



Unit

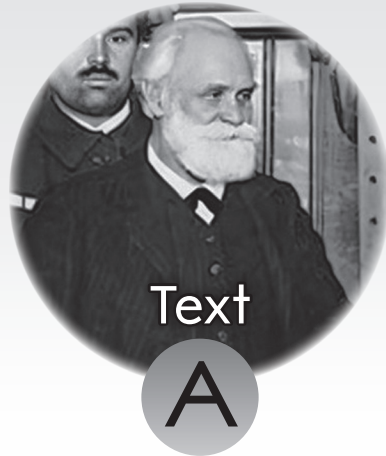
# One

## Physiology of Digestion

### **Ivan Petrovich Pavlov**

The Nobel Prize in Physiology or Medicine in 1904 was awarded to Ivan Petrovich Pavlov for his work on the physiology of digestion, through which knowledge on vital aspects of the subject has been transformed and enlarged.





# Pavlov's Dogs and Classical Conditioning

behavioral  
psychology:

a theory of learning based on the idea that all behaviors are acquired through conditioning. 行为心理学

1 One of the most revealing studies in **behavioral psychology** was carried out by Russian physiologist Ivan Petrovich Pavlov (1849–1936) in a series of experiments today referred to as “Pavlov’s Dogs”. His research would become renowned for demonstrating the way in classical conditioning (also referred to as Pavlovian conditioning) could be used to cultivate a particular association between the occurrence of one event in anticipation of another.

## Pavlov’s Dog Experiments

2 Pavlov came across classical conditioning unintentionally during his research into animals’ gastric systems. Whilst measuring the salivation rates of dogs, he found that they would produce saliva when they heard or smelt food in anticipation of feeding. This is a normal reflex response which we would expect to happen as saliva plays a role in the digestion of food.

3 However, the dogs also began to salivate when events occurred which would otherwise be unrelated to feeding. By playing sounds to the dogs prior to feeding them, Pavlov

showed that they could be conditioned to unconsciously associate neutral, unrelated events with being fed.

### Experiment Procedure

**4** Pavlov's dogs were each placed in an isolated environment and restrained in a harness, with a food bowl in front of them and a device was used to measure the rate at which their saliva glands made secretions. These measurements would then be recorded onto a revolving drum so that Pavlov could monitor salivation rates throughout the experiments.

**5** He found that the dogs would begin to salivate when a door was opened for the researcher to feed them.

**6** This response demonstrated the basic principle of classical conditioning. A neutral event such as opening a door (a neutral stimulus, NS) could be associated with another event that followed—in this case, being fed (known as the unconditioned stimulus, UCS). This association could be created through repeating the neutral stimulus along with the unconditioned stimulus, which would become a conditioned stimulus, leading to a conditioned response: salivation.

**7** Pavlov continued his research and tested a variety of other neutral stimuli which would otherwise be unlinked to the receipt of food. These included precise tones produced by a buzzer, the ticking of a metronome and electric shocks.

**8** The dogs would demonstrate a similar association between these events and the food that followed.

**9** The implications for Pavlov's findings are significant as they can be applied to many animals, including humans.

**10** For example, when you first saw someone holding a balloon and a pin close to it, you may have watched in anticipation as it burst the balloon. After this had happened multiple times, you would associate holding the pin to the balloon with the "bang" that followed. Like Pavlov's dogs, classical conditioning was leading you to associate a neutral stimulus (the pin approaching a balloon) with bursting of the balloon, leading to a conditioned response (flinching, wincing or plugging one's ears) to this now conditioned stimulus.

11 Similarly, Craik and Lockhart's Levels of Processing theory on memory<sup>1</sup> suggests that the deep processing (e.g. repeated rehearsal) of a piece of information can lead to an increased likelihood that it will enter a person's long-term memory and the response that can be recalled at a later date.

12 Let us look now at some of the nuances of Pavlov's findings in relation to classical conditioning.

### **“Unconditioning” Through Experimental Extinction**

13 Once an animal has been inadvertently conditioned to produce a response to a stimulus, can this association ever be broken?

14 Pavlov presented the dogs with a tone which they would come to associate with food. He then played the tone but did not follow that by rewarding the dogs with food.

15 After he made the sound without food numerous times, the dogs produced less saliva as the conditioning underwent experimental extinction—a case of “unlearning” the association.

### **Recovery**

16 When experimental extinction occurs, is the association permanently broken?

17 Pavlov's research would suggest that it remains but is inactive after extinction, and can be reactivated by reinstating, for example, the food reward, as it was given during the original conditioning. This phenomenon is known as spontaneous recovery.

### **Forward Conditioning vs Backward Conditioning**

18 During conditioning, it is important that the neutral stimulus is presented before the unconditioned stimulus in order for learning to take place. This forward conditioning is more likely to lead to a conditioned response than when the neutral stimulus is presented after the conditioned stimulus has been provided (backward conditioning).

19 In the case of Pavlov's dogs, the tone must be played to the subject prior to the food being provided. Making a sound after the dogs have been fed may not lead to a

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1 Craik, F. I. M. & Lockhart, R. S. 1972. Levels of Processing: A Framework for Memory Research. *Journal of Verbal Learning and Visual Behavior*, 11(6): 671-684.

conditioned association being made between the events.

**20** Carr and Freeman<sup>1</sup> attempted both forward and backward conditioning in rats, between a buzzer sound and closed doors in a maze. They found backward conditioning to be ineffective when compared to forward conditioning.

### **Delay Conditioning vs Trace Conditioning**

**21** We may use forward conditioning in one of the two forms:

**22** Delay conditioning—when the unconditioned stimulus is provided prior to and during the unconditioned stimulus—there is a period of overlap where the neutral and unconditioned stimuli are given simultaneously, e.g. a buzzer sound begins, and after 10 seconds, food is given whilst the buzzer continues.

**23** Trace conditioning—when there is a delay after the unconditioned stimulus has been provided before the unconditioned stimulus is presented to the subject, e.g. buzzer sounds for 10 seconds, stops and after 10 seconds of silence (the trace interval), food is presented.

**24** Discussing delay conditioning, Pavlov<sup>2</sup> asserted that the longer the delay between the stimuli, the more delayed the response would be.

### **Temporal Conditioning**

**25** So far, we have looked at conditioning in which a neutral stimulus is key to eliciting a desired response. However, if an unconditioned stimulus is provided at regular intervals, even without a preceding neutral stimulus, animals' sense of timing will enable conditioning to take place, and a response may occur in time with the intervals.

**26** For example, in a study in which rats were fed at either random or regular intervals, Kirkpatrick and Church found that the subjects underwent temporal conditioning in anticipation of food when they were fed at set intervals.

### **Generalization**

**27** Pavlov noticed that once the neutral stimulus had been associated with an

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1 Carr, H. & Freeman, A. 1919. Time Relationships in the Formation of Associations. *Psychology Review*, 26(6): 335-353.

2 Pavlov, I. P. 1927. Conditioned Reflexes: An Investigation of the Physiological Activity of the Cerebral Cortex. Date Unknown. From Psychclassics website.

unconditioned stimulus, the conditioned stimulus could vary and the dogs would still generate a similar response. For example, once a specific tone of a buzzer sound was associated with food, differing toned buzzer sounds would solicit a conditioned response.

**28** Nonetheless, the closer the stimulus was to the original stimulus used in conditioning, the clearer the response would be. This correlation between stimulus accuracy and response is referred to as a generalization gradient, and has been demonstrated in studies such as Meulders et al.<sup>1</sup>

### Modern Classical Conditioning

**29** Pavlov's dog experiments are still discussed today and have influenced many later ideas in psychology. The US psychologist John B. Watson was impressed by Pavlov's findings and reproduced classical conditioning in the Little Albert Experiment<sup>2</sup>, in which a subject was unethically conditioned to associate furry stimuli such as rabbits with a loud noise, and subsequently developed a fear of rats.

**30** Classical conditioning forms the basis of behaviorist approach which he articulated in *Psychology as the Behaviorist Views It*.

[Source: Anon. 2019. Pavlov's Dogs and Classical Conditioning. 06–20. From Psychologist World website.]

#### Facts:

**Ivan Petrovich Pavlov** was born on September 14, 1849 in Ryazan, Russia. In 1870, he abandoned his theological studies to enter the University of St. Petersburg, where he studied chemistry and physiology. After receiving the MD at the Imperial Medical Academy in St. Petersburg, he studied during 1884–1886 in Germany under the direction of the cardiovascular physiologist Carl Ludwig (in Leipzig) and the gastrointestinal physiologist Rudolf Heidenhain (in Breslau). In 1891, Pavlov was invited to the Imperial Institute of Experimental Medicine in St. Petersburg to organize and direct the Department of Physiology. Over a 45-year period, under his direction, the Institute became one of the most

- 1 Meulders, A. et al. 2013. Generalization Gradients in Cued and Contextual Pain-Related Fear: An Experimental Study in Health Participants. *Frontiers in Human Neuroscience*, 7(345): 1-12.
- 2 Watson, J. B. & Rayner, R. 1920. Conditioned Emotional Reactions. *Journal of Experimental Psychology*, 3(1): 1-14.

important centers of physiological research in the world. Pavlov continued to direct the Department of Physiology at the Institute, while taking up the chair of physiology at the Medical Military Academy in 1895. Pavlov headed the physiology department at the Academy continuously for three decades. Dr. Pavlov died in Leningrad on February 27, 1936.



## Reflection & Practice

1. Match the terms related to Pavlov's experiment in Column A with their corresponding definitions in Column B.

### Column A

- (1) classical conditioning
- (2) neutral stimulus
- (3) unconditioned stimulus
- (4) conditioned response
- (5) experimental extinction
- (6) spontaneous recovery
- (7) forward conditioning

### Column B

- a. NS is presented before the UCS in order for learning to take place.
- b. A period of overlap where the neutral and unconditioned stimulus are given simultaneously.
- c. If an unconditioned stimulus is provided at regular intervals, even without a preceding neutral stimulus, animals' sense of timing will enable conditioning to take place, and a response may occur in time with the intervals.
- d. A learning procedure in which an unconditioned stimulus is paired with a previously neutral stimulus, and leads to a response.
- e. A neutral event.
- f. NS is presented after the conditioned stimulus has been provided.
- g. "Unlearning" the association between a neutral stimulus and the unconditioned stimulus.

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|-------------------------------|--|
| (8) backward conditioning     | h. A response elicited by repeating the neutral stimulus along with the unconditioned stimulus.                              |
| (9) delay conditioning        | i. A subject was unethically conditioned to associate furry stimuli.   |
| (10) trace conditioning       | j. A delay after the unconditioned stimulus has been provided before the unconditioned stimulus is presented to the subject. |
| (11) temporal conditioning    | k. Another event that followed a neutral stimulus.   |
| (12) Little Albert Experiment | l. A phenomenon showing that the association can be reactivated by reinstating.  |

**2. Fill in the blanks with the correct forms of the words given.**

Noun

Verb

Adjective

anticipation

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stimulate

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associated

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relation

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replicability

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assert

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**3. Summary writing.**

After reading the whole text, use your own language to write a 150-word summary of the procedure and theory resulted from Pavlov's dog experiments.

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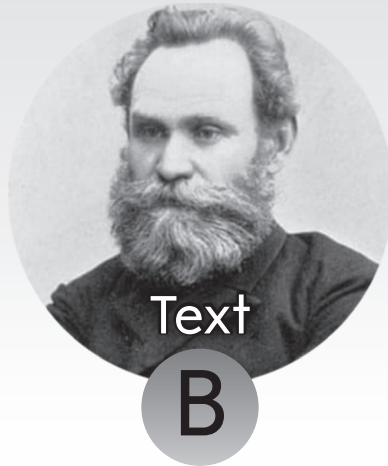
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## Pavlov's Award Ceremony Speech

1 Your Majesty, Your Royal Highnesses, Ladies and Gentlemen:

2 The medical sciences are mutually interdependent. Progress in one field is often closely associated with development in others. The rise in one branch of science can often have its origin in a recently made analysis within another sphere, and yet it may appear at the first glance that the former is of outstanding importance while the latter is apparently of secondary value. It is not always such progress, as immediately are useful and of benefit, which should be considered as especially important; this character can also be attributed to those which are themselves less spectacular but form the basis for the others which are then only a further development of it.

3 The aim of science is the acquisition of knowledge, the value of which should not be measured by the ease with which it can be brought immediately into practical usefulness. Examples of this can be seen in various accounts of scientific developments which have given their originators a prominent place in the history of Medicine. One may point to **Vesalius**

### Vesalius:

(1514–1564) namely Andreas Vesalius, the 16th-century Flemish anatomist, physician, and author of one of the most influential books on human anatomy, *De Humani Corporis Fabrica* (*On the Fabric of the Human Body*). Vesalius is often referred to as the founder of modern human anatomy.

Harvey:

(1578–1657) namely William Harvey, an English physician who made seminal contributions in anatomy and physiology. He was the first known physician to describe completely, and in detail, the systemic circulation and properties of blood being pumped to the brain and body by the heart.

and **Harvey**. When Vesalius, in spite of the personal risks to which he exposed himself, through his masterly researches opened the way to the study of human anatomy, he was impelled by his desire to carry the torch of science through the covering veil of prejudice and authoritarian belief. When Harvey through long years of investigations and deep study was able to prove the circulation of the blood, it was his thirst for truth which spurred him on in his work; to satisfy it was his reward.

4 The importance of the activities of these men for the whole of Medical Science must be estimated from the contributions they gave to the advancement of knowledge—from the view which thus became established in these sciences and has stimulated them to new and vigorous development. It would be a very unjust underestimation of them, if they were judged by the immediate value of their work.

5 The man, whose magnificent intentions established the Nobel Foundation was not unfamiliar with or averse to the aims and achievements of scientific research. This can be seen from the fact that his directions about the medical Nobel Prize linked it with physiology. The study by the physiological sciences of normal life processes and associated problems is in most cases of a purely scientific nature and however important the results of research may be in themselves, it is only exceptionally and in a roundabout way that they emerge into practical use. The questions of the investigator to Nature and the yearning which fires his desire are directed in the first instance to the gaining of new and deeper knowledge. Other factors also show that Nobel greatly appreciated investigators who were seeking knowledge for its own sake without considering other circumstances.

6 The medical Nobel Prize has this year been bestowed upon a man whose activity falls within the theoretical