

Driscoll Chapter 8

The Biological Bases of Learning and Memory

1. Introduction

- One could easily reduce this chapter to the banal notion of nature vs. nurture. But this is an important question; how much affect can educators' have vs. what is determined by birth? For years psychologists have spoken in terms of the IQ (intelligence quotient) or in more general terms such as "talented" or "gifted." All of these imply preexisting conditions inherent in the individual's brain.
- So this is a profound question for educators. How much effect can we have, and at what stages of life? To what extent is learning governed by biology? This chapter is an exploration of two possible answers - evolution and neurophysiology. The latter is a constant changing and intriguing field.

2. Terms to Know

- Plasticity
- Genetic evolution
- Algorithms
- Engram

3. Comments

- Ultimate causes: Evolution and Behavior
 - Behavior may be explained by the evolution of the brain. A couple of interesting points brought out are:
 - Most evolution took place before civilizations
 - The search in this area is for specialized instructions for evolutionary adaptation. These are not general, but direct responses to a specific problem that resulted in natural selection.
- Evolution and Conditioning
 - Skinner immediately comes to my mind when discussing biology. Yet this field also contains a criticism of one of his tenets, that learning was trans-species.
 - Read and understand the evidence that both classical and operant conditioning may be influenced by biology.

- Evolution and Cognition
 - Darwinian algorithms are those mechanisms that describe how the neural architecture has adapted cognition to specific learning tasks over time.
 - There are ties in this area to Piaget's ideas, in that both describe an adaption to environment and creation of an environment.
- Implications for Learning and Instruction
 - Review Table 8.1 on page 271
 - Genetic history and environmental stimuli are factors in learning
 - Genes control the mechanisms while environment makes the choices
 - Rapidly changing environmental change is outpacing our biological adaptation to it. (This is a very interesting point!)
 - This view would favor more group participation over individual competition.
- Proximate Causes: Neurophysiology of Learning
 - This part deals with questions of how memory works and how the brain is localized in function (mapped).
 - Neural architecture in learning
 - Discussion of where processes are located and how learning results in new synapses
 - Cerebral Localization and the Search of the Engram
 - Early searches in this area were concerned with information storage.
 - Gall made an early attempt by positing different locations of certain emotions
 - Engram - trace in trance storing memory
 - Follow the discussion of localization vs. generality of brain function
 - Hebb's cell assembly distributes memory in a web of neurons that participate in more than one memory. They are seen to be widely spaced in the brain.
- Attention and the Brain
 - Attention = selectivity and ultimately leads to automaticity
 - Selectivity is
 - a state
 - a resource
 - a process

- Attention is the capacity to selectively allocate more attention to one particular event of several competing events.
- A lack of ability in this area is called (these days) Attention Deficit Disorder (ADD), and is treated with drugs.
- Attentional States
 - Like many issues, there is a reliance upon studies of damaged brains to point out what takes place in certain areas. If a person with localized brain damage cannot perform some function, that function is felt to reside in that area. Oliver Sack's book "The Man Who Mistook His Wife for a Hat" is a popular discussion of this phenomenon. The title is a complete description of one case.
 - Damage shows specific task attention loss.
 - Hyperactivity and schizophrenia are less localized damages, and manifest themselves throughout behavior.
 - Again, drugs can be administered in many of these cases.
- Allocation of Attentional Resources
 - This area depends upon the capacity of the brain to store. The "blooming, buzzing confusion" of reality cannot simultaneously be attended to, so theorists look for ways to describe capacities and locations of attention.
 - It is in capacity that we start to locate concepts such as "gifted" and "talented"
 - This is the evolutionary ability to filter stimulus. It may be a foundational adaptation for survival, as the humorous example of the flying brick illustrates.
- Selectively Organized Attention
 - By selectively processing certain information, individuals are consciously directing their attentional resources. They are intentionally organizing attention.
 - The example of an orchestra member playing in tune illustrates how a musician must have the capacity to process qualities of sound, and be able to concentrate on certain qualities of that sound (tuning) to perform well.
 - Dyslexia seems to be a lack of ability in this area and is studied with brain pattern measures. but this may not be user.
- Learning, Memory and the Brain
 - This is an emerging field of great current interest.

- Types of Memory Systems
 - There exist many different memory systems that process different types of information through differing operations.
 - Again, much of the work in this area draws on damaged brains as comparison devices, as in H.M.
 - This case shows that there are different systems, some intact and some not in the case of H.M. See table 8.2 on page 284
 - Again, the entire brain is seen to participate in memory, but different systems contribute in different ways.
- Biological basis for Language Learning
 - This is an alternative method of study to brain-damage
 - The question here is if language skills are evolved and species-specific
 - Chomsky and Lenneberg argue for a universal and irrepressible facility for language acquisition
 - Evidence for this claim of biological basis includes
 - Acquisition of language is essentially the same across cultures
 - Children do not copy, but make rule mistakes. My 3 year old son is now saying he “hitted” the ball, which is grammatically incorrect yet makes sense according to an abstract rule.
 - Children understand language structure early on.
 - Age may be seen as a limiting feature. Adults seem to learn language less well than children.
 - There are many differences in how the brain seems to deal with language, meaning there is still much to be learned.
 - Note that Chomsky’s account of “universal” language capacity is currently being criticized.
- Cognitive Development and the Brain
 - Fixed Circuitry and Critical Periods
 - This area has two ramifications. One is the ability to recover from injury, and looks at the extent to which the brain can heal. Also in this area, there is the attraction that if we can see how fixed patterns are in the brain, we can better help those with learning disabilities.
 - Critical Periods is kind of a hot topic. We are guided by a lot of educational policy based upon the idea that childhood is a critical period for brain development. Head Start is based on this premise, for instance. You can

see that this assumption is not universally accepted, and current research is questioning it more.

- Plasticity
 - If not fixed circuitry, then there is the notion of plasticity. Do what degree can the brain change through life. Apparently quite a bit.
 - Again, the recovery from injury is important here. There is increasing evidence that sever damage can be overcome through a “re-wiring” of functions to different parts of the brain.
- Modularity
 - This is where the multiple-intelligences argument is located. Gardner feels that there is an ability to develop each of several separately located “intelligences” that together make up the brain. To me this is similar to the different kinds of memory discussed above.
- Implications of neurophysiology for Learning and Instruction
 - So after all this, what does neurophysiology have to contribute to education?
 - Modularity and “Brain-Based” Curricula
 - Gardner made the point that schools are aimed at only one or two cognitive functions. As educators we need to account for all of the brain’s intelligences in some way. Certainly a system of education that only rewards logical - verbal behavior is unfair to those with less capacity in those areas.
 - The notion of a “brain-based” curriculum is quite premature. An early example of this futility is found in the “right-brain, left-brain” notion that led to attempts to educate both sides. This right-left metaphor has proven extremely weak, and the resulting work was just plain silly.
 - Environments, Periods and Plasticity
 - I have to smile about the increase of rigidity after early childhood. I’m trying to get my 3 year old to eat foods he loved as a baby, but there is a definite change in acceptance. We are now pruned down to fish sticks and ketchup.
 - There seem to be certain periods that offer opportunity for rich educational growth. This seems true especially in early development, where challenging environments can be correlated to later performance.
- Language Learning
 - This would encourage language training to take into account the cultural background of students. Their speech patterns are not “wrong”, just different. Teaching a standard language needs to flow from this understanding.

- Background will be reflected in student difficulties in later problems
- Learning Disabilities and their Treatment
 - Disabilities may not be as unchangeable as we think. Certainly and understanding of plasticity would help encourage persistence in treatment.
 - This study can show that brain differences are not necessarily defects. Reconsideration of educational programs can be effective.