

Pavlov's Physiology Factory: Experiment, Interpretation, Laboratory Enterprise

by Daniel P. Todes

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In 1894, Ivan Pavlov summarized the physiological state of knowledge about digestion in this way:

The digestive canal is in its task a complex chemical factory. The raw material passes through a long series of institutions in which it is subjected to certain mechanical and, mainly, chemical processing, and then, through innumerable side-streets, it is brought into the depot of the body. [...] Anatomy and physiology have disassembled this factor into its component parts and have become acquainted with the significance of each. [...] What is the activity of this factory at full operation, how and by what is it brought into motion, in what manner does one part go into operation after another, in what manner does the work change in dependence upon the type of raw material, does the entire factory always operate with all its parts, or not?

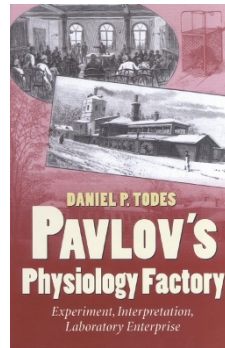
Daniel P. Todes, a historian of biology and medicine at Johns Hopkins, adopts this metaphor of the factory as the organizing theme of his fascinating new book entitled *Pavlov's Physiology Factory: Experiment, Interpretation, Laboratory Enterprise*.

Not only does the factory suggest the elaborate and precisely interlocking mechanisms of digestion, Todes argues, but it is an apt description of Pavlov's laboratory itself. Moving away from the nineteenth century tradition of the physiological laboratory as single-man workshop, Pavlov supervised a large-scale, centralized research enterprise. Pavlov's scientific achievements in digestive physiology—for which he received the 1904 Nobel Prize in Physiology or Medicine—relied on his ability to combine and carefully manage several resources: a well-furnished laboratory, a steady stream of physicians (*praktikanty*)

needing discrete dissertation projects, the development of some ingenious surgical techniques allowing chronic experimentation on digestion, and, not least of all, hundreds of dogs, Pavlov's favored experimental subjects. Todes refers to these surgically-altered subjects as "dog technologies," which enabled researchers to measure the production and composition of digestive juices produced under various experimental conditions. This is not to say that these organisms were simply digestive machines: appetite and other intangible psychic phenomena were undeniably important, and variation was a constant challenge in the interpretation of data. As Todes shows, Pavlov relied on a considerable interpretive flexibility and selective use of data to come up with a coherent scientific explanation of results.

But he also emphasized the reproducibility of results in his laboratory, such that even appetite "takes form as scientific flesh and blood, transformed from a subjective sensation into a precise laboratory fact."

Pavlov's emphasis on quantification and precision in physiology built on Claude Bernard's determinist philosophy of experimental medicine while challenging more mechanistic modes of explanation. In particular, he emphasized the importance to physiological explanation of adaptation, or "purposiveness"—the ability of the organism to respond appropriately to specific circumstances. By 1897, Pavlov and his coworkers had constructed a compelling account of the physiology of digestion. In this Pavlovian picture, the nervous system controlled and coordinated the output of digestive glands, which also responded to different foodstuffs with specific secretions. Appetite had a critical role as well, generating the first "psychic" phase of gastric secretions. Pavlov's attention to the role of appetite and his emphasis on the ability of the digestive glands to respond differently according to type of food gave scientific validity to longstanding therapeutic traditions (such as feeding milk to gravely ill patients) that had been inexplicable according to earlier mechanical theories of digestion. Pavlov also offered physicians a new therapeutic product: natural gastric juice produced by his "factory dogs." By World War I, proceeds from selling bottled gastric juice had increased the laboratory budget by more than 500 percent.



Beyond providing a vivid portrait of Pavlov as scientific entrepreneur, Todes sheds new light on how Pavlov came to his theories of conditional reflex, his most enduring legacy. Pavlov's early attempt to 'black box' the psyche in the physiological processes of digestion was increasingly thwarted by evidence that the role of psychology overshadowed that of physiology. In particular, Pavlov's assertion that the salivary gland had a "mind"—insofar as it

could discriminate among and respond purposively to different substances—was regarded by his prakticant Anton Teofilovich Snarskii as naive. Snarskii drew on Wilhelm Wundt's theory of recognition to argue that "psychic secretions" did not result from volition or judgment but rather habitual reflex, set up by processes of association.

Pavlov's subsequent collaborator Ivan Filippovich Tolochinov further differentiated "conditional reflex" (as Pavlov termed it) from unconditioned salivary reflexes, and showed how these two kinds of reflexes interacted.

During this same era, developments beyond Russia called Pavlov's interpretation of digestive control into question. William Bayliss and Ernest Starling's 1902 discovery that release of pancreatic juice was controlled by a hormone, secretin, unsettled Pavlov's longstanding preference for "nervist" control of digestion. The new biochemistry of ferments shifted digestive research towards chemical extraction and experimentation, which was beyond Pavlov's area of expertise. In response, Pavlov eventually decided to abandon studies of digestion altogether to pursue the conditional reflex, retooling his dog technologies towards psychological questions. Todes concludes the book by briefly discussing how World War I and the Bolshevik revolution disrupted Pavlov's laboratory work. Remarkably, Pavlov's scientific enterprise not only survived these massive changes but grew under Lenin's patronage to encompass four laboratories with large teams of researchers. This epilogue foreshadows the burgeoning of Pavlov's psychological experimentation in Soviet Russia that will undoubtedly be further developed in Todes's upcoming biography of Pavlov. This extensively researched and satisfying book on the experimentation leading up to the 1904 Nobel prize whets the reader's appetite for a fuller rendition of this remarkable scientist's life.