable in narrowing the search for models and theories that accurately reflect the way our brain/mind functions.

Sejnowski, formerly of Johns Hopkins University, joined the UCSD faculty this fall as a professor of biology and an adjunct professor of both physics and cognitive science. He also directs the newly created Laboratory of Computational Neurobiology at the nearby Salk Institute.

Churchland, a professor of philosophy at UCSD, is the author of Neurophilosophy, a book that attempts to recast the traditional concerns of philosophy to be compatible with new findings in psychology and brain science.

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