

## FACULTY PSYCHOLOGY & MODERN NEUROSCIENCE

Robert B. Sivley, Ph.D

***Gallia est omnis divisa in partes tres, quarum unum incolunt Belgae, aliam Aquitani, tertiam qui ipsorum lingua Celtae, nostra Galli appellantur.***

For the older members, who may not remember their Latin or for the younger members who did not take it in high school, that sentence may be translated as follows: *All Gaul is divided in three parts, one of which is inhabited by the Belgians, another by the Aquitanians, and the third by those who in their own language are called Celts, but in our language are called Gauls.* This is the first sentence of Julius Caesar's Commentary on the Gallic Wars, a sentence translated by all second year Latin students.

Besides high school Latin I also took two years of koine Greek in college, but I will spare you any feeble effort on my part to recall much of that.

Your first thought may be why in the world is he talking about those dead languages – since modern Italians do not speak Latin, and the people of Greece do not speak the ancient Greek of either the Odyssey or the New Testament. And why did he waste some valuable years of his youth studying something for which there is no current use, since anyone who wants to read Homer, Julius Caesar, or the New Testament can do so in modern English – or in any other currently spoken tongue?

**The fact is that** more than a hundred years ago what was then called “modern psychology” set forth a theory which said, in effect, that studying difficult subject matter would alter one's brain and make one smarter. The theory was known as Faculty Psychology, and it was a popular educational theory in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries. Students who took algebra, geometry, and Latin might never have occasion in adult life to recall such information, but it was believed that having done so in school would have some beneficial effect on their brains, so that they would be able to think more clearly. One Latin teacher used to say (and he did so frequently) that “studying Latin and Greek deepens the convolutions of the brain.” While he may have had little knowledge of neurology, he obviously thought that making the brain more wrinkled would make people smarter.

By the time I began to study psychology around 1950, the theory of Faculty Psychology had been more or less discarded, and I began to resent the fact that I had struggled with those ancient declensions and conjugations in vain. I wasn't very smart, and I did not know whether my brain was very convoluted or whether it made any difference if it were. I could have been learning something more useful, such as how a generator produces an electric current or how to choose an investment that will produce income, or any number of other useful things. Studying algebra and geometry proved to have some value beyond just wrinkling the brain, but I never seemed to find a good reason for

learning Latin or Greek, because it never came up in a social conversation, and no employment application that I filled out ever asked whether I had any knowledge of the conjugation of Latin verbs or of the ablative absolute.

**I did have one good fortune, however**, when I moved to Hopkinsville some 40 years ago, to rent a room from Mrs. Annie Payne, who had been a Latin teacher, and was the mother of Drs. Gabe and Faxon Payne. She was pleased that I had been a Latin student, and immediately jumped to the conclusion that I must be intelligent, so she did me the favor of reviewing all the prominent people in Hopkinsville – judges, doctors, realtors, etc. – and telling me how competent (or in some cases incompetent) each one was, based on the fact that she had taught most of them in high school. Her idea was that I could rely on those who had excelled in Latin. I should be a little careful with those who only made average grades, and pay no attention to the ones who did not even take the course. Mrs. Annie was evidently a believer in faculty psychology.

It turns out, however, that psychological theories – like fashions and the stock market – have a way of fluctuating, or circulating, and an idea very popular at one time may be replaced with another point of view in a later generation, but then, with further research may have a resurgence. And research in the neurosciences during the past three decades suggests that the faculty psychologists were not 100% wrong, though I still resent those conjugations and that awful Greek alphabet.

**Now we have the exciting field of neuroplasticity**, and the literature is replete with findings that support the idea that mental exercise does lead to actual changes in the brain and thence to increased mental ability, though no one seems to give the old faculty psychologists much credit for having guessed that correctly before the physical data were made available by the advent of brain scan technology.

We know now that greater cognitive capacity comes from having more neurons (i.e., the brain cells), more synapses (i.e., connections between those cells), and higher levels of neurogenesis (i.e., higher levels of creation of new neurons). Yes, I said *new neurons* ! As recently as the time when I took my first course in physiological psychology (a mere 55 years ago), the textbook stated flatly that no new neurons were generated in the central nervous system.

Neuroplasticity has changed our thinking. It has introduced, or at least made more familiar, such terms as *synaptic plasticity* (changes in the strength of connections of brain cells), *synaptogenesis* (creation or removal of groups of such connections), *neuronal migration* (the process whereby neurons extend from their place of birth to far reaching areas of the brain), and *neurogenesis* (the creation of new neurons). And modern brain scan techniques suggest that there are other forms of neural change that do not involve direct measurement of individual neurons. And those brain changes have been found to come about as a result of learning experiences, if you include in the term learning experiences such behaviors as arithmetic skills, knowledge of history, remembering your wedding anniversary, driving a car, and how to hit a golf ball

accurately. But you must include the less desirable behaviors such as habitual gambling and becoming addicted to alcohol and tobacco, because those are learned behaviors also, and they also bring about changes in the brain

**How do we know that brain changes** may be brought about by variations in behavior ? There are many studies to substantiate that fact, many of which are very difficult for those of us who are not well versed in modern neuroscience to comprehend and many that are hardly appropriate for an Athenaeum paper, with all due respect. But many are quite easy to understand. Consider, for example, the famous study of London cabdrivers who must memorize that city's confusing 25,000 streets. It was found that compared to the average Londoner, the experienced drivers had developed larger posterior hippocampi, the region of the brain that files spatial memories, suggesting that their driving practice had led to an actual physical, neurological change. The hippocampus is a small component of the human brain that plays a crucial role in the consolidation of information from short term memory to long term memory. Its deterioration is thought to be a factor in the development of Alzheimer's disease.

Another area, in which studies have shown that changes in the brain may be brought about by experience is in the many studies of the brains of superior athletes. It turns out that being a good athlete is not just a matter of size, muscle strength or running speed. Research has shown that the brains of superior athletes are different from those of average people, and part of that difference is due to the fact that practice changes the brain's anatomy and function. With practice, some neurons strengthen their connections to other neurons, and weaken their connections to others. As the brains of athletes become more efficient they learn how to make sense of a new situation sooner. This leads to being a better running back, a better free throw shooter or a better infielder. How does "practice make perfect?" It changes the brain, which, in turn, further changes behavior.

**We have long known** that during the first few years of life the brain grows rapidly, with each cell sending out multiple branches and increasing the number of connections, so that by the age of three there are approximately 15,000 connections with each of the some one billion cells, and that is about twice as many connections as are in the average adult brain. Because as we age, many of the old connections are deleted by a process of synaptic pruning, which not only causes us to forget a lot, but also makes our brains more efficient.

Modern magnetic resonance imaging studies of the brains of adolescents indicate that a second period of over production and pruning starts just before puberty and leads to a growth spurt in the frontal cortex, which is the seat of our highest level of mental functioning (which leads one to wonder whether it was wise to lower the voting age to as low as 18), but may account for the greater maturity and judgment that parents tend to welcome in their children as they move into adulthood.

During brain repair following injury, plastic changes are geared toward maximizing functions in spite of the damaged brain. Studies involving rats found that in one area of

the brain that was damaged brain cells underwent changes in function and shape that allowed them to take on the functions of the damaged cells, and it appears that such phenomena may occur in human brains, as well.

And there are many other simple studies that tend to confirm the plasticity of the brain, as it both responds to our activity by changing structurally and then to influence and mold our behavior and abilities. For example, there are studies among the blind in *human echolocation*, the ability of some blind people to use auditory cues to sense their surroundings in detail and learn to get around more independently. I spent several days observing students in a school for the blind many years ago and was amazed at how well many of them were able to get around without bumping into everything. I tried closing my eyes to see if I could do it, and it was impossible. MRI studies have shown that parts of the brain associated with visual processing may be adapted for this new skill of echolocation – a kind of human sonar.

There is concern about the effect of video games on the brains of teenagers and others who spend hours on end developing skills that can hardly be developed any other way – something unknown to previous generations. Studies of the effects of such activity on the brain are yielding mixed results – some positive and some negative – but all confirming that the brain does change as a result of such learning experience – in much the same way that other learned activity – from music to playing tennis may alter the brain.

Some researchers report improvement among video game players in decision making and perception, but some brain scans have suggested negative effects. The surge of dopamine, a neurotransmitter brought on by killing lots of the angry birds may be pleasant but may also be addictive in the same way that certain drugs may be addictive.

And of course there have been many studies that indicate that the onset of the neurological disorders that often occur with aging – Alzheimer's and other forms of dementia is related to whether or not one maintains an active mental life, so that aging people are encouraged to carry on with such activities as reading, new learning, crossword puzzles or writing things like Athenaeum papers that may bore other people but help keep one's brain sufficiently active to stave off senility.

So how do I feel now about Caesar's account of the Gallic wars? It is a remarkable account of an important phase of history, and very interesting to know that a man so gifted as a military leader and government administrator could write such an important chapter of history, but I think I could have gotten along without it. I no longer resent Professor Raines' idea that learning to decline Latin nouns would make my brain more convoluted and thus help me to get by later in life, because he was trying to help me, and I guess he was not entirely wrong.

Today's high schoolers, however, with their computer skills and smart phones, are learning so much more than I did as a boy, and they look like they're having a lot more

fun. But I do have some concerns about the possible effects of some of the current technology (like Google and the GPS) that makes all information readily available on a digital screen and relieves us of the necessity of studying a subject in detail or of reading a map to find directions to a distant location.

If the London cab drivers are using GPS's now I don't think their hippocampi are going to develop as well. You may not think that should matter, but the hippocampus is a very important little part of the human brain. And it is a lot easier to turn to Google for the answer to every question than to look it up in a dictionary. You remember what a dictionary is – it's a bound volume that sits on a desk, and is not plugged into anything, but you have to find an old one, because they're not publishing them any more.

And it may no longer be necessary to actually read Hamlet's soliloquy in order to find out why he was considering suicide. But if you don't read it, you will miss both the wisdom and poetic majesty of Shakespeare's work. Is it possible that the ready access to isolated bits of information will interfere with the ancient practice of simply trying to learn things? And if so, how will our brains adapt to that?

Welcome to the Brave New World.

*Presented to the Athenaeum Society September 6, 2012*