The Adolescent Brain: Still Ready To Learn

Ever wonder what goes on in the teenage mind? Or, what happens in the human brain when a learner approaches the teen years? Brain studies can provide clues toward a better understanding of learning and development from early childhood to adolescence.

The "critical period" hypothesis. Countless authors write about a "critical period" in the process of learning. They point to early, even preschool, years as vital - a time when neural capacities are blooming with supercharged increases in branch-like connections (called dendrites) within the brain cells (Bruer, 1997; Johnson & Newport, 1991). Brain activity occurs in a network of neurons, which create connections (synapses) by sending impulses to each other via axons and dendrites. Because so many connections form during these time periods -- from about the second trimester of pregnancy through ages 3,10, or 12 -- researchers sometimes refer to these periods as "critical."

Early synaptic activity lay some of the preliminary foundations (in the form of neural networks). However, during this time the brain may also be acting primarily out of its relative ignorance-wanting to know more and more, but not yet having the capacity to determine what is important.

The "early childhood" perspective. In early childhood, the brain records things in multiple places or repetitively, forming duplicative or "redundant" synaptic connections. A density of synapses results, doubling the amount found in mature adult brains. Similarly, brain activity and the resulting energy use (glucose consumption) are much higher during early years. One of the most noted studies by Chugani, Phelps, and Mazziotta, in 1987 identified high glucose consumption beginning in the early years and continuing into the second decade of life.

Primary research literature has not yet documented whether the greater densities of synapses or the larger consumption of energy correlates in any viable fashion to the propensity for long-term memory or learning. Although evidence of critical or sensitive periods for seeing, hearing, and acquiring languages without accents exists, these do not translate directly into learning capacities.

The "later childhood" reality. As life experiences increase, some synapses become involved more routinely, and, as a result, the activated cellular paths become myelinated or

strengthened. Other earlier, less-used or redundant connections atrophy and are ultimately pruned away for potential use in other capacities. Thus plasticity develops, allowing new experiences to continue molding the architecture of the brain.

Neurobiologist Patricia Goldman-Rakic suggests, "While children's brains acquire a tremendous amount of information during the early years, most learning takes place after synaptic formation stabilizes… That is, a great deal, if not most, learning takes place after age 10 and after pruning has occurred. If so, we may turn into efficient general learning machines only after puberty, only after synaptic formation stabilizes and our brains are less active."

In other words, the human brain acts like a sponge early in life, soaking up everything it can. It eagerly works to discover patterns and to understand what behavior will be the most efficient and effective for its existence. At the earliest juncture in life, the brain must concern itself with a need to hold on to everything and anything, and perhaps in some superficial manner, it uses this time to catalog all the information it possibly can. Then, in the adolescent years, the brain begins to define what is important to remember, discards useless or irrelevant information and develops ways to retain, access, and learn new information.

President of the National Institute for Mental Health Dr. Steven Hyman speaks to these theories in his commentary on the human genome project. At a national brain and leaning conference, he stated that while genetics are inherited, gene expression is environment-dependent. In other words, “lived” experience plays the ultimate role in final behavior adopted by an individual.

Perhaps Jacqueline Johnson and Elissa Newport best summed it up when they wrote: “In most domains of learning, skill increases over development.” Most learning is developmental and accrues over time. Therefore, adolescents, even adults, have valuable time to learn more.

How can we apply this evolving research about early opportunities for learning to middle- and high-school level learners? However fascinating and even influential brain studies may be, they cannot yet claim prescriptions for teaching and learning. At this point, we can make applied inferences to inform methods and practice that take advantage of the learning capabilities in the middle and high school years. Educators can pay attention to how they form the environment in which adolescents learn and to how they instruct and deliver information to adolescents. Clearly, we should not overlook the adolescent years as a good time for learning and growth.

References

Bruer, John. (1997, November) Education and the brain: A bridge too far. Educational Researcher, 26, (8) 4-16.

Greenleaf, Robert K. (1999, September) It's Never Too Late: What Neuroscience has to Offer High Schools. NASSP Bulletin, 83, (608) 80-89.

Bruer, J.T. (1999, May) In Search of… Brain-based Education. Phi Delta Kappan, 80, (9).

Greenleaf, Robert K. (2000, May/June) Developing Language: The Science Behind Learning to Read. American Language Review, pp. 32-33.

Greenleaf, Robert K. & Park, Jeffrey L. (2001, May/June) The bilingual brain. American Language Review, p.36.

Chugani, H.T., Phelps, M.E., & Mazziotta, J.C. (1987) Positron emission tomography study of human brain function development. Annals of Neurology, 22, 487-97.

Society for Neuroscience (n.d.) Brain briefings [Online]. Washington D.C. Author. Available: www.sfn.org/briefings

Johnson, J., & Newport, E. (1991) Critical period effects on universal properties. Cognition, 39, 215.

Greenleaf, R. K.. “Brain-based teaching: Building excitement for learning.” Self-published. For information write: greenleaflearning@cox.net or Greenleaf Learning, 34 Raymond Drive, Narragansett, RI 02882.

Vedantuam, S. Science's new leap: Teenage minds. (2001, June 10) The Washington Post.