Behavior

Where in the brain is working memory?

Working memory holds and relates a variety of stored information during tasks such as talking, reading, and recognizing objects. The dominant theory of working memory divides the labor into executive control, which coordinates brain activities, and active maintenance, which acts as a holding bin for data. These two functions have been thought to occupy separate regions of the brain.

Two studies in the April 10 NATURE used functional magnetic resonance imaging to take second-by-second pictures of the brain during simple memory tasks. These brain scans reveal that executive control and active maintenance aren't entirely distinct.

In one study, volunteers viewed a face on a computer monitor for 3 seconds, tried to keep it in mind during an 8-second pause, then viewed another face. If the faces matched, the volunteers pressed a button.

The scans showed that areas at the back of the brain lit up briefly when the faces first appeared and that frontal areas became and stayed active during the pause. That distinction wasn't complete, however. Some rear areas lit up slightly during the pause, while some frontal areas responded slightly when the faces appeared.

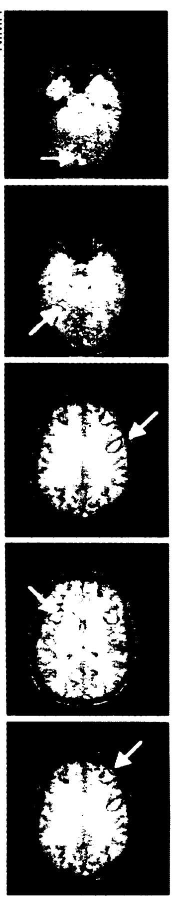
The results demonstrate that perception and memory require the coordinated efforts of different parts of the brain, says Susan M. Courtney, who conducted the study with colleagues from the Laboratory of Brain and Cognition at the National Institutes of Health in Bethesda, Md.

In the second study, scientists scanned volunteers' brains as they tried to recall increasingly long sequences of consonants flashed on a screen. The volunteers were also asked to say whether the letters had appeared in previous sequences. As the string of letters lengthened, activity in frontal areas of the brain increased; other areas of the brain also lit up.

Like the results of the first study, these challenge the theory that one part of the brain coordinates information processing while another part keeps the information available, says Jonathan D. Cohen of Carnegie Mellon University and the University of Pittsburgh, who led the investigation. Cohen theorizes that several parts of the brain work together to hold and coordinate information.

Courtney and Cohen agree that imaging brain activity from millisecond to millisecond in the future could improve scientists' understanding of working memory.

Patricia Goldman-Rakic, a neurobiologist at Yale University School of Medicine, notes in a commentary accompanying the reports that although activity in the front of the brain increased in each study as memory tasks grew longer and more complex, different frontal areas of the brain were activated. Therefore, the type of information being processed dictates where memory will be located at any given time. "It's not just one spot in the brain." — *P.S.*



NIMH

Red and yellow areas show increased brain activity, while blue and green areas show decreased activity during tests in which people saw, then remembered, faces. In the top picture, the areas in the lower back of the brain, associated with sight, respond immediately to the pictures. Activation moves quickly to the front of the brain as the subject stores the image after the face was removed from view. Elapsed time from top picture to bottom picture is 11 seconds. Arrow indicates region of greatest increase in activity.

Chemistry

From a meeting in San Francisco of the American Chemical Society

Obesity drug takes a different strategy

A compound that helps the body burn fat may one day become a drug to treat obesity. The compound raises the metabolic rate in rodents by 10 to 30 percent, which would translate into a weight loss of about a half pound per week in humans, says Robert L. Dow of Pfizer in Groton, Conn.

The compound stimulates the beta-3-adrenergic receptor, a protein on fat cells that signals them to break down fat molecules, generating heat (SN: 8/12/95, p. 103). Compounds that work similarly have shown promise in animals but have failed to trigger weight loss in humans. Moreover, those compounds caused unwanted side effects by stimulating two other kinds of beta-adrenergic receptors, one that raises heart rate and another that dilates blood vessels (SN: 5/7/94, p. 303).

The Pfizer scientists shaped the new compound specifically for the beta-3 receptor, reducing its ability to bind to the other two beta receptors. This greater selectivity should also improve the compound's effectiveness in humans, the researchers say.

Unlike weight loss drugs that work by decreasing appetite, a drug that stimulates the beta-3 receptor would get around a problem that afflicts many dieters: The body's metabolism adapts to the lower intake of calories, making it more difficult to lose weight. — *C.W.*

How UV light causes cancer and wrinkles

Skin can be its own worst enemy. Scientists have learned in recent years that two substances which protect skin from the harmful effects of the sun can also, under certain conditions, have a hand in causing that damage. Now, researchers at the University of California, San Diego (UCSD) in La Jolla have found some clues as to why.

The physical properties of the substances, melanin and urocanic acid, change with exposure to ultraviolet (UV) light. The variability of their response to different wavelengths may explain the observed biological effects of UV exposure, such as the initiation of skin cancers and wrinkles.

Melanin, a skin pigment, protects against UV exposure by absorbing the light and then dissipating the energy as heat. In test-tube studies of this reaction, chemists Susan E. Forest and John D. Simon found that at short wavelengths in the UVC range, melanin retains 27 percent of that heat. Such an excess could allow melanin to interact with oxygen to create destructive free radicals, they suggest. Whether such ill effects occur depends on what melanin does with the stored energy, Forest says. The molecule may dissipate the energy as heat, or the energy may go into chemical reactions that create oxygen radicals. Further studies should be able to tell how much energy is lost through each mechanism, she says.

Kerry M. Hanson, working with Simon at UCSD, looked at urocanic acid, a compound found in the outermost layer of skin. Previously, scientists had suggested that urocanic acid causes wrinkling during exposure to longer wavelength, UVA radiation but suppresses the immune system when stimulated with short wavelength, UVC light.

Hanson's findings support those assertions. Exposed to UVA, urocanic acid creates reactive oxygen radicals that can cause wrinkles by breaking down collagen and elastin in the skin, she says. Larger quantities of oxygen radicals that are produced under UVC exposure, however, could damage the immune system. Exposure to UVB radiation does not produce radicals.

Sunscreens and cosmetics once contained urocanic acid, until scientists discovered it might harm rather than protect, Hanson says. Most UVC is blocked by the atmosphere, but ozone depletion may make short wavelength UV light more of a concern.

The use of physical chemistry techniques to investigate how photobiology occurs in the skin makes this project "a nice blend between the two fields," Hanson says. — *C.W.*