Ivan Petrovich Pavlov

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Abstract

Ivan P. Pavlov was a Russian physiologist who later discovered psychological concepts and became world renowned for his findings. Born in 1849, his early life consisted of teaching at the Saint Petersburg Military Medical Academy and marrying his wife Seraphima. His main experiments involved collecting gastric juices from dogs to study the digestive system, classical conditioning and conditioned reflexes. He conducted his research on classical conditioning by collecting the saliva of a dog with a fistula and measuring the amount of saliva after certain stimuli were presented to the dog. Most of his conditioning work involved the salivary gland. He received the nobel prize in 1904 for his work on the digestive system. His studies were performed on dogs, who were so well cared for that their health started encouraging and improving all research labs to become more sterile. He passed away in 1936 from pneumonia.

*Keywords*: Classical conditioning, digestive system, conditioned reflexes, noble prize

Ivan Petrovich Pavlov

 Ivan Petrovich Pavlov was not a psychologist, at least according to him. Instead, he was a physiologist, a man who wanted to study the function of living organisms instead of the mind. However, unbeknownst to him, he became one of the most influential psychologists in history by further exploring concepts such as classical conditioning and reflexes. He allowed for learning to be explored and further discovered in a scientific manner (Kimble & Schlesinger, 1985). Pavlov influenced and worked with many, leading a life full of experimentation and excitement.

Behavioral psychology is a branch of psychology that looks mainly at the observable features of the surrounding world. Behavior is described as the way in which an organism acts or responds according to a specific situation. This branch of psychology was most related and intertwined with John B. Watson since he rejected what the structuralists and the functionalists had to say. Behaviorism also became known as S-R psychology, since it had so much to do with stimuli and response (Kimble & Schlesinger, 1985). There are two main categories of behavior: respondent and operant or involuntary and voluntary. Respondent behavior is a response to a specific stimulus within the environment (Pavlov, 1966). A particular stimulus causes the same response to occur. This is commonly shown by the dilation of the pupil when light is shown into it. The response just happens, it is involuntary. Operant behavior occurs spontaneously; the behavior acts upon the environment (Pavlov, 1966). This behavior is shown through every day activities such as walking around and washing cars.

# Early Life

Ivan Pavlov was born on September 26th, 1849 in a small Russian town called Ryazan (Gray, 1979). He grew up in a religious household where his father, Peter Demitrievich Pavlov, was a priest, and attended a seminary at a young age. His father loved to learn and it is believed that Pavlov inherited this trait from him (Babkin, 1949). He attended the University of Saint Petersburg in 1870 and earned his degree by 1875. His degree was in natural history with a specialization in animal physiology. He later enrolled in a medical school to help him with his research in physiology, not to pursue a medical career (Watson, 1963). He became a teacher in 1890 at the Saint Petersburg Military Medical Academy and was the department head of the Institute of Experimental Medicine.

 One of Pavlov’s greatest influences at the University of Saint Petersburg was his physiology professor, IIya Cyon. Pavlov decided to become a physiologist in his third year in school because of Ilya Cyon. Cyon was known for how advanced and accurate his skills were involving surgical methods and Pavlov saw great influence in this. Pavlov even wrote in one of his autobiographies that Cyon was a teacher that could never be forgotten (Babkin, 1949). Pavlov and Cyon seemed to have equal effects on each other because when Pavlov graduated, Cyon offered him an assistant position in his lab at Medico-Chirurgical Academy, which Pavlov graciously accepted. But when Pavlov went to the Academy, Cyon retired and he never fulfilled the assistant position in the laboratory.

 In 1881, Pavlov married Seraphima Vasilievna, which lasted for fifty-six years. Their marriage started out rough because Pavlov was poor and not making a lot of money while working in a laboratory. It is believed that Seraphima’s spirit of self-sacrifice is why their marriage did not fail in those early years. Pavlov and Seraphima’s friendship was enforced by their shared interest in Shakespeare. They were both admirers and were able to discuss Shakespeare with each other, growing closer as time went on. Pavlov proposed to Seraphima on June 13, 1880, right after she had graduated from the Pedagogical Institute. Pavlov went to meet her godfather the day after the proposal and he had nothing but poor words to say about Seraphima. He said she was worthless, lazy and not pretty at all and was baffled as to why he would want to marry such a girl (Babkin, 1949). Pavlov did not care about his thoughts and went on to marry her anyways.

 Pavlov was madly in love with Seraphima and everyone seemed to know this. He spent more money on her than he should of, and more than they could afford. He bought her countless delicacies and took her to multiple theatrical plays. Seraphima barely ever had to spend money on herself because Pavlov was constantly buying her things. One time, however, she did buy herself a pair of shoes but when she arrived back at her house after visiting with Pavlov, she realized she was missing a shoe. Pavlov had taken one of the shoes as a reminder of her and kept it on his desk (Babkin, 1949). He was teased by others, mainly his brothers, for this display of affection but Pavlov did not care and loved Seraphima openly.

 Their marriage was tumultuous to start because of Pavlov’s financial struggles and his time constantly being fulfilled with his research. For the first few years of their marriage, Seraphima’s sister gave money to the young couple since Pavlov had none (Gantt, 1928). He was always preoccupied with his work and had a difficult time paying attention to those around him. When Seraphima was pregnant with their first child, Pavlov was once again careless and not thinking about those around him. They enjoyed going on long walks together but Pavlov was a fast walker and all of this extra exertion on Seraphima was believed to have led to their first child being miscarried (Babkin, 1949). After this event, Pavlov was much more aware of Seraphima and when they were expecting another child, he even refused to let her walk up the four flights of stairs to their apartment and would carry her in his arms. Even with all of this precaution, their second child was born but died shortly after from some type of illness when Seraphima and the baby were travelling in the winter. They later had two children, Vladimir and Vera.

 Pavlov was a teacher at the Military-Medical Academy and taught physiology classes. His classes were always animated and interactive. He performed experiments whenever he could and always showed the same enthusiasm for it, no matter how many times he had already performed that exact same experiment (Babkin, 1949). At the Military-Medical Academy, Pavlov did not get along well with the principal because of how he handled any type of voting. Pavlov wanted to become the chair of general and experimental pathology but when the ballots were handed out, there was no place on the ballot for Pavlov to be selected and voted on. The voting was predetermined so that someone who the principal really liked could become the chair. Pavlov then began to carry the Academy regulations book around with him so he could continue to stop unjust behavior in the Academy.

 A lot of the experimental research that Pavlov worked on was not at the Military-Medical Academy but at the Institute of Experimental Medicine, where he founded the physiology department, which was one of the first in the world (Gantt, 1928). Some of his first research involved the practicality of sterile surgical equipment and methods on animals in this laboratory, particularly to explore the digestive tract. He wanted the animals, dogs in his work, to survive and switched from doing surgeries that guaranteed death to surgeries that the animal survived and was cared for after the experiment is over. The laboratory at the Institute of Experimental Medicine received a budget around $1,500 (Babkin, 1949). He made extra money by selling the gastric juices that he collected and claiming they cured stomach problems. This alone brought in another $1,000 to the laboratory. The Institute tried to take some of this extra income but Pavlov, a stubborn and strong-willed man, protested and they never won the battle. It was never confirmed whether the juices actually helped or not and after a while, the sales died down because of the taste as well as the quantity that had to be consumed for any benefit to occur.

 There were around three medical graduates per year through the department of physiology that Pavlov instructed. This rate was due in part because of Pavlov’s fame in Russia from his publication of *Lectures on the Work of the Principle Digestive Glands*. Another reason for this rapid rate was because the students finished their degree in one year. Pavlov had the newer students continue the work of the students who had already graduated. This meant the dogs were already set up as well as the literature search being complete. Lastly, all surgeries were done by Pavlov himself (Babkin, 1949). This sped up the process and almost all of the preparation work was done ahead of time.

 Pavlov had an appreciation for the United States of America and its citizens. He believed that they were a great contrast to Russians and was amazed at how diligent they were (Babkin, 1949). He had many friends that were American scientists, including P.A. Levene and A.J. Carlson. One time, when Pavlov and Vladimir went to America to visit the Rockefeller Institute of Medical Research, he got robbed of $800 in New York. They were waiting at Grand Central Station and a group of thieves came up and took the money right out of his pocket. Pavlov always carried paper money with him and the large bulge of money and his foreign look made him an easy target (Babkin, 1949). In the same trip, he had lost his luggage and had to order all new suits when he returned back to Russia. Besides these misfortunes, Pavlov’s love for America never faded.

 The temperament that Pavlov had was an unpredictable one. He was often remembered as having sudden bursts of anger; however, they would never last long. He worked on an experiment once with one of his students, N. J. Chistovich. It was recalled that during said experiment, Chistovich had done something wrong; he simply forgot to remove a pair of forceps and this caused Pavlov to have a fit of rage, screaming and shouting at Chistovich about how he had done something wrong. He told Chistovich to never come back into the lab because they were two men who could never work together. Later, however, Pavlov sent him a letter, apologizing for his mistake and anger, and asked Chistovich to come back and work with Pavlov, which he did (Babkin, 1949). There was also an instance where Pavlov got so annoyed with the whining of one of his dogs, “Whitey”, that he ran out while there was an experiment being performed and beat the dog with a towel. Not even five minutes later, he came back out and told the experimenters to never hit one of the dogs. Apparently, after that day, “Whitey” and many of the other dogs could whine all they wanted without punishment (Gantt, 1928). Pavlov was also known for his strong swearing habit.

 Pavlov had an incredible memory when it came to his experiments. He was able to recall the smallest details, even when the experiment had been performed years past (Gantt, 1928). When past students would come and visit Pavlov, he was able to talk to them about figures they had found, and was even able to name the dog they had worked on at the time, even though multiple dogs had passed away since their research. Only after Pavlov had turned 75 did he admit that his memory was starting to fail and he started using a notebook. Some believe his accurate and expansive memory was due to his ability to concentrate and to select what he wanted to remember (Gantt, 1928). He was able to remember raw data and basic facts and rarely cluttered his mind with trivial facts that were not important to the advancement in some experiment.

Ivan Pavlov received the nobel prize in December of 1904. He received it in Stockholm, Sweden for his physiological work on the digestive system. He received the award from the king of Sweden, as well as a diploma and a gold medal. The prize was worth $36,000, which he put into the St. Petersburg branch of the Nobel’s firm. Unfortunately, he lost all of this money during the Revolution of 1917. He asked for a refund but the Nobel’s had lost all of their money as well, and could not provide a refund for him. Positively though, during his acceptance speech, instead of talking about the gastric system, he spoke about conditioning, or conditioned reflexes, which he had only just begun to discover and explore. He spoke about how complicated the functions of the cerebral cortex were (Babkin, 1949). He bravely gave the full attention of his speech to conditioned reflexes, instead of gastric glands like everyone expected.

# Experiments and Research

Being called a psychologist was not something Pavlov condoned. He was a physiologist first and foremost. Most of his original work dealt with the digestive system of dogs. He began work with the pancreas. He was able to get the pancreatic juices from the dogs by attaching a duct to the digestive canal, and this would be attached to a cannula, which let the fluid flow out of the body through a funnel and into a vessel. With these early workings, Pavlov became aware of some common problems his dogs were having. He realized the dogs needed to be on soft, porous materials when not strapped into the harness for hours (Pavlov, 1957). This led to less skin abrasion, which also could be cured with ointments and lotions. He realized a few weeks after beginning experimentation that many of the dogs were becoming very sick. They were having violent convulsions, which led to death two or three days later. The dogs were having a difficult time digesting the meat with the lack of pancreatic juice so Pavlov only fed them bread and milk. He also found out that they were losing a large amount of alkali so he included more foods into their diet that were high in sodium bicarbonate (Pavlov, 1957). Pavlov cared deeply for his dogs and anything to ease their time during the experimentation was practiced and used.

 Another operation Pavlov did to collect gastric juices from the dog in the purest form was to sever the esophagus. This allowed for both ends to be sewed to the skin, leading outside of the body. The dog could still eat the food it was offered through the mouth but it would fall back out of the mouth through the first cut of the esophagus. The dog could continuously eat for hours while never being full and getting increasingly hunger. The stomach, however, would still produce gastric juices. Since these gastric juices never had food interact with them, they were pure and clean (Pavlov, 1957). When the dog was fed, the other half of the esophagus was used and the gastric juices would clean themselves within a day or two. This allowed for cleaner gastric juices to be collected as well as a much larger quantity.

 Pavlov took great pride in how clean and sterile his operation rooms were. He wanted the dogs to survive and did not believe that the dogs should die just because of an experiment. His operation section of the lab included four rooms: one for washing the animal, one for giving the animal anesthesia and shaving the operable area, one for cleaning the equipment and preparing the surgeon and one for actually operating on the animal (Pavlov, 1957). The series of the rooms kept the last room, the operation room, the cleanest. The animal, primarily dogs, were than carried into the fourth room by whoever was going to be in the operation room, and not rolled in on a table to further keep the operation sterile. The entire department had gutters in all of the rooms to aid in cleaning. The dogs were kept for ten days in 7 foot kennels with hot air, adequate ventilation and a large window (Pavlov, 1957). The building was also surrounded by an isolating trench with special structural devices so as to not allow any uncontrolled stimuli into the building and disturb the dog. He was proud that he had worked there and after countless years, the place was still sterile.

Ivan Pavlov is most famous for his work on classical conditioning. Most of his work was done with dogs and saliva secretion, or the salivary reflex. He noticed that dogs would salivate when they saw meat, regardless if they actually got to eat the meat or not. He later noticed that not only did the dog salivate when he saw the meat, but also started to salivate when he heard the footsteps of the assistant. Pavlov coined this occurrence conditioned reflex in 1901 (Watson, 1963). This interested Pavlov immensely and he began experimentation on this. Classical conditioning is exposing an organism to a specific stimulus and having a specific response to it (Pavlov, 1966). This response gets conditioned over time to always occur. So the response can be controlled to a certain aspect. There are two main types of stimuli: primary eliciting stimulus and neutral stimulus. The primary eliciting stimulus is the stimulus that naturally causes the response. With the dogs and saliva production, the primary eliciting stimulus would be the food. The neutral stimulus is usually something in the environment, or something that does not originally cause a response (Pavlov, 1966). With the dogs and saliva production, this would be the assistant’s footsteps, which now causes saliva production because of the association between the steps and the food. Once the assistant’s footsteps cause saliva consistently, it is no longer a neutral stimulus but is now a conditioned stimulus. The primary eliciting stimulus can also be referred to as an unconditioned stimulus, since no associations were needed in order to connect the stimulus and the response.

Pavlov’s most famous experiment involved his dogs that had been operated on and a metronome. The dog was conditioned to the metronome, meaning the sound of the metronome meant the dog was going to eat food soon. Because of this association, once the metronome was started, the dog started salivating after only 9 seconds (Pavlov, 1960a). The dog reacts the same way to the metronome as it does for food because the noise is the signal for food. To demonstrate this, Pavlov showed the dog food and recorded how long it took the dog to start salivating in comparison to the metronome. The saliva reflex starts working because of what the experimenter has done, the signals to salivate come from him and he forms these signals originally. The metronome is a neutral stimulus and it is presented to the dog at the same time as the food to begin the association between the two. If the stimuli are presented in reverse, where the metronome is presented first then the food, the association will not form. A study conducted by one of the experimenters in Pavlov’s lab showed this (Pavlov, 1960a). The experimenter gave the dog vanilla, than preceded it with acid. The dog never seemed to associate the vanilla with the acid. However, when the order was reversed, the dog made the connection after 20 times. This was also done with a loud set of bells and the introduction of food. Only when the order was reversed, where the unconditioned stimulus comes first before the neutral stimulus, is the connection made.

To measure the saliva produced by the dog, Pavlov surgically attached a fistula to the side of the dog’s mouth. The fistula attached directly to the salivary duct and went through the outside of the mouth. Whenever the dog would salivate, the fistula would capture the saliva and Pavlov would record the number of drops. The fistula attached to a device that electronically measured the volume of the saliva. Through these measurements, Pavlov began to discover different amounts of saliva depending on what the dog was going to eat (Pavlov, 1928b). If the dog was going to consume dry, hard food, much more saliva is produced. If the dog was going to consume more watery food, much less saliva was produced. When the dog consumed water, little to no saliva was produced because it was not needed. Pavlov did begin to realize when the dog was consuming milk that the saliva quantity was close to when it was going to consume dry, hard food (Pavlov, 1928b). This was to help with the digestive process of milk. These varying degrees of saliva were essential to know the foundations of how much the dog was salivating naturally and how much was caused by the conditioned response to the food.

Interestingly enough, if the dog was trained as a puppy, it had no salivary response to meat if it had never experienced meat. One of the experimenters in the lab took a brand-new puppy and fed it milk for several months (Pavlov, 1960b). That was all the puppy was fed and all it was accustomed to. He made a fistula for the puppy and collected the saliva before to see if there was any change in saliva secretion when meat was shown. When the puppy was shown solid food, there was no effect on the salivary glands. No matter what food the puppy was shown, the salivary glands and saliva secretion did not change. When the meat was placed in the puppy’s mouth however, the association formed and the puppy now had a new reflex to the sight, sound and smell of meat. The puppy was displaying two different forms of reflexes: inborn reflexes and acquired reflexes. To show the difference between an inborn reflex and an acquired one, Pavlov gave the dog food by putting it in his mouth. This caused the dog to instantly salivate. The salivation is brought on by the physical and chemical properties of the food acting upon the tongue. It is solely reflex (Pavlov, 1960b).

He chose to use dogs and the salivary reflex because of convenience. Once the dogs were trained, they were good subjects to study. They would stand in the special harnesses completely still once they were trained. Also, the life span of a dog is multiple years so he could use the same subjects throughout these years without having to retrain them to stand still every time he wanted to conduct an experiment, or buy new subjects because of higher death rates from a shorter life span. Pavlov was also well educated about the unconditioned salivary reflex (Grey, 1979). He understood that saliva was produced when food was presented but was curious about how to control this production. Because of these multiple factors, Pavlov experimented and learned about conditioning using dogs and saliva.

In the time he lived, many found it strange that Pavlov used dogs, especially over a large period of time. Most experiments were being held with rats brought up in controlled laboratories. Pavlov’s dogs were stray dogs, having grown up outside and having a larger number of completely uncontrolled experiences happening to them. His dogs would also live for several years, unlike the short life span previously expected. He did this so as to know the personalities of the dogs and even named them according to the personality, such as ‘Gunshot’, a more aggressive dog (Gray, 1979). His dogs were also studied under a larger variety of tasks. This made it easier when the time came to condition the dogs. Over the years, he had learned their behaviors and what they did or did not already know. When the time came to condition them, Pavlov could make sure the act was not merely being performed because the dog had previously learned it, and was actually being conditioned.

Through this work with the dogs, Pavlov saw the bigger picture of how this experimentation could apply to higher functions than just saliva and higher organisms than dogs. He was studying and experimenting on general laws. The fact that Pavlov chose the salivary reflex to research and study is something that is interchangeable and arbitrary; he could have been researching a number of other reflexes and the findings would have been essentially the same (Grey, 1979). He established general laws of learning by using the salivary reflex of a dog.

Pavlov explored much more than the simple conditioning of the dogs to food. He found a guarding reflex in certain dogs (Pavlov, 1928a). Certain dogs showed excessive aggressive behavior when newcomers came into the lab. The aggression was reinforced when the stranger would approach the experimenter, which the dog was trying to ‘guard’. The dog would become even more wild and louder when the stranger would touch the experimenter, such as shaking hands. However, when the experimenter approached the dog, the behavior the dog exhibited was completely opposite of the behavior just shown. The experimenter could attach the fistulas to the mouth and even scold the dog, without an ounce of aggression being portrayed. Pavlov began to notice that these behaviors were portrayed solely when the dog was in the isolated, closed room of the lab. The behavior was also only triggered when the dog was strapped into the harness. If the dog was outside, or even on the floor of the lab, he tolerated strangers with no aggression being displayed. The dog had to be presented with all three stimuli for the reflex to occur. Pavlov explored this guarding reflex with the food reflex to see if one could dominate the other (Pavlov, 1928a). He used two dogs that had the guarding reflex already in them and started to give them food while talking to them. Over a two month span, he was able to strap the dog in the harness and pretend to strike the experimenter and as long as food was present, the aggressiveness of the dog was overpowered by desire for food. He found a way to experiment and control certain reflexes in dogs to get a desired response. ­

Since Pavlov called himself a physiologist, and not a psychologist, he had lectures on how certain psychological aspects and observations were just another way of seeing physiological observations. In these lectures, he would first start by saying the obvious, that a dog will drool and salivate when it sees food, even though the food has not touched the tongue or entered the mouth yet. He claimed this salivation occurred because there was an external agent causing the salivation, regardless if there was contact with it (Pavlov, 1957). He also claimed that since there was a definite nervous path that the nerves travelled on, this was just a physiological reaction. The psychological aspects were presumed to occur when actions could not necessarily be explained through physiological terms; certain acts would occur that did not occur before and had no apparent physiological reason. The example of the assistant’s footsteps causing increased salivation, as mentioned before, is a stimulus that did not exist before but now does. So although Pavlov did not want to be called a psychologist, he understood how certain acts could not be definitively defined through physiological purposes only.

# Later Life

 One of Pavlov’s influences was Ivan M. Schenov. He published a book called *Reflexes of the Brain*, which was a source of this influence. Ivan Schenov was famed as founding Russian physiology (Watson, 1963). His book, *Reflexes of the Brain*, included his work which showed that mental activity could be explained through reflex and motor activity. He also believed that reflexes were born and learned, showing this through associations. Pavlov found all of this work influential and experimented on it (Watson, 1963).

Pavlov became seriously ill in 1927, 1935 and 1936. In 1927, he had gallstones, but this was not determined until later on. His wife and he thought it was much worse, being cancer of the liver or malaria (Babkin, 1949). His sickness was never correctly diagnosed until April of 1927, after his first struggle with the illness. It was suggested that a German surgeon come over and operate on Pavlov to make him better, but he refused the help of foreign services. He found a Russian surgeon, one without a lot of experience, and had the operation to remove the gallstone. He made it through the surgery but because of his older age, he was at a higher risk to catch post-surgical infections. He caught pneumonia, which also passed in time, allowing him to fully heal and continue researching and experimenting. In 1935, he fell ill with a severe attack of grippe, which developed into pneumonia again. With this, Pavlov became weak and stopped eating. He caught a slight cold which turned into pneumonia. This illness ultimately led to his death, on February 27, 1936. Before his death, however, Pavlov was still in the lab, all the way to the end (Babkin, 1949). He had a grand funeral since his presence was loved by all of Russia.

 Throughout his life, and especially after his death, Pavlov was an influence to many. In 1921, Lenin set up a committee whose sole purpose was to safeguard the work of Pavlov and his collaborators (Gray, 1979). Lenin even had the Provisions for Workers give Pavlov and his wife double the food rations. He supported Pavlov and believed his work was going to bring psychological and physiological advantages to the Soviet Union. Pavlov continued to influence those closest to him as well. Many have made important observations and modifications to his theories, but his experimental findings on conditioned reflexes seem to have made no advantages. Also, little advances on animal behavior have been made and many psychologists after Pavlov looked into conditioned reflexes and humans. Multiple books have been published since Pavlov’s time but two books in particular, written by Konorski, have compared Pavlov to other theorists of the time. These are *Conditioned Reflexes and Neuron Organisation* and *Integrative Activity of the Brain* (Gray, 1979). There have been many more new experimental material discoveries in the Soviet Union since his death.

Ivan Pavlov was a physiologist first, psychologist second. But his work in the field of psychology changed history. He worked feverishly on his experiments for over 40 years, never wanting to stop up until a few days before his death when he was almost forced to by illness and family members. He helped form what is behavioral psychology today with his experiments on classical conditioning and reflexes. He brought grand ideas to the table of psychology and laid the foundations for many more to come. Pavlov was an influential man and psychology as a whole would not be where it is today without his contributions.

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