

## Medicine in Stamps

# Ivan Petrovich Pavlov (1849-1936): conditioned reflexes

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**P**avlov is famous for demonstrating that once conditioned, a dog's digestive system can respond to the simple ringing of a bell without the actual introduction of food. The phenomenon was termed conditioned reflex, and it won for this Russian physiologist the Nobel Prize in 1904. Secrecy and poor communication led to his premature obituary in the Western media in 1916. Pavlov, in fact, worked on for an additional twenty years as one of the Soviet Union's leading scientists.

**EARLY INFLUENCES** Ivan Petrovich Pavlov was born in Ryazan, Russia, on September 14, 1849. He was the eldest of eleven children, six of whom died in childhood of infectious diseases. At the age of nine, Pavlov fell from the top of a fence onto a brick pavement, striking his head and causing him to miss a year of school. This did not deter the young man from pursuing an illustrious career in science. He initially entered the seminary, but after reading British scientist, George Henry Lewes's book, *Physiology of Everyday Life*, he enrolled in the University of St. Petersburg to pursue courses in chemistry and physiology. He then studied medicine at the Imperial Medical Academy, and trained in research in Germany under Carl Ludwig, a cardiovascular physiologist and Rudolf Heidenhain, a gastrointestinal physiologist. Pavlov was most influenced by Ivan Sechenov, the father of Russian physiology, whose book, *Reflexes of the Brain*, theorised that reflexes were a result of the environment, which ultimately controlled both conscious and unconscious actions. This led Pavlov to his landmark studies and subsequent elucidation of the conditioned reflex.

**NOBEL WORK** Pavlov is best known for his dog experiments. To determine whether physiological

functions, such as the secretion of digestive juices, could be "learned," he created an animal model by surgically severing the esophagus and exteriorising both ends, in effect creating two fistulas. In this manner, the secretions of the stomach could be collected and measured without oral contamination. In this model, Pavlov found that the stomach began secreting gastric juice with placement of food in the dog's mouth. More importantly, Pavlov noted that gastric secretion was activated when the animal was conditioned by certain stimuli, such as the smell of food. In his most famous experiment, he rang a bell whenever a dog was given food. After being trained in this manner (conditioned), the animal was found to secrete digestive juices simply upon hearing the bell, even though it was given no food. Thus, he was able to distinguish two types of reflexes – inborn and learned reflexes. Inborn reflexes were controlled in the spinal cord and brainstem, whereas learned reflexes were controlled in the cerebral cortex. Pavlov demonstrated that learned reflexes could be abolished if the stimulus was inconsistent or not reinforced. For this novel work on the physiology of digestion, he was awarded the 1904 Nobel Prize in Physiology/Medicine.



Pavlov had many admirers, perhaps none greater than the famed American behavioral psychologist, B F Skinner, who first met Pavlov at Harvard during the International Congress of Physiology in 1929. Skinner adored the man for his emphasis on careful experimental conditions and his meticulous gathering of data (to wit: "On December 15, 1911, at exactly 1.55 in the afternoon, a dog secreted nine drops of saliva"). Another admirer was English science-fiction author, H G Wells, who stated that he would unhesitatingly choose to throw a life preserver to a drowning Pavlov over playwright George Bernard Shaw, as Pavlov "is a star which lights the world, shining above a vista hitherto unexplored."

**PERSONAL AND FAMILY LIFE** In 1881, at age 32, Pavlov married a teacher, Seraphima Karchevskaya, who was the daughter of a doctor. They had five children; four sons (one of whom died) and a daughter. Money problems plagued Pavlov and his family. Early in his marriage, he and his wife lived in an empty room in his younger brother's house. At one point, he had to leave his family to live with a friend, Dr. Simanovski. Because Pavlov cared little for material things, he was able to weather his financial plight. One of his pupils recalled: "We, Pavlov's pupils, knowing of his financial straits, thought of a way to help him. We invited him to deliver to us a course of lectures on the innervation of the heart, and clubbing together to raise some money, we handed it over to him, pretending that this was to defray the expenses of the course. But we did not gain our end. He used the entire sum to buy animals for these lectures and nothing was left for himself."

Leading a regimented life, Pavlov was punctual to a fault. He was said to arise at 6 am each morning, walked the three miles to his laboratory, had dinner at 6 pm, tea at 9.30 pm, and then worked until bedtime at 1 am. He was also an impatient man. For example, he considered three minutes in a barber's chair a waste of time (which may explain the luxurious beard he wore). And his scientific creativity contrasted with his everyday helplessness. His doting wife thought, for example, that he was quite incapable of purchasing a suit or a railroad ticket by himself.

**POLITICS** The political environment in Russia changed dramatically with the Revolution in 1919, and Pavlov often spoke out against the new communist government. In 1922, he unsuccessfully requested permission to move his laboratory overseas. Lenin felt the Soviet Union had a need for scientists, and believed that Pavlov's research efforts were important and meaningful to the proletariat. The following year, Pavlov made a trip to the United States. Upon his return, he publicly denounced communism saying, "For the kind of social experiment that you are making, I would not sacrifice a frog's hind legs." Later, however, his views toward communism softened as he continued to receive research funding from the Communist Party. This support for

Pavlov and other scientists allowed the Soviet Union to achieve world prominence in the area of physiology and behavioural research. In 1935, for example, the prestigious International Physiological Congress was held in Leningrad.

**HEALTH** Pavlov suffered from gallstones. His wife wrote of "severe chills . . . usually after dinner, and were accompanied by pains in the stomach; we relieved him with a hot-water bottle but the chills continued for an hour or an hour and a half." She suggested the problem was his liver, but Pavlov and others thought it was malaria. The correct diagnosis finally surfaced at a surgical convention in Leningrad, when a panel of scientists reviewed his symptoms. Pavlov consented to surgery (he chose a Russian surgeon over the recommended German specialist), and his postoperative course was complicated by pneumonia, from which he recovered. However, a decade later, he would again be stricken by pneumonia, this time succumbing to the infection. He died on February 27, 1936, with colleagues and the Soviet government heaping praise for his scientific contributions. In addition to multiple original articles, Pavlov's work is memorialised in his seminal book, "Conditioned Reflexes." American colleagues founded the Pavlovian Society of North America in his honour, and in 1999, an entire issue of the Russian Journal of Physiology was dedicated to this great scientist on the occasion of the 150th anniversary of his birth.

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Conditioned reflexes and operant responses can be weakened by extinction. Operant behavior maintained by reinforcement can be reduced in frequency by terminating the reinforcement contingency or by delivering reinforcers independently of responses.Â

Physiology of conditioned reflexes forms an objective background for neurofeedback<sup>3</sup>. The experiments on conditioned reflexes were carried out by Ivan Pavlov in the Institute of Experimental Medicine in St. Petersburg. And I suggest the hypothesis that I call Theory Of Pathological Conditioned Reflexes, to explain what is happening in the body when a disease appear and disappear during stimulation of the reticular formation through the trapezius muscle.Â Thus new reflex arcs and new reflexes are formed, though they are not formed out of the blue, they are formed at the expense of existing normal, genetically inherited ones. Conditional reflexes are helpers of an organism, allowing it to react quickly to any changes and adapt to them. History. The idea of a conditioned reflex was first put forward French philosopher and scientist R. Descartes. Somewhat later, the Russian physiologist I. Sechenov created and experimentally proved a new theory concerning the reactions of the organism. For the first time in the the Conditioned reflex " led now the separate physiological term designating a certain nervous phenomenon, detailed studying to-rogo to formation of new department in zoophysiology " physiology of higher nervous activity (see) as chapter 1 of physiology of the highest department of the central nervous system. For a long time empirical and scientific observations collected that the bruise or a disease of a brain and specially big hemispheres caused disturbance of the highest, most difficult behavior of (Return to index). Conditioned reflexes: an investigation of the physiological activity of the cerebral cortex. By Ivan P. Pavlov(1927) Translated by G. V. Anrep (1927). [Classics Editor's note: Pavlov used both square and round brackets in his texts.