ENRICHMENT AND BRAIN CELL GROWTH

Two highly significant questions for the 21st century worker are: In a volatile and ever-changing economy, can I continuously enhance my work intelligence, avoid obsolescence and stay on the cutting-edge? If so, am I willing to take the necessary steps?

Organizational research reveals that the answer to the second question is distressing. The huge majority of workers stop learning once they've gained competency in their field. Competency is usually gained within the first four to six years of your career. When organizations weed out the dead wood, they're identifying the people that quit learning. Research on physicians suggests that the statistics are little different than business people—and scarier than hell.

In his latest book, *Better: A Surgeon's Notes on Performance*,[1] Atul Gawande, the Harvard surgeon, lays out the data. He points out that the differences among physicians in a particular specialty used to be considered insignificant. Today, it's a known fact that physician performance falls along a bell curve with a handful of physicians obtaining "remarkably good results, and a great undistinguished middle." The issue? After an insightful conversation with a teaching physician, I suspect there is little difference between business people and physicians when it comes to staying on top of their expertise. They've stopped adding to their intelligence.

With the demise of the old dogma that the mature brain cannot produce new nerve cells, scientist have taken another step up the ladder of neurobiology. The research by Fred Gage[2] and his team at the Salk Institute demonstrates that neurogenesis—the birth of new brain cells--takes place in adult humans. It continues throughout our life. What it doesn't tell us is whether these new cells function. We know we're growing new cells, but will they add to our intelligence?

The scientific research is flooding in, and the answer is a nearly unqualified affirmative.

The science behind enrichment

Back in 1960 three scientists at Berkeley, Mark Rosenzweig[3], Edward Bennett and David Krech identified a difference between "maze-smart" and "maze-dull" rats. The rats from the more complex environment showed increased levels of the chemical acetylcholine. Although the research made hardly a ripple among scientists, those in the know recognized it was a very important finding. Acetylcholine, you see, is strongly correlated with memory. And when you reduce our understanding of intelligence to its most basic components, they are two in number: memory and adaptability. One pivotal question, however, remained. Were the "maze-smart" rats already that way at birth? Was it nature or nurture?

Enter Marian Diamond, a young neuroanatomist. Along with the insights of her three Berkeley colleagues, she separated mentally similar rats into three learning environments: enriched, standard and impoverished. The enriched cages were filled with toys of interest to rats. She changed them daily, and provided plenty of cagemates. In contrast, the impoverished environments had no toys and no cagemates. After several weeks, the brains of the different groups were studied. In 100 percent of the enriched rat brains, the animals had significantly thicker

cortexes—the outer front layer of the brain structure. Furthermore, the enriched animals also had more complex dendrites—the branches of the brain cell that conduct impulses. Both the actual structure of the brain as well as the nerve cell branches were altered by enrichment.

Still, the research was about rodents, not humans. In classic scientific fashion, one new discovery leads to another. By the 1980's, Diamond had become a renown expert in the neuroscience of enrichment. A piece of the research from the 1960's revealed that rats living in enriched environments had more glial cells than those from impoverished environments. Glial cells are the support cells for the nerve cells. Just those two cells are responsible for all of the behavior generated by your brain. It's the glial cells that establish and maintain the neuron circuitry that makes it possible for you to do complex thinking like strategy and negotiation and innovation—the "higher" thinking.

Dr. Diamond's question was whether the glial cells would continue to increase when the neuron's increased with enrichment.[4] Active neurons will need still more supporting glial cells. Her question went to the heart of intelligence and increasing a person's potential. How she found the answer is a fascinating story.

Einstein's brain

As Dr. Diamond tells the story, a German colleague had suggested that the more highly evolved area in the human brain should have more glial cells per neuron. She checked that out from eleven human, male preserved brains, and found the hunch correct. Using the available technology, she was able to count out the glia and neurons from her samples, and actually create a ratio between glia and neurons.

One day she saw a photo from the journal, *Science*, showing that Einstein's brain was in a box in a lab in Kansas. Later, while waiting for her husband who was teaching at UCLA, she mused over her glia/neuron studies, wondering if she could get tissue from Einstein's brain to assess the ratio between glia and neurons in an exceptionally functioning adult. She only needed four pieces of tissue, so she called the University of Kansas and tracked down the pathologist who had been at Princeton at the time of Einstein's death. Thomas Harvey had had the foresight to fix the brain in celloidin—a substance which hardens tissue--when Einstein died, and the tissue was still in perfect shape for her kind of research. Twenty-five years after Harvey's act of preservation, Diamond began calling and negotiating with him about every six months. Finally, after three years she received four pieces of sugar-cube sized tissue from Einstein's brain in a mayonnaise jar filled with fluid.[5]

Einstein's tissue was ideally preserved making it possible to compare the ratio of glial/neuron tissue with the eleven normal males in her previous study. Utilizing the help of a technician and a statistician, she learned that in four major parts of the brain—the right and left prefrontal and inferior parietal cortexes, Einstein had more glial cells per neuron than the average man. But in the left inferior parietal area of the brain, Einstein had significantly more glial cells.

What's the inferior parietal area? Diamond wanted to study Einstein's brain because the inferior parietal area focuses upon "higher" mental functions. Rather than directly receive primary sensory information, that region associates, connects and

analyzes inputs from other brain regions. It handles high level synthesizing and innovating.

With this research, Dr. Diamond confirmed solidly that highly enriched experiences result in the development of superior intelligence. In short, neurons that "fire together, wire together." And it's the glia that makes all this possible.

So what?

Diamond has broadened and deepened the conclusions of enrichment: Enriched environments enrich your intelligence. Buddy, if you want to stay employable you want to keep moving and keep moving into enriched environments. An environment's level of enrichment determines a lot more than we ever dreamed about our success. Some environments, though financially rewarding, can be also be carriers of obsolescence.

Recently, one of my clients was told that if she took a certain executive position, she could dig down for most of her life and have a high-paying "fur-lined trench." My response to her was unequivocal: " A fur-lined trench is nothing more than a grave with both ends knocked out."

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[1] Gawande, Atul (2007) Better: A Surgeon's Notes on Performance. (New York: Henry Holt and Company).
[2] Gage, Fred, et al (1998) Neurogenesis in the Adult Human Hippocampus. *Nature Medicine*. 4, 1313-1317.
[3] Rosenzweig, Mark, et al (1964) Chemical and Anatomical Plasticity of Brain. *Science*, **146**, 3644, 610-619.
[4] Diamond, Marian C. (2001) Response of the Brain to Enrichment. *New Horizons for Learning.* (newhorizons.com).
[5] Diamond, Marian C. (n.d.) Why Einstein's Brain? *New Horizons for Learning.* (newhorizons.com).