Historical Roots

By Richard H. Hall, 1998

Philosophical Roots of Neuroscience

In every day life we often make the distinction between our "mind" and our "body". For example this morning you may have had trouble making yourself get up. This common notion implies two entities: "you", that had trouble, and "you" that was hard to get up. The first is analogous to the mind in the classic "mind/body" distinction, and the second is the "body". The mind in this case is an intangible, non-physical object representing your consciousness and free will, while the body is a purely physical object that lays in bed at the mercy of what your mind eventually decides to do with it. Little did you know when you were having trouble getting out of bed that your thoughts on the matter were illustrative of this profound philosophical issue that has baffled psychologists and philosophers for centuries.

The idea that the mind and body can viewed as independent is a position that is not only quite intuitive, but it is a position that has been supported by philosophers for years. For example, Rene' Descartes, the seventeenth century French Philosopher believed that the mind was inherently human, spiritual, and unknowable (could not be examined through the scientific method). While the body was physical, and was subject to laws of science. Descarte's position that the mind and body are separate entities is known as **Dualism**.

Most contemporary Neuroscientists, on the other hand, can be considered **Monists**. Monism is the assumption that both the "mind" and the "body" are both parts of one physical system, and, that the "mind" is simply a product of the brain. (Figure 1 illustrates the characteristics of mind and body, and the relationship to the monist and dualist philosophies). This may seem difficult to accept when it is so useful for us in our everyday life to suggest that there is a separation between the mental and the physical, but Neuroscientists point to several areas of evidence to support this assumption. First, cases of brain damage indicate that some of the highest level "human" types of processes, such as conscious awareness can be affected by damage to certain areas of the brain. Second, there is more and more evidence that non-human animals are capable of cognitive processes that were originally thought to be properties of the mind; by definition, an inherently human phenomenon. Third, simulation and artificial intelligence researchers have found that many human types of phenomena can be simulated to an extent to which a real human can not tell the difference between the computer and another human.

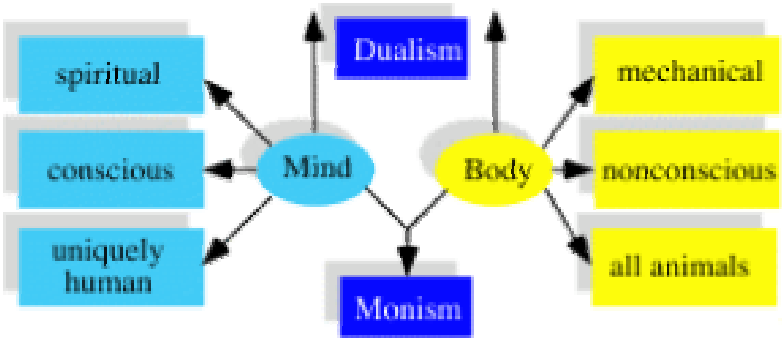

Figure 1. Monism vs Dualism

On the dualist side of this debate it is important to point out that there are many complex forms of human behavior for which scientists have not been able to find the physiological correlates. In fact, we are just beginning to understand how simple processes, such as the recognition of a face, are processed in the brain. Perhaps the most important point, for our purposes, is to note that contemporary Neuroscientists, and your text, and this course are based on the underlying assumption that psychological processes are represented in the nervous system. While philosophers will continue to debate whether or not there is a non-physical, unknowable entity above and beyond the nervous system that impacts our behavior and experience, no one could argue that there are many, many psychological factors for which neural correlates have been found, and the list is growing every day.

Biological Roots of Neuroscience

As your book notes, Descartes was not only a well know Dualist, but he was also one of the first to view the body as a machine, subject to natural laws. Not long after Descartes a series of researchers began to test his assumptions about how a mechanical message moved through the body, the conclusion being that the body's communication system was made up of connected pathways "nerve cells", and that they communicated via electrical messages. The building block of this system, the neuron, will serve as the starting point for our discussion of the nervous system in future modules.

A second, and fundamental, discovery about the nervous system was made soon after the basic properties of nerve communication were uncovered and this involved the division of responsibilities among the various parts of the nervous system. This issue is central to the study of the relationship between biology and behavior/perception in that our psychological experience is multifaceted, yet the body's communication all runs via one basic system, the neuron, the nerve pathway, and an electrical signal. This brings up questions such as the following: "How are we able to differentiate a visual experience from an auditory one?" The term **specificity of function** is often used to describe the answer to this question. Different parts of the nervous system, and different parts of the brain have specific functions. This is not to say that they don't interact and are not interconnected in many complex ways. But it is to say that differences in experience are associated with physically different locations within the nervous system. The point is that, for the most part, neurons all carry the same type of electrical signal, and the reason

that they create different experiences is because they are located in different pathways and go to different places. Much as the same electricity that powers your TV can also power your computer or microwave oven. In fact, as we'll see, sometimes the system gets confused because of this similarity among signals. You can demonstrate this simply by closing your eye and gently pushing on your eyelid. You "see" a light when you do this, but the fact is that the actual stimulus was tactile (touch). You have, in effect, "tricked" you brain, by taking advantage of the fact that nerves in both visual and tactile pathways carry the same type of basic signal. (Figure 2 illustrates this "illusion")

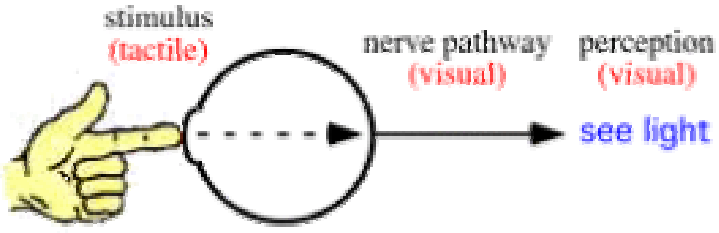

Figure 2. The tactile/eye "illusion"

Neuroscience Today

Neuroscience today is very much an extension of it's philosophic and biological roots. The basic assumption that behavior and mental processes are represented in the nervous system guides most research in the field today. This research, which reveals a more complete picture of the conduction of the neural message, still supports the basic notion that the signal is largely electrical in nature, and that specific nerve pathways, and brain areas, serve specific functions.

Another factor, which has remained constant since at least the time of the German physiologist, Johannes Muller, is that research in neuroscience has rested firmly on the scientific method. Neuroscientists rely on empirical data to draw conclusions about the relationship between biological processes and overt behavior and mental processes. In order for data to be considered empirical they have to meet two basic criteria. First, they have to be experienced through one or more of the senses. Second, there has to be consensus/agreement among observers as to what has occurred. This is the fundamental characteristic at the heart of scientific research. The nature of these empirical data and psychological processes can often be complex and illusive, but the importance of empirical observation remains constant in all neuroscience research.