EVOKED POTENTIALS

Turning Perceptions and Mental Images Into Ideas

This is the third chapter in our creativity story. Creativity is an intentional process in which we try to change *what is* into *what should be* (as is well illustrated by the research described in each of our issues). In February, we considered the importance of motivation, and this month we turn to perception.

We perceive what is before us, but much of what we perceive is only the part that our mind is prepared to perceive. In 1851, Henry David Thoreau noted that astronomers were better served in their quest to define planets, galaxies, and other heavenly phenomena by insightful and experienced perception than by the power of their telescope. Perception is the critical bidirectional interface between external and internal reality, between the world around us and our mental image of it.

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Motivationally relevant stimuli drive our behavior. We perceive an existing state and imagine a desired state. Some desired states are conceptually simple and based upon the restoration of a biological set point such as hunger and thirst. Those we generally assign to the realm of creative behavior are less directly linked to a biological set point, yet are still motivated by the same reward systems and achieve their own form of satiety. Creative behavior requires that we perceive what is and imagine a more rewarding what should be.

Each perceptual experience is a unique neurophysiological event generated by the activation of specific neuronal pathways distributed across primary sensory, association, and paralimbic cortices. These collectively constitute our mental image of the outside world (Brain 1998;121:1013-52) and our synchronously experienced inner bodily state ("The Feeling of What Happens: Body, Emotion and the Making of Consciousness" [New York: Harcourt Brace, 1999]).

Each experience activates a specific group of neuronal pathways, resulting in a unique pattern of synaptic facilitation. Synaptic facilitation leaves a lasting physiological trace of the image in our mind, digitized and distributed across all the cortical regions that contributed to the synthesis of the percept. The next time we see the "same thing," whether it is a familiar face or a shaded contour, synaptic pathways previously facilitated by prior experience of that "same thing" process the new real-time input more quickly, more automatically, and with embellishments of coactivated details from previous similar experiences. By tapping into one piece of a facilitated pathway that constitutes a past perceptual experience, we may be reminded of parts of that past experience, thus contributing to our current experience.

Mental imagery arises from these retained, synaptically facilitated patterns of past perceptions. Conjured mental images may approximate an original percept, or be abstracted by combining select details from multiple experiences, as the philosopher David Hume observed nearly 300 years ago. Mental imagery tasks activate some of the same sensory regions as actual perception (Brain Res. Cogn. Brain Res. 2004;20:226-41), and damage to these brain regions results in both perceptual and mental imagery defects (Brain 1997;120:217-28). Yet, as Hume observed, "these faculties may mimic or copy the perceptions of the senses; but they never entirely reach the force and vivacity of the original sentiment" (Great Books of the Western World, Vol. 35, "An Enquiry Concerning Human Understanding" [Chicago: Encyclopedia Britannica, 1952, pp. 445-509]).

PET and functional MRI activation patterns are similar between perceived imagery and mental imagery, but they are not identical. The reduced clarity and vivacity of mental images compared with perception may reflect a reduced role for primary visual regions in mental imagery, different neuronal subpopulations for each, or another explanation (Psychol. Bull. 2003;129:723-46).

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Mirror neurons, initially described in monkeys, encode a form of motor imagery reflecting intention rather than an actual movement. Evidence for mirror neurons in humans comes from several sources, including PET scans of people observing other people imitating their actions, electrical recordings of brain activity in epilepsy patients, and the effects of imagined and observed imitated behavior on the magnetic excitability of the brain (Exp. Brain Res. 1996;111:246-52). An implication of the ability to recognize movement patterns is our ability to generate signals that are understood by the sender and the receiver. If I wave my hand in a way that you recognize, then we both understand I am waving hello.

In a similar way, a shared symbol system based upon sound may have contributed to the evolution of language (Nat. Rev. Neurosci. 2001;2:661-70), which in turn has allowed humans to pass on knowledge from generation to generation.

Imagining what another person is thinking or feeling is another type of mental imagery, called theory of mind. The role of sensory and motor imagery substrates (including mirror neurons) in theory of mind is debated (Trends Cogn. Sci. 1998;2:493-501), but theory of mind is nonetheless important for creative behavior, because if I imagine a course of action that will impact others, it will benefit me to know how it might make them feel.

We can even combine different modalities: a dragon that meows or a fish named Nemo that talks. What we envision draws from the repository of what we have stored, but what we choose to imagine depends on prefrontally mediated attentional systems that, in turn, are motivated by our internal state, our perceived needs, the state of the world around us, our own abilities, and other factors. The relative reward of different contingencies depends on our state of need so that conjured images have a reward value within the context of present circumstances. Our prefrontal attentional network directs our sensory regions to conjure images relevant to our needs (Cereb. Cortex 2001;11:260-6), which allows us to plan a course of action to create what should be. How we formulate and execute that plan will be our next consideration. ■

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Funds From Federal EHR Incentive Programs Now Available

BY MARY ELLEN SCHNEIDER

A new federal initiative offering bonus payments to physicians who successfully implement electronic health records launched in early January, and signs indicate it could help spur adoption of the technology.

Officials in the Office of the National Coordinator for Health Information Technology recently released two surveys showing that more than 40% of office-based physicians and 80% of hospitals plan to seek federal incentives for the adoption and use of EHRs under Medicare and Medicaid.

The incentive programs offer payments to physicians for using health information technology (HIT) to improve patient care. The federal government recently issued regulations detailing how physicians and hospitals can meet standards for so-called "meaningful use" of the technology. Physicians who meet the criteria are eligible to receive up to $44,000 over 5 years under the Medicare program or $63,750 in 6 years under the Medicaid program. Eligible hospitals could receive millions of dollars, according to the Centers for Medicare and Medicaid Services (CMS).

The survey of office-based physicians, conducted by the Centers for Disease Control and Prevention, found that 41% plan to achieve meaningful use and seek federal incentive payments. Of those, about 80% said that they plan to enroll during the first stage of the program, this year or next.

A separate survey, conducted by the American Hospital Association, found that 81% of hospitals plan to achieve meaningful use and apply for incentive payments, with about 65% enrolling in the same time frame.

While the federal government has promoted these incentives for more than a year, it was uncertain whether physicians would choose to participate.

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DR. WALDREN

Officials at the American Academy of Family Physicians said that while they do not have concrete data, informal polls of their members show high interest in the incentives. Dr. Steven Waldren, director of the Center for Health IT at the AAFP, said that among physicians who attended lectures on meaningful use at the group's annual meeting last fall, about 80% reported that they currently use an EHR in their practice and about 90% said they plan to try to achieve meaningful use this year.

It's a biased sample, Dr. Waldren said, but it still paints a picture. "What it kind of tells us is that there are a lot of doctors out there, especially those that have adopted the technology, [who] are trying to figure out how to be meaningful users in 2011."

The big question is how many physicians will be able to convert their interest in the program into the ability to achieve meaningful use of EHRs, he added.

Dr. Waldren said most physicians will be able to meet the current thresholds for functions like electronic prescribing, which are outlined in the meaningful use criteria. However, the greater challenge will come in capturing and reporting that data to the government, he said.

Dr. Waldren recommended that physicians seek out the Regional Extension Centers set up by the federal government. These centers have been established around the country and are specifically charged with aiding small practices, primary care physicians, and those working in underserved areas. But he also cautioned that expertise may vary by center. ■