

The Impact of Pavlov on the Psychology of Learning in English-Speaking Countries

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The translation of Pavlov's lectures (Pavlov, 1927) provided English-speaking psychologists with access to the full scope of Pavlov's research and theoretical ideas. The impact this had on their study of the psychology of learning can be assessed by examining influential books in this area. This reveals that Watson (1924) had been highly effective in promoting the misleading idea that Pavlov was a fellow S-R theorist. This assumption was not questioned by Tolman (1932), Hilgard and Marquis (1940) or by Hull (1943). However, this mistake was not made by Skinner (1938), who also provided the strongest arguments against Pavlov's belief that behavioral effects required explanation in terms of physiological processes. Post-1927 most learning research in the English-speaking countries continued to use instrumental, rather than Pavlovian, conditioning procedures. Nevertheless, many of the issues addressed by this research were ones that Pavlov had been the first to raise, so that his major influence can be seen as that of defining a research program for subsequent students of learning.

Keywords: Pavlovian conditioning, operant conditioning, behaviorism

La traducción de las conferencias de Pavlov (Pavlov, 1927) proporcionó a los psicólogos angloparlantes el acceso al panorama global de la investigación y las ideas teóricas de Pavlov. El impacto que esto supuso para su estudio de la psicología del aprendizaje puede evaluarse mediante el examen de libros influyentes en esta área. Esto revela que Watson (1924) promovió eficazmente la errónea idea de que Pavlov era un teórico del E-R. Esta suposición no fue cuestionada por Tolman (1932), Hilgard y Marquis (1940) o Hull (1943). Sin embargo, Skinner (1938) no cometió este error y además proporcionó los más sólidos argumentos contra la creencia de Pavlov de que los efectos conductuales requieren una explicación en términos de procesos fisiológicos. A partir de 1927 la mayor parte de la investigación en aprendizaje en los países angloparlantes usó procedimientos instrumentales más que pavlovianos. Con todo, muchos de los temas planteados por estas investigaciones habían sido planteados por primera vez por Pavlov, así que se puede considerar que su influencia principal fue la de definir un programa de investigación para los estudiosos del aprendizaje.

Palabras clave: condicionamiento pavloviano, condicionamiento operante, conductismo

The Twin Roots of the Experimental Study of Learning

Contemporary research on learning can be traced back to two main sources: experimental studies by comparative psychologists in the USA and the work of Pavlov. There is a fascinating synchronicity between these two developments, ones that were initially entirely independent. In 1898 Pavlov and his students in St. Petersburg began to study “psychic reflexes” just as Thorndike in New York published his PhD work on problem solving that initiated the experimental study of instrumental conditioning. In 1903 Pavlov gave his first lecture on conditioning outside of Russia just as Watson obtained his PhD for a developmental study of learning in rats. Over the next few years the first studies in animal psychophysics using conditioning methods were carried out in Pavlov’s laboratory and one of the questions addressed by these experiments was whether dogs have color vision. During this same period, Watson collaborated with Yerkes and others to study visual perception in various species, including rats and monkeys, and one of the main issues for them was color vision (Boakes, 1984). From early on, the study of conditioning in Russia became intertwined with the philosophical questions raised by Bechterev’s objectivism, while in the USA, comparative psychologists became the main proponents of what Watson, in 1913, named “Behaviorism” (Boakes, 1984).

These coincidences, at first, resulted from common issues in an intellectual setting that stretched from New York to St. Petersburg. There were also differences, most importantly those of underlying ideology. The research questions addressed by American comparative psychologists arose either from debates about what would now be called “comparative cognition” following Darwin’s views on mental evolution or from the more pragmatic attempt to further understanding of phenomena from everyday life inspired by James’ (1890) *Principles of Psychology*. Following the latter, questions concerning habits were of particular interest to comparative psychologists early in the 20th century. This is in marked contrast to Pavlov’s approach to the study of conditioning from the standpoint of a physiologist concerned with understanding how the brain works.

As the years went by, English-speaking psychologists learned more and more about Pavlov’s work. By the 1930s research on learning was expanding at an ever-increasing rate (Coleman, 1988). The main question addressed by the present paper is: In what ways was this expansion influenced by Pavlov’s research?

Pavlov and Watson’s Behaviorism

Pavlov’s research on conditioning became known among English-speaking psychologists at just the right time for Behaviorism. Decades later Watson recalled: “I had worked

the thing out in terms of HABIT formation. It was only later, when I began to dig into the vague word HABIT that I saw the enormous contribution Pavlov had made, and how easily the conditioned response could be looked upon as the unit of what we had been calling HABIT. I certainly, from that point on, gave the master his due credit” (Hilgard & Marquis, 1940, p. 40). Watson gave such credit to Pavlov in his APA Presidential Address of 1916 and in 1924 Watson placed the conditioned reflex as the foundation stone for the future development of behaviorist psychology in his highly influential and very widely read book, *Behaviorism* (Watson, 1924). From that time on almost every introductory textbook published in English contained a chapter on learning that gave prominence to Pavlov’s conditioned reflex.

Pavlov seemed at first to have been pleased by this marriage between his conditioned reflex and Watson’s behaviorism. In 1927 he commented in a negative way on American psychological research in general, writing that “with the exception of a small group of behaviorists their work cannot be regarded as purely physiological” (Pavlov, 1927; p. 7). In a sentence that purely Watson could have written, Pavlov stated that “habits are nothing but a long chain of conditioned reflexes” (Pavlov, 1927; p. 395). However, a few years later Pavlov was as critical of behaviorists as of any other kind of psychologist (Pavlov, 1932).

Old habits die hard. Starting with Thorndike (1898), comparative psychologists like Watson had for many years been studying learning processes and other aspects of animal behavior using instrumental conditioning procedures, whereby whether and when a cat in a puzzle box or a rat in a maze obtained food reward depended on how it behaved. Recognition of Pavlov’s contribution did not lead at first to any marked change in the behavior of these comparative psychologists.

Again following Thorndike (1898), Watson and his fellow behaviorists had become deeply committed to the view that the basic unit of behavior is the stimulus-response—*S-R*—connection. Watson (1925) cast Pavlov as a fellow *S-R* theorist and, as we shall see, this assumption was hardly questioned by the learning theorists that followed later. It can well seem that American behaviorism adopted the language of the conditioned reflex, while rejecting the method and ignoring the theoretical and empirical content of Pavlov’s research (Ruiz, Sánchez, & De la Casa, this issue).

In the 1960s Behaviorism began to lose its dominance in American psychology. It was only then that research on classical conditioning exploring Pavlovian themes—notably those of inhibitory learning, overshadowing and configured representation—and using Pavlovian (i.e. non-instrumental) procedures became the main focus for learning theorists in the USA and other English-speaking countries, notably Canada and the UK.

This may suggest that there was a 50-year break in terms of the influence of Pavlov’s work on English-speaking psychology, apart from the continued use of his terminology

and the continued inclusion of a few pages on Pavlovian conditioning in every introductory textbook. However, closer examination reveals considerable continuity in the development of learning theory and the influence of Pavlov, and also much more variety in the reaction to Pavlov among the learning theorists who are often placed together in the category “behaviorists.”

Conditioned Reflexes of 1927

Early accounts in English of Pavlov’s work rarely went beyond the basic phenomena that Pavlov and his students studied in the early part of his long and massive research program on conditioning. As in contemporary psychology textbooks, these usually covered only the acquisition and extinction of a conditioned salivary response, stimulus generalization and discrimination training—Pavlov’s ‘differential conditioning’—plus spontaneous recovery, disinhibition and higher-order conditioning.

This was quite understandable in 1924 when Watson published *Behaviorism*. Outside of Russia what was known about Pavlov’s research findings came from a few short articles in English, French or German, and mainly conference papers by Pavlov or brief reviews. This situation was changed in 1927 when Anrep published his translation of the set of lectures that Pavlov had given in 1924 into English. The book was titled *Conditioned Reflexes: An Investigation of the Physiological Activity of the Cerebral Cortex* (Pavlov, 1927). It provided a comprehensive and detailed account of research that had taken place over the previous twenty-five years in Pavlov’s laboratory. It would be difficult to find any body of research within psychology in this era that could even attempt to rival Pavlov in terms of either scope, consistency of development or richness of original discoveries and of detailed theory. Following the first two lectures with mainly introductory content, the book contains twenty-one lectures, each containing experimental results interwoven with a discussion of their significance. Of these, the eleven that concentrate on basic processes of conditioning (Lectures 3–13) and the three that report experiments involving cortical lesions (Lectures 19–21) are of special interest in the present paper. Other topics, such as experimental neurosis and Pavlov’s account of differences in temperament, are discussed by other contributors to this volume (Plaud, this issue).

Given how little was known in detail about Pavlov’s research prior to the English publication of Pavlov (1927) – and in the following year the translation into English of a further set of lectures (Pavlov, 1928) – perhaps it is not surprising that Pavlov’s impact was limited for at least a decade after Watson (1916) had proclaimed how important Pavlov was to psychology (Hilgard & Marquis, 1940; pp. 13-14). However, from around 1930 the psychology of learning obtained an increasingly dominant position in North

American psychology as a result of the influence of Watson’s successors and their various versions of neo-Behaviorism. Almost all of those who became productive researchers in the field of learning must have read some of Pavlov (1927) as students, if only casually. Consequently one might have expected Pavlov’s theoretical ideas, methods and findings to have had some continuing influence.

One way of assessing Pavlov’s influence is to examine some of the more influential books in English on learning published after 1927. For this paper I selected four that were arguably the most important for the generation that began research on learning in the 1940s and 1950s.

Tolman (1932)

The first important book on learning theory to follow Pavlov (1927) was Tolman’s (1932) *Purposive Behavior in Animals and Man*. Possibly because it was based largely on articles written over the preceding decade, it displays little interest in Pavlov’s research. Instead it consists of a sustained critique of Watson’s theories and an attempt to develop an alternative account of learning in which the conditioned reflex hardly plays a role. Nevertheless, Tolman’s book is of interest here for two reasons. First, it starts with the argument for a *molar* approach to behavior, one in which the terms *stimulus* and *response* can refer to more complex events than those that physiologists deal with. Tolman stated that an act *qua* behavior has distinctive properties all its own that are strictly correlated with and dependent upon physiological motions, but descriptively are other than those motions.

This move away from the *molecular* view of behavior inherent in Pavlov, and adopted by Watson, was increasingly adopted by later behaviorists, even by those that strongly objected to other aspects of Tolman’s theories.

A second reason that Tolman (1932) is interesting in this context is that it reveals how dominant Watson’s version of the conditioned reflex had already become. In a chapter sub-titled “The Conditioned Reflex Doctrine” (Tolman, 1932; pp. 319-338) Tolman inadvertently reveals how little attention he had paid to what Pavlov himself wrote. Instead, Tolman refers to the account of Pavlov’s theories and research provided by a psychology textbook (Woodworth, 1929). Incidentally, this is an unimpressive source in that it provides a brief and superficial account of conditioning at a level appropriate for a first year student. Tolman criticizes the view that classical conditioning is based on the formation of a direct connection between the conditioned stimulus (CS) and the conditioned response (CR). Instead, Tolman suggests what he considers to be a new perspective, that the CS serves to *signal* the arrival of the unconditioned stimulus (US). This was exactly the point that Pavlov had made in the second lecture in his *Conditioned Reflexes* (Pavlov, 1927; p. 22).

Skinner (1938)

Skinner was one of the later behaviorists who accepted Tolman's argument about the molar nature of behavior, but rejected almost every other claim by Tolman. From Skinner's *The Behavior of Organisms: An Experimental Analysis* (1938) it is clear that he had read what Pavlov had to say with great care. In fact, the only other researcher that Skinner cites at any length is Pavlov. Skinner did not make the mistake of seeing Pavlov as an S-R theorist. By then, Skinner and a few other American theorists had followed Konorski and Miller (1937) in distinguishing between two kinds of conditioning: Pavlovian, classical or what Skinner in 1938 called 'Type S' conditioning, as opposed to instrumental, operant or what Skinner (1938) referred to as 'Type R' conditioning.

In several respects, Skinner's (1938) book can be seen as an attempt to document the properties of Type R (instrumental) conditioning in the way that Pavlov (1927) had studied the properties of Type S (classical) conditioning. Skinner placed the same emphasis on the extreme importance of tightly controlled experimental conditions and hence the value of data obtained from individual subjects. Skinner's behaviorist predecessors worried that Pavlov's (1927) strong claims were based on reported data from a few trials with a single dog, while little detail was provided about the experiment as a whole or about how representative these small data sets were. This did not concern Skinner particularly. For example, he accepted Pavlov's account of positive and negative induction and then looked to see whether similar phenomena could be found in Type R (operant) conditioning, although preferring to rename them as positive and negative *contrast* (Ibid; pp. 173-175).

In 1938 Skinner made clear his appreciation of the quality, extent and importance of Pavlov's work, except for two related respects. Early in the book he rejected Pavlov's analysis of extinction in terms of inhibition, arguing that no such concept was needed in the analysis of either type of conditioning (Ibid; pp. 96-102). Later came a celebrated and highly influential chapter on behavior and the nervous system. This starts by noting "the all but universal belief that a science of behavior must be neurological in nature" and that the common practice of extrapolating from behavioral data to neurophysiological events had really nothing to do with the real nervous system studied by physiologists. Instead this practice led to the invention of a 'conceptual nervous system' that provided an illusion of explanatory power (ibid; pp.418-422). He went on to express the strongest criticism of Pavlov in this book: "The use of terms with neural references when the observations on which they are based are behavioral is misleading.... An outstanding example is the systematic arrangement of data given by Pavlov" (Ibid, pp. 426-427).

Hilgard and Marquis (1940)

Far less famous now than Tolman and Skinner, Hilgard had published a series of experimental articles reporting eyelid conditioning in human subjects and some important theoretical papers on conditioning throughout the 1930s (see Garcia-Hoz, this issue). At the end of this decade he collaborated with one of his research collaborators to publish a book that provided a comprehensive and detailed account of research on conditioning and learning (Hilgard & Marquis, 1940). This became a handbook for learning researchers and was not replaced until Kimble published his revised edition of their book (Kimble, 1961). The latter was followed in turn by the entirely new handbook on learning by Mackintosh (1974), for which there is still no clear successor.

In relation to Pavlov's influence on the psychology of learning, the two most interesting aspects of Hilgard and Marquis's (1940) *Conditioning and Learning* are, first, it reveals just how extensive research on classical conditioning had been during the 1930s and, second, the degree to which Pavlov (1927) had set the agenda for this research activity. The very first sentence of the book reads: "The classical conditioning experiment is known to every student of physiology and psychology". The first chapter provides an excellent historical introduction that, among other things, compares the limited initial impact of Pavlov's work with its immense influence following the 1927 publication of *Conditioned Reflexes*. The chapters that follow provide an account of research directly inspired by Pavlov. They are organized in a very similar way to the lectures in Pavlov (1927) and the sequence of topics is not very different from what could be found in a contemporary textbook on learning. The contents of Chapter 12, however, are topics that have disappeared from most current books on learning and conditioning; this chapter covers 'personality', including Pavlov's work on experimental neuroses and on individual differences.

The final chapter in Hilgard and Marquis (1940) examines neurophysiological mechanisms of conditioning. It begins by examining the reasons why "Pavlov's conception of cortical physiology has not met with any wide degree of acceptance" (ibid, p.311). and identifies four main objections. The first is similar to the point made by Skinner (1938): "Terms like 'irradiation', 'concentration', 'induction' and 'drainage' remain 'purely inferential concepts derived from measures of overt movements or of amount of saliva secreted' and remain mere figures of speech unless 'specific verification can be obtained through more direct observation of the cortex'" (ibid, p. 312). The other three objections have to do with recent experimental evidence that contradicted Pavlov's physiological claims; for example, demonstrations that conditioning can take place at a sub-cortical level. On the other hand, unlike Skinner, Hilgard and Marquis did not try to make a clear separation between physiology and a science of behavior. This is particularly clear in their discussion of what today would be described

as the key question of *what is learned* in the course of a conditioning experiment (Rescorla, 1988). Their discussion is still couched in terms of hypothetical neural pathways. It also still tends to promote the idea that Pavlov was an S-R theorist (ibid, pp. 313-326).

As an alternative to looking at what Hilgard and Marquis (1940) and Pavlov (1927) have in common, one can consider what both leave out. When the uninitiated first come across even contemporary textbooks on learning, they are often surprised by the narrowness of the topics that are covered, and by the heavy emphasis on conditioning and on animal research. Why so little attention to studies of human learning, especially ones that involve procedures other than conditioning? Why nothing in most textbooks on an issue that most outsiders would see as of critical real-world importance: how children learn in school? Why is concern with learning early in development rare, so that topics, such as imprinting, have remained largely the preserve of zoology-trained researchers or 'developmental psycho biologists', while language acquisition in children is part of psycholinguistics and not to be mentioned in texts on the psychology of learning? The answer must be at least partly that such omissions reflect the way that influential handbooks such as Hilgard and Marquis (1940) and Kimble (1961) defined the boundaries of the psychology of learning, and in turn their definitions were heavily influenced by Pavlov (1927).

Hull (1943)

The unexamined assumption that Pavlov was an S-R theorist is also found in the final book considered here. Hull's (1943) *Principles of Behavior* is in many respects as non-Pavlovian as Tolman (1932), if not distinctly *anti-Pavlovian*. Hull acknowledges Tolman's arguments for a molar analysis of behavior and, like Tolman, rejects physiological levels of explanation. Hull too relies on secondary sources—the textbooks by Murphy (1935) and Dashiell (1937) in his case—for his understanding of Pavlov's theory. Since Hull believed that all learning was based on the instrumental reinforcement of S-R connections, he saw it as Pavlov's major error not to have reached the same conclusion (ibid, pp. 76-79). He attributed this partly "to the exceedingly limited type of experiment that (Pavlov) employed". Rather than appreciating that Pavlov's choice of conditioned salivation was because it provided a very effective tool for uncovering general principles of conditioning, Hull dismissed this paradigm on the grounds that it was 'artificial'. By this he meant both that as a response system salivation was inferior to "motor effectors ... because of their greater variety and general interest" (ibid, p. 50) and that conditioned salivation provides a poor method for studying the effects of instrumental reinforcement (ibid, p. 86).

Despite the dismissive and often patronizing attitude towards Pavlov that is expressed in the first few chapters, much of the rest of Hull's book can be seen as a tribute to Pavlov's experimental work. In Hull's development of the concept of secondary reinforcement, his analysis of temporal relationships between CS and reinforcement, of extinction, of conditioned inhibition and of stimulus compounds, he acknowledges the importance of Pavlov's data. Out of a total of fourteen chapters that address specific topics in learning, at least five are heavily dependent on Pavlovian data.

Learning, Performance and Physiology

Two of the chapters in Hull (1943) concentrate on motivation. Tolman (1932) and Skinner (1938) were also concerned with the question of how variations in an individual's internal state affect the performance of learned behavior. This was not an area where Pavlov (1927) provided much help. Interestingly, when in the 1960s learning theorists in English-speaking countries started to concentrate on classical conditioning, once again, most concentrated on principles of learning. They rejected their behaviorist predecessors' concern with changes in behavior and placed questions to do with motivation in another basket, one perhaps to come back to another day.

On the other hand, learning theorists trained in the 1960s and 1970s have been quite *unPavlovian* in maintaining the rejection of 'physiologizing' by behaviorists of the previous generation. Experiments that examined the effects of cortical lesions were discussed in three of the chapters in Pavlov (1927). In these he is almost apologetic about the crudeness and limitations of this approach to the problem of "determining the importance of different parts of the brain for the normal functioning of the cortex as a whole... Imagine that we have to penetrate into the activity of an incomparably simpler machine fashioned by human hands, and that for this purpose, not knowing its different parts, instead of carefully dismantling the machine we take a saw and cut away one or another fraction of it, hoping to obtain an exact knowledge of its mechanical working!" (Pavlov, 1927, p. 320). In the English-speaking world researchers using behavioral methods to study conditioning largely kept their distance from their neuroscience colleagues in a way that has often generated mutual disdain. However, the last decade or so has seen an increase in research projects that combine a sophisticated understanding of conditioning principles with elegant physiological and neurochemical procedures of the kind that Pavlov would have delighted in.

Resources

A photograph included in Pavlov (1927) provides a graphic reminder of a major difference between his research

and that of psychologists in English-speaking countries. This shows the large building that was specially built to house his laboratory. As detailed in another contribution to this issue (Klimenko & Golikov, this issue), Pavlov had at his disposal laboratory space, technical support and time for research, plus an army of able research assistants, that together provided resources that were far superior to those available to any psychologist who has studied learning. While in Soviet Russia Pavlov was the single dominant figure in the study of conditioning, elsewhere such research was undertaken by a large number of individuals, most of whom had very limited resources. In this context it is hardly surprising that Pavlov's influence was diverse; researchers varied greatly in the degree and way in which Pavlov affected their work. It also goes towards explaining why there have been no equivalent individual researchers in any other country who can be compared to Pavlov in terms of the volume, scope and continuing influence of their research.

Summary

From 1903 onwards, Pavlov's research on conditioning became increasingly well known in the English-speaking world, and from 1916 onwards the conditioned reflex was incorporated as an important element of behaviorism. In this process Pavlov was taken to be an S-R theorist who could contribute a respectable theoretical and physiological basis for the behaviorist concern with the learning of habits. When the details of his research became known in 1927, it provided a research program for the psychology of learning as developed by learning theorists of the 1930s and 1940s, stimulating, at first, considerable research using classical conditioning methods. However, particularly because of the influence of Skinner and Hull, this was followed by a period when such methods fell out of favor. In parallel fashion Pavlov's use of physiological concepts to explain conditioning phenomena was increasingly rejected. Nevertheless, the issues originally addressed by Pavlov continued to remain the backbone of research programs in the psychology of learning. Consequently, what is most striking in looking back over a century of conditioning research is the degree of continuity there has been.

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