# Functional Specialization of Cerebral Hemispheres



### 1981 Nobel Prize Medicine (Part 2)

In 1981 Roger Sperry was recognized as a co-recipient of the Nobel Prize in Physiology or Medicine for his seminal discoveries concerning the functional specialization of cerebral hemispheres.

The research conducted by Sperry was definitely the most fascinating chapter in the history of brain research. He was able to provide profound insights into the specialized functions of the two cerebral hemispheres. Sperry showed that despite the similarities in the anatomic structures of the two hemispheres, their corresponding functions are very distinct and unique. His research also demonstrated the great importance of the structure that links the two cerebral hemispheres.

Read about Nobel Prize Medicine 1981, Part 1: The Visual System

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## Background

The workings of the human brain have been one of the most fascinating enigmas in the field of research. Can

you imagine how difficult it is to study the functions of the brain? It is the most protected organ in our body; no other vital organ is completely covered by a set of protective bones. Its functions are almost limitless. Unlike any other organ in the body, the brain is responsible for all the processes that take place within an organism.

It was known that the brain is composed of two structurally identical halves or hemispheres. Scientists also knew that the two hemispheres of the brain perform different tasks despite their structural similarities. These two hemispheres are connected by millions of nervefibers collectively known as corpus callosum. It is much like a bridge connecting two islands; allowing traffic from one island to reach the other island; allowing information from the left hemisphere to reach the right hemisphere and vice versa.

Scientists have not succumbed to the challenges of studying the functional specialization of cerebral hemispheres. As early as the 1860's, Broca was able to identify a small part in the left cerebral hemisphere that was responsible for speech. In the 1940's, Penfield and Jasper introduced the concept of contralateral motor innervations wherein movements of the left side of the body are controlled by the right cerebral hemisphere and the movements of the right side of the body are controlled by the left hemisphere.

Because of these discoveries, scientists thought that the left hemisphere is the dominant hemisphere; the left hemisphere is responsible for speech and since most of us are right-handed, then the left hemisphere controls our dominant hand. This notion of having a “dominant” hemisphere changed when Sperry published his findings in his split-brain studies.

# The Winner

Roger W. Sperry was born on the 20th of August 1913 in Hartford, Connecticut. His father was in banking and his mother was trained in business school. He received early schooling from Elmwood, Connecticut and William Hall High School in West Hartford, Connecticut. He received a 4-year Amos C. Miller scholarship and attended Oberlin College. He received his AB in English in 1935 and studied two more years for an MA in Psychology. He then switched to zoology for his Ph.D. work under Paul Weiss at University of Chicago which he finished in 1941. He then conducted a postdoctoral research as a National Research Council Fellow at Harvard University under Professor Karl S. Lashley.

# The Discovery

Sperry started his work on cerebral functions in the 1950's with experimental studies in animals. Sperry severed the corpus callosum, the connection between the two cerebral hemispheres, of monkeys and noticed that the hemispheres retained their ability to learn and function independently but the two halves could not communicate or access the information stored in the opposite half. His next step was to test his findings in human subjects, but he had no volunteers.

He learned that in the 1940's, severe cases of epilepsy were treated by surgically severing the corpus callosum, a surgical technique called commissurotomy; the corpus callosum is also referred to as cerebral commissure. Patients who underwent commissurotomy showed reduced seizure frequency and severity with very little effect on the patient’s behaviour and ability to learn. These patients were the perfect subjects for Sperry’s further investigation on the functional specialization of cerebral hemispheres and brain function [1].

Ten commissurotomy patients underwent his split-brain experiment. First, he asked patients to look at the center of a screen or a piece of paper with one eye at a time. Images or words are presented to one eye, hence, one hemisphere at a time. If the stimulus is presented to the left eye, only the right hemisphere can process the stimulus. On the other hand, if the stimulus is presented to the right eye, only the left hemisphere can process the image.

Sperry found that if a word is presented to the left hemisphere, the patient can easily read the word but if the same word was presented to the right hemisphere, the patient cannot read the word but understands the meaning or context of the word. Similarly, if an image of an object was presented to the left hemisphere, the patient can name the object but if the same image was presented to the right hemisphere, the patient cannot communicate what the object is but can select the corresponding object from a set of different objects placed in front of him.

Due to these findings he concluded that the left hemisphere is responsible for reading and naming object while the right hemisphere is responsible for understanding the meaning and context of the words and objects.

Furthermore, he also found that the isolated left hemisphere can perform calculations easily while an isolated right hemisphere can only perform simple addition up to the number 20.

All in all, Sperry found that the left hemisphere is concerned with speech, writing, abstract thinking, symbolic relationships, temporal relationships, leading hemisphere in control of nervous system and calculations.

On the other hand, the right hemisphere is responsible for concrete thinking, spatial relationships, comprehension of complex relationships, word comprehension, facial recognition, interpreting auditory stimuli, space perception, reproducing three-dimensional pictures, intuition and higher brain functions. The right brain is essentially mute since it can only feel, process and understand but cannot communicate those thoughts while the left brain is the expressive brain capable of communicating with the environment.

# Significance

The work of Sperry proved to be an inspiration to many new scientists. His discoveries sparked a movement in cognitive science and triggered more researches to be conducted aiming to uncover the higher functions of the brain.

With the advent of more sophisticated brain imaging techniques, it is now easier to localize brain functions. Scientists used cerebral blood flow to identify regions of the brain responsible for different cognitive tasks. Scientists can now easily monitor the cerebral blood flow in all parts of the brain. Since we know that after eating a meal, most of our blood is directed to our GI system and in times of emergencies, our blood is directed to our muscles. This means that the more work a region of our body does, the more blood is delivered to it.

Applying this same logic to our brain, if a patient is asked to move his right leg, the region of the brain with a significant increase in blood flow during the course of the movement is responsible for the control of that movement. By the use of this method, most of our functions are now localized to a certain region or groups of regions in our brain.

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**Links**
[1] http://en.wikipedia.org/wiki/Lateralization_of_brain_function