

The Learning Vaccine

We sit at the dawn of a new healthcare where lifestyle emerges as fundamental and where the human brain shall open new vistas for human potential and longevity. Lifestyle entails both opportunity and responsibility as our longevity and health can be affected by how we live. Behaviors such as exercise, proper diet, spirituality, maintaining role and purpose, and medical compliance are examples of healthy lifestyle behaviors.

Perhaps our greatest challenge for health and longevity deals with the human brain. How do we nurture, develop, and maintain a healthy brain across the lifespan? The United States has accomplished much regarding cardiovascular health. Our society has welcomed changes in diet, exercise, and stress reduction to assist in slowing the upward trends of cardiac disease. The time has come for a similar national agenda dedicated to the health of the human brain.

Three lines of research (see below) have produced a new understanding and opportunity for proactive brain health, thereby potentially reducing risk for late life neurodegenerative disease. One of the behaviors contributing positively to brain health is **learning**.

In a series of articles published in *Responses to an Aging Florida* (Fall, 1999), *LifeTimes* (July, 2001) and presented to *The Learning Development Institute* (1999) and to the Annual Conference of the American Society on Aging (2000; 2001), Nussbaum has proposed learning as a proactive health-promoting behavior that might limit development of neurodegenerative diseases late in life. Within this conceptual framework, our educational system and ancillary arenas of learning (i.e., libraries and lifelong learning programs) were proposed as “wellness centers” for brain health in the 21st century.

I now propose further that the physiological and psychological aspects of learning actually represent a potential vaccination against late-life neurodegenerative diseases of the brain.

Alzheimer’s disease (AD) is a classic example of a late-life progressive brain disease affecting nearly four million Americans over the age of 65. Much research is ongoing to slow and even cure the disease. Unfortunately, very little work is focused on lifestyle behaviors (i.e. learning) that might minimize the risk of developing AD and other dementias.

Rats and Environmental Enrichment

Research by leading neuroscientists has triggered new ideas of brain function and potential. Marion Diamond and Janet Hopson (1999) wrote a book entitled “Magic Trees of the Mind” in which they describe the positive relationship between an enriched environment and brain development in rats. A recent study by Erickson and colleagues (1998) published in *Nature Medicine*, found the human brain has a similar capacity to regenerate neurons in the hippocampus, precisely the same brain region found for rats. The hippocampus is the primary structure for learning.

Education, Occupation, Socialization and Dementia

Multiple studies have discovered an inverse relationship between number of years of education and risk of AD. This finding has been explained by Albert (1995) in the *Journal, Annals of Epidemiology* and by Stern (1995) in an article published in *Journal of the American Medical Association*. Further, Christensen & Mackinnon (1998) published a paper in *British Geriatrics Society* that found a similar inverse relationship between enhanced level of occupation and reduced risk of AD in late life.

Taken together, these and other studies support the finding of a direct relationship between our environment and our brain integrity. More specifically, as Diamond and Hopson articulated in their text, the more enriched and stimulating the environment, the greater the likelihood for brain development and neuronal growth. Our continued involvement in education and our rise in occupational status necessitate a greater challenge to our brains.

If the environment were important to our brain development, timing of such environmental stimulation would seem important. As Ronald Kotulak described in his 1997 book entitled "Inside the Brain," a critical period for brain development is childhood. A recent study (Rapoport & Giedd, 1999) published in *Nature Neuroscience*, however indicates the human brain continues to develop beyond the second decade of life. Environmental stimulation therefore may indeed enrich the human brain across the lifespan, and help to explain creativity in advanced age.

Despite the wonderful opportunities raised by the prospect of lifespan brain enrichment, our early years may indeed represent a critical time for inoculation against late-life dementia. Studies by Snowdon in the *Journal of the American Medical Association* in 1996 and 1997 support the potential power of maintained mental stimulation against AD. Further, and perhaps most interesting is the finding that linguistic ability of young women around the age of 20 correlated significantly with the presence of autopsy-based neuropathological markers of AD in their brains. Reduced language capacity in early life, therefore, may represent a type of risk factor for later development of dementia.

Linda Acredolo, psychologist at the University of California Davis, found that teaching American Sign Language (ASL) to hearing babies' results in increased IQ scores two years later when compared to controls. As higher IQ scores in early life relates to lower risk for dementia in late life, ASL would seem to be an important part of the learning vaccine.

Early life environmental influence on neurodegenerative disease in late life gained additional support from Mocieri in her 2000 publication in *Neurology*. Poverty in childhood was found to be a risk factor for late life dementia. Other recent work by Whalley and colleagues published in *Neurology*, 2000 and by Starr and colleagues (*Age and Ageing*, 2000) supports the importance of early childhood mental abilities as protective to late life dementia. Similar to Diamond's work that found minimal brain development in rats raised in sterile cages without environmental enrichment, children raised in poverty without resources or without adequate mental stimulation may incur dementia later in life.

Finally, Katzman published a relatively bold 1995 study in American Geriatrics Society that found certain activities such as travel, gardening, and knitting may delay onset of dementia. Each of these activities necessitate new learning and planning, particularly travel where presumably one is exposed to a constantly new environment.

In contrast to the positive effects of maintaining mental stimulation from an enriched environment, Bassuk and colleagues published a 1999 paper in *Annals of Internal Medicine* that demonstrated a relationship between social disengagement and cognitive decline in older community dwelling persons. Similarly, Friedland and colleagues published a 2001 article in *Proceedings of the New York Academy of Sciences* that found development of Alzheimer's late in life may be related to the diversity of activities and intensity of intellectually challenging activities in young adulthood (age 20-60).

These and other interesting studies permit a potential application of findings towards practical brain-health promotion for the human being. My ideas regarding such applications are being prepared in a book to be published by the American Psychological Association in late 2002. At present, active learning from lifespan mental stimulation appears to offer a vaccination against neurodegeneration. The following principles of the learning vaccine are offered:

1. Learning, as a physiological and psychological event, must now be considered a health promoting behavior, "the learning vaccine."
2. The learning vaccine should be initiated as early in life as possible. Language, via American Sign Language, can be taught to children prior to their ability to speak. This will nurture the language neural system and enhance IQ.
3. Language itself seems to represent a far greater asset to the human brain than perhaps previously considered. Snowdon's work supports the significant value of early linguistic acumen. Language may gain additional import when we consider the fact that humans are the only animals who get AD. Could the sophistication of our language system and our unique vulnerability to AD have some connection?
4. The learning vaccine deserves a national prioritization, initiated early in life and supported throughout the lifespan. Our educational system can be re-cast away from a setting where children attend school simply to receive a diploma. Indeed, the schools of our country represent true wellness centers for neuronal development. They are the direct masseuse to our brain and therefore should play a major role in our health system.
5. A team of teachers, neuroscientists, language specialists, etc should develop "brain development" curriculum in the school system. Schools should have ready access to advanced neuroimaging procedures for use in measuring brain response in students to learning approaches and curriculum design. As Murray pointed out in an article

published in the 2000 Monitor from American Psychological Association, it is time to go “from the brain scan to the lesson plan.”

6. Brain health mandates a lifespan approach, much the way “aging” demands it. There is no artificial age threshold. We must reinforce a continuity of learning opportunities. Lifelong learning should represent a mantra supported and reinforced on a national level. Many great lifelong learning programs already exist, yet they could be enhanced if such learning could be shown to enhance health and reduce neurodegenerative disease.
7. The older brain requires environmental enrichment, perhaps as much as any age cohort. Approached from a health and wellness perspective, social integration is indicated. As such, retirement is a direct contradiction to brain enrichment and I would argue for its collapse. Our country adheres to invalid age thresholds for outdated social policy and we would be wise to implement 21st century policy focused on health promotion.
8. Learning has been proposed as a significant lifestyle for overall health and brain wellness. As such, learning should be included as a standard part of any existing health promotion program in this country. Further, such learning should be included as part of all federal and private health care payment systems. Payment for such learning behavior should occur across the entire lifespan with specific curriculum developed and implemented to match the progressive development of the human brain. Measures of outcome could be established, one being a reduction in health care utilization for dementia care late in life.