Due to his industrious studies on classical conditioning, Ivan P. Pavlov (1849–1936) is considered one of the most prominent researchers in psychology. He was born in Ryazan, Russia, a small village where his father was the local priest. Although initially interested in theology and considering following in his father's footsteps, Pavlov was heavily influenced by Charles Darwin's *On the Origin of Species*, which contributed to his shift in vocation and dedication to the study of science instead of religion. Pavlov studied medicine at the University of Saint Petersburg in Russia, where he received his doctorate in medicine and then traveled to Germany to continue specializing in physiology. During his early work, he focused on the study of the digestive system, which earned him the Nobel Prize in Physiology or Medicine in 1904.

During Pavlov's research on the physiology of gastric and salivary glands in dogs, he and his colleagues noticed that secretion of saliva may be induced not only in response to food but also due to psychic causes, as the salivary glands would often activate at seemingly unnecessary times. Pavlov concluded from his experiments that this psychic activity allowed organisms to differentially respond to stimulation from the environment and to adapt to it.

Pavlov demonstrated this in one of his many experiments. When a stimulus such as food is placed in the mouth of most mammals, salivation is a naturally occurring (or unconditioned) response to such stimulation. Additionally, if Pavlov's dogs had experienced presentations of the food stimulus preceded by another stimulus that initially did not produce salivation (e.g., the ring of a bell), this initially neutral stimulus came to elicit the salivation response by itself. The neutral stimulus had become a conditioned stimulus. In other words, Pavlov identified what is now called classical or Pavlovian conditioning, a learning mechanism that is at the basis of many behaviors beyond gland secretions or other reflexive actions, including emotional reactions and normal and abnormal behavior. Classical conditioning is one of the principal theories used in behavioral modification, which is applied in various clinical settings (e.g., exposure therapy). Moreover, Pavlovian conditioning is thought today to be an adaptive tool that helps organisms regulate themselves by recognizing the causal and predictive relationships between events.

Based on the path of his discoveries regarding classical conditioning in glands and the ideas proposed by the illustrious Russian physiologist Ivan Sechenov in *Reflexes of the Brain*, which posited that the entire behavior of humans may be explained in physiological reflex terms, Pavlov became interested in studying the function of the brain. Pavlov's scientific vision made him think that the acquisition and extinction of conditioned responses was indicative of brain function, which resulted from the interaction between organisms and the environment. Specifically, Pavlov's studies led him to suspect that excitatory processes in the brain result in the acquisition of conditioned responses, whereas inhibitory processes are responsible for the extinction of conditioned responses (i.e., a phenomenon in which presenting a conditioned stimulus by itself after a conditioned response was acquired results in the attenuation or elimination of such a response; e.g., Pavlov observed that after presenting the bell repeatedly without food, the dog no longer salivated). Interestingly, Pavlov thought that abnormal behavior, such as the ones he observed in neurotic and psychotic patients, was due to a conflict...
between these inhibitory and excitatory processes.

The initial evidence of the role of classical conditioning in the development of abnormal behavior came from Pavlov's studies on experimental neuroses. Again using dogs as experimental subject, Pavlov and colleagues assessed whether neurotic behavior could be induced and then treated. Dogs were trained to discriminate between a circle associated with food, which provoked a conditioned excitatory salivary response, and an ellipse associated with the absence of food, which provoked the inhibition of such a response. The dogs easily learned this discrimination, as evidenced by the amount of salivary secretions evoked by the respective stimuli. The response was higher to the circle relative to the ellipse. Of importance, training of the discrimination was then manipulated to become increasingly more difficult by making the ellipse more circular on successive trials. Eventually, the ellipse and the circle were hardly able to be differentiated by the dog, which was unable to respond appropriately to the task. The procedure had apparently generated a direct conflict between inhibitory and excitatory processes. Furthermore, a once peaceful dog became highly excitable, aggressive, and showed erratic behavior as well as other emotional responses indicative of distress.

Pavlov's curiosity in psychopathology did not stop at identifying a potential source of experimental neurosis but continued on with the intent to give treatment to neurotic dogs. Interestingly, similar efforts to induce neurosis were replicated by one of Pavlov's students with children who were trained to master increasingly difficult levels of discrimination between two sounds until they had difficulty discriminating, at which point, they showed signs of distress. However, those particular experiments were found to be ineffective in reducing the subjects’ symptoms of the experimentally induced neurosis. Research conducted in Pavlov's laboratory on experimental neurosis is important not only based on the merits of the specific results but also because it illustrated a methodology through which psychopathological causes and treatment could be studied with a high degree of experimental control. Therapeutic approaches that followed Pavlov's research focused on the experimental methods of classical conditioning rather than on the specific underlying neural mechanisms proposed by the physiologist. Pavlov's studies on experimental neurosis were the basis for the use of classical conditioning in psychotherapy (e.g., systematic sensitization).

Pavlov was also a pioneer in linking physiology to individual differences that resulted in personality types. In 1924, during a flood that affected his laboratory, Pavlov noticed that some dogs were frightened, others were excited, and some seemed withdrawn while being rescued from the rising waters. These events, in addition to previous observations of dogs manifesting different personalities regarding aggressiveness and friendliness, inspired Pavlov to investigate individual differences. Pavlov developed rigorous research practices that led him to theorize about nervousness. He hypothesized that individual nervous systems differ in their levels of excitation and inhibition. For him, the baseline levels of excitation and inhibition are individually determined by various physiological variables and therefore result in diverse types of personality. These ideas evolved into the theory of physiological bases of extraversion and introversion elaborated by Hans J. Eysenck and the concept of arousability developed by Jeffry A. Gray.

In Pavlov's diverse research interests, from his research on the physiology of the digestive system to his studies of classical conditioning, psychopathology, and individual differences, we can find a common pattern: All the studies were always conducted with a rigorous methodology, paying extreme attention to detail and empirical control. This might be one of the greatest lessons researchers in psychology learned from Pavlov's work.

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In addition to the Nobel Prize, Pavlov received much academic recognition for his industrious research. He collaborated in the foundation of the Department of Physiology at the Institute of Experimental Medicine, St. Petersburg, Russia, where he used the facilities as the headquarters for his research, mentored several doctoral students, and conducted much of his research. His most important legacy is the discovery of classical conditioning, an important learning mechanism that allows an organism to adapt to a changing environment. The discovery that neurosis can be experimentally induced, and the idea that classical conditioning principles can be involved in its acquisition and potentially in its treatment, set a precedent for the future development of behavior therapy in the 1950s. Even today, the knowledge established by Pavlov has generated a productive line of research and theory regarding classical conditioning in the field of basic learning and behavioral psychology. Pavlov's methods for studying conditioned responses is still used to assess processing of the brain in modern neuroscience, while translational and clinical research based on the principles of classical conditioning is still informing psychotherapeutic approaches, as in the case of exposure therapy. Through his life, Pavlov demonstrated scientific brilliance and a great instinct for research. Affected by pneumonia at the age of 86, Pavlov asked one of his colleagues to record every detail of his passing, a last indication of his dedication to his rigorous and scientific approach to life.

See also Behavior Therapies: Overview; Behavior Therapy; Classical Conditioning; Exposure Therapy; Operant Conditioning; Skinner, B. F.; Systematic Desensitization

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