EVOKED POTENTIALS

Biological Differences Bring Action to Creativity

I can think of no better example of how strategic formulation must translate into dexterously executed action to effect change than health care reform, a topic we extensively cover in this month's issue of CLINICAL NEUROLOGY NEWS. And so it is appropriate that we dedicate this month's issue to concluding our consideration of action as an important step in creativity.

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Just as some reform measures and proposals seek to recognize the intrinsic nature of neurologists, so then do we include by considering the intrinsic biological differences between people that render some better equipped to execute a particular plan successfully than can their neighbors. Biology matters. As recent sports scandals have suggested, athletic performance can be enhanced by drugs such as anabolic steroids and amphetamines. Some neuroscientists have even advocated the cosmetic use of therapeutic drugs as "cognitive enhancers." Drugs are exogenous biological influences, but there are endogenous sources, too.

Some of the more readily visible biological differences thought to explain enhanced performance have regarded brain structure. Regional differences in brain function are reflected to some extent by differences in structure. For example, the planum temporale, an auditory region of the temporal lobe, is larger in the language dominant (typically left) hemisphere (Science 1968;161:186-7), a trait shared by nearly all people.

Some regional alterations reflect individual differences in use. The lateral aspect of Heschl's gyrus is larger in the left hemisphere among musicians whose pitch perception strategy favors fundamental frequency or rapid temporal processing, but larger instead in the right hemisphere among musicians whose pitch perception strategy favors spectral pitch processing. This region also is physically larger in accomplished musicians compared to nonmusicians (Nat. Neurosci. 2005;8:1241-7).

Studies of Albert Einstein's brain revealed a greater density of neurons in the cerebral cortex than normal (Neurosci. Lett. 1996;210:161-4), and an aberrant Sylvian fissure with disproportionately larger and more symmetric parietal lobes (Lancet 1999;353:2149-53). The significance of these differences has prompted speculation that the greater neuronal density reduced the time delay for one neuron to communicate with another, and the enlarged parietal lobes enhanced his inherent math and spatial skills, arguments that have some parallels in comparisons between low and high IQ individuals (Trends Neurosci. 1997;20:365-71).

Genetic variations have been considered another source of individual differences. The performances of identical twins on a variety of cognitive and physiologic tests are far more similar than the comparative performances of genetically unrelated people (Behav. Genet. 2004;34:41-50). The search for genetic variations that enhance cognitive performance has revealed several that influence memory, including the serotonin 5-HT2a receptor (Nat. Neurosci. 2003;6:1141-2), brain-derived neurotrophic factor (J. Neurosci. 2003;23:6690-4), KIBRA (found in kidney [KI] and brain [BRA]) (Science 2006;314:475-8), and the dopamine D_2 receptor (Science 2007;318:1642-5). Variations of genes related to serotonin are also thought to affect our reaction to novelty and anxiety-provoking situations (J. Neurosci. 2005;25:6460-6) that in turn might influence our drive for seeking creative change. Allelic variations of the gene for catechol-O-methyl transferase (involved in dopamine metabolism, the neurotransmitter of the mesolimbic reward pathway) correlate with performance on a problem-solving task (Am. J. Psychiatry 2002;159:652-4). Interactions between genes and environmental factors may result in unexpected or "emergent" behaviors that may also affect creativity, such as the difference in emotion processing between men and women (Curr. Opin. Neurobiol. 2004;14:233-8).

Less obvious sources of enhanced performance are suspected to reflect individual physiological differences. A functional MRI study comparing the calculation skills of Rüdiger Gamm, a mathematical calculation prodigy, with nonexpert calculators showed that both activated brain regions serving arithmetic, quantity, and visual imagery, but only Gamm additionally activated memory regions (Nat. Neurosci. 2001;4:103-7). In a related study, expert abacus calculators activated the same areas for mental calculation as nonexperts, but additionally activated visuospatial cortices, congruent with the greater visuospatial demands of an abacus-based strategy (NeuroImage 2003;19:296-307). These studies suggest that the neural networks underlying prodigy-level skill may be different than those underlying ordinary-level skill. The regions required for the basic function are active in both, but the prodigies have another functional system in their skill-related network that seems to reflect their training background. It is unclear if the extra system is inherently available to anyone with sufficient practice – and if so, to what degree – or is instead a form of biologically conferred "performance synesthesia."

Disease-mediated biological alterations of brain structure and function seem an unlikely source of heightened ability, yet autistic savants are a well-known group of individuals whose extraordinary talent resides in a circumscribed area that is grossly disproportionate to their general intellect. Savant skills have included memory, mathematics, music, calendrical calculations, and, less consistently, mechanical or artistic skill.

Biological substrates of savantism are unclear, but some correlates have included a larger amygdala (in children) and hippocampus (J. Neurosci. 2004;24:6392-401). Perseverative fixation on a single activity that is their sole avenue of socialization and reward, coinciding with their area of savant-level talent, suggests that savantism may derive from the extreme focus of reward on a single activity and structurally altered paralimbic reward substrates, but this is currently speculative.

Another group of patients whose disease can sometimes enhance creativity are patients with frontotemporal dementia possibly reflecting the reduced behavioral inhibition that characterizes FTD (Arch. Neurol. 2004;61:842-4). Some FTD patients have developed newly expressed artistic skills reflected in greater volumes of less constrained art. But contrary to popular belief, psychiatric disease is not a pathway to enhanced creativity. A large study of eminent men concluded that depression and personality disorders were common, especially among writers, and that their prevalence among the gifted exceeded that in the general population. But those disorders were generally a hindrance to creative ability, and psychosis was a frank handicap (Br. J. Psychiatry 1994;165:22-34).

Some individuals have increased dexterity to carry out creative plans for reasons that range from environmental influences on normally structured nervous systems to altered "wiring diagrams." But regardless of how we have acquired our talents, the ways we choose to use them depend in part on our personality and temperament, which will be our focus in the next issue. ■

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Practice-Based Research Needs More Emphasis in Neurology

BY DOUG BRUNK

EXPERT ANALYSIS FROM THE ANNUAL MEETING OF THE AMERICAN ACADEMY OF NEUROLOGY

HONOLULU – The way Dr. Robert C. Griggs sees it, neurology lags behind other medical specialties when it comes to practice-based research that emphasizes changing physician and patient behavior to optimize outcomes.

During his presidential address at the meeting, he said that while surgeons, cardiologists, and other nonneurology specialists have implemented checklists, patient safety measures, system engineering, and outcome reporting, neurologists have been slow to adapt standardized care algorithms.

"Changing physician and patient behavior has to move to the top of our agenda in order for us to bring the benefits of what we've worked hard to do for all of our patients," said Dr. Griggs, professor of neurology, medicine, pathology, laboratory medicine, and pediatrics at the University of Rochester (N.Y.).

He made his remarks while giving a progress report on the categories of T1, T2, and T3 translational science research in the neurology field. He defined T1 as laboratory work that translates the understanding of disease into new diagnostic tests, new treatments, and disease prevention, from mice up to the first work in humans.

"For T1 we're brilliant" as a field, said Dr. Griggs, who also is a professor in the center for human experimental therapeutics at the university. "We've defined hundreds of mutated genes, we can make animal models, and we can find possible treatments off of small molecules that improve a mouse model. We're not as good yet on gene-modified treatments, but on the whole, we're confident that we will be able to do it soon."

He defined T2 as translating basic research into clinical trials for a diagnostic test, prevention strategy, or new treatment. This consists of phase II, III, and IV clinical trials and includes cost/benefit analyses, as well as research on disparities and outcomes.

"We're not quite as good at T2 research as we are in T1 research, but we have many new treatments, some that are truly breakthroughs," Dr. Griggs said. "However, lots of tough questions remain."

He described T3 as practice-based research focused on disseminating and implementing research advances, and changing physician and patient behavior through quality and safety measures, checklists, and being mindful of economic and health policy considerations. T3 may be "less familiar territory to neurologists" than T1 or T2 research, but he recommended that it become a priority.

One easy way to implement T3 research into your clinical practice, he said, is to advise your patients to follow the American Heart Association's "Life's Simple 7" ways to prevent stroke. Those seven steps are get active, control cholesterol, eat better, manage blood pressure, lose weight, reduce blood sugar, and stop smoking.

Dr. Griggs said that he had no relevant financial disclosures. ■