Revista de Historia de la Psicología, 2024, Vol. 45(2), 35-43

Revista de Historia de la Psicología

www.revistahistoriapsicologia.es

The Reflex Theory and the Psychology of Science

David. O. Clark
Independent Scholar

INFORMACIÓN ART.

Recibido: 9 febrero 2024
Aceptado: 26 mayo 2024

Key words
Historiography,
Lashley,
Guthrie,
Pavlov,
Reflex Psychology

ABSTRACT

By 1930 reflex physiology supported American psychology's ambition to be considered a science. When a challenge threatened the consensus, this initiated a conflict over the direction of psychology's future. Events that constitute the history of science involve countless complex interactions, and the necessity for a thesis to focus the interpretation involves historiography. A traditional method for psychologists who write history is to organize the significant events around biography, and the history of the reflex in psychology is inseparable from those who were involved in defining its importance for 20th century. However, Kurt Danziger noted that in psychology biography often resulted in a substitution of the individual for the history of psychology. An alternative was to use biography but to focus on the discourse and to emphasize the themes, conflicts, interests, and the individual's assumptions. This essay combines biography, Danziger's criticism of biography-historiography in psychology, and a psychological conflict theory of science proposed by Edwin Boring. This focuses the history of the important reflex theory on dynamic inter-personal forces that clashed over the future direction of experimental psychology.

La Teoría del Reflejo y la Psicología de la Ciencia

Palabras clave
Historiografía,
Lashley,
Guthrie,
Pavlov,
Psicología del Reflejo

RESUMEN

En 1930, la fisiología refleja apoyó la ambición de la psicología estadounidense de ser considerada una ciencia. Cuando un desafío amenazó el consenso, se inició un conflicto sobre la dirección del futuro de la psicología. Los acontecimientos que constituyen la historia de la ciencia implican innumerables interacciones complejas, y la necesidad de una tesis para centrar la interpretación implica la historiografía. Un método tradicional de los psicólogos que escriben historia es organizar los acontecimientos significativos en torno a la biografía, y la historia del reflejo en psicología es inseparable de aquellos que participaron en la definición de su importancia para el siglo XX. Sin embargo, Kurt Danziger señaló que en psicología la biografía a menudo resultaba en una sustitución de la historia de la psicología por el individuo. Una alternativa era utilizar la biografía pero centrarse en el discurso y enfatizar los temas, conflictos, intereses y suposiciones del individuo. Este ensayo combina la biografía, la crítica de Danziger a la biografía-historiografía en psicología y una teoría de la ciencia del conflicto psicológico propuesta por Edwin Boring. Esto centra la historia de la importante teoría del reflejo en las fuerzas interpersonales dinámicas que chocaron sobre la dirección futura de la psicología experimental.

Introduction

Emerging from the nexus of philosophy and physiology, modern experimental psychology assimilated the reflex theory. The origins of the reflex concept began in the Enlightenment with the emerging material view of nature and a mechanical interpretation of animal motion. As the centuries passed and biological science progressed, the simple reflexive analogy was used to characterize ever more complex

I wish to thank the following for their help: Dennis Brooks PhD., René Van Hezewikj PhD., and Mr. Raj Maharajh.
Correspondencia David. O. Clark: davidoclark7@gmail.com
ISSN: 2445-0928 DOI: https://doi.org/10.5093/rhp2024a8

Para citar este artículo/ To cite this article:
Clark, D.O. (2024). The Reflex Theory and the Psychology of Science. *Revista de Historia de la Psicología, 45*(2), 35-43. Doi: 10.5093/rhp2024a8
Vínculo al artículo/Link to this article:
DOI: https://doi.org/10.5093/rhp2024a8

features of vital functions. By the 1930s confusion over the continued usefulness of the reflex for psychology contributed to a conflict among psychologists over the direction of psychology's future.

As one scholar noted, "The elements which contribute to advance in any field of science are so inter-dependent, and their ramifications so numerous and intricate, that an attempt to isolate a particular portion for intensive historical study results, of necessity, in a certain amount of artificial simplification and distortion. This is particularly true of the reflex arc concept which is based not only upon physiology, but upon anatomy, psychology, philosophy, and even physics and chemistry" (Fearing, 1930, p. viii).

A traditional method in psychology is to organize the significant events around biography. Biographical history is not without criticism. Kurt Danziger (1926-) observed that when psychologists wrote the history of psychology there was a tendency to substitute the history of a psychologist for the history of psychology. Danziger did not object to biography; detailed biography and interrelationships yielded valuable insights. What Danziger objected to was biographies that lacked any conception of a public discourse, the dynamic exchange "… that represented themes, conflicts, interests, assumptions, and practices that were shared unequally among various contributors" (Danziger, 2009, p. 116).

The history of the reflex is inseparable from the scientists who were involved in defining its importance for 20th century psychology. Ideally scientific truth is a consensus achieved through objective research and impartial discourse; however, as Edwin Boring (1896-1968) pointed out, the same mind that makes science possible is also characterized by irrational features, and it is inclined to argument. To paraphrase Kluckhohn & Murray (1948), the individual scientist is like all other people; in another sense, by virtue of belonging to the vocation of science, scientists share some similar characteristics, and finally the individual scientist is uniquely thus. This essay focuses on dynamic inter-personal psychological forces that clashed in a debate about the future of experimental psychology, a conflict between the esteemed psychologists: Karl Lashley (1890-1958), Edwin Guthrie (1886-1959), and Pavlov (1849-1936). Acknowledging Danziger's criticism, this essay uses a psychological conflict theory of science proposed in 1928 by Boring to understand an argument over the usefulness of reflex theory for the future of experimental psychology.

Section 1: The 1929 International Congress of Psychology

In 1929, from the 1st to the 7th of September, Yale University in New Haven, Connecticut hosted The Ninth International Congress of Psychology. "Among the evening lectures, given by the 'stars' of the Congress, those of Prof. Pavlov of Leningrad and Prof. Lashley of Chicago attracted the most attention….The former (Pavlov) spoke, with a vigor amazing in an octogenarian,…, but did not say anything new: while the latter (Karl Lashley) was generally considered to have produced the most memorable message delivered to the Congress,…" (Schiller, 1930, p.129).

For the 50th anniversary of this historically important conference for American psychology, Duncan (1980) solicited recollections. Among the replies he received was one from Frances Withington. She recalled Pavlov's Monday night speech: "On the platform he seemed gentle, even shy, showing the frailty of his age. When he began to speak, his personality and vitality were dynamic. His intense speech had to be interrupted periodically by his interpreter…. As you can imagine, the audience was spellbound, and the following standing ovation brought little smiles and bows of appreciation from the Guest of Honor of the Congress" (Duncan, 1980, p. 3-4).

Lashley

On Wednesday night, the president of the American Psychological Association, Karl Lashley, delivered his presidential speech to the assembled members of the Congress. Lashley stated the consensus, the ultimate explanation for a science of psychology was going to be found in brain processes, and currently, brain processes were understood in terms of the neural reflex. Lashley reminded his audience of the physiological facts, the reflex arc was comprised of individual neurons that served specialized functions. Lashley then told the audience that his experiments using lobotomized rats in learning experiments failed to confirm the existence of reflex physiology in the brain (Lashley, 1929). Because reflex theory played an important role in almost every phase of American psychology, Lashley felt that it was his duty to criticize the cerebral reflex in depth. At one point in his long speech, Lashley said that the current psychology textbooks misrepresented the facts of cerebral reflexes and that this misled students and obstructed progress in psychology. Lashley concluded, "…it was not very important that we should have a correct theory of brain activity, but it is essential that we shall not be handicapped by a false one" (Lashley, 1930, p. 24).

One reviewer said of Lashley's speech, "… it was an "Inspiring exposition" of Lashley's latest views concerning the central nervous system. It was the general opinion of those who attended that Lashley's speech was the outstanding feature of the congress, and Lashley's ideas would have an important place in the history of psychology" (Langfeld, 1929). Note: Langfield was the next president of the APA, and he could have been preaching to influential members of psychology's choir. By criticizing the reflex theory, Lashley emphasized his own theory as progress. What could be more egotistic of Lashley than a resolute dismissal of the reflex with the internationally esteemed Pavlov in the audience. Pavlov would eventually reply, but in the meantime, Edwin Guthrie, the co-author of one of Lashley's misleading and obstructing textbooks was also present to take offense.

Guthrie

Soon after Lashley's criticism of his textbook, Guthrie published his aggressive reply in *The Psychological Review,* "Conditioning as a Principle of Learning." Guthrie reminded his fellow psychologists that any scientific theory of learning must explain the facts. That was sarcastic; rhetorically, the word fact emphasized science. Indirectly pointing to Lashley's brain-damaged laboratory rats, Guthrie said that currently most learning experiments measured learning in terms of the end results. These experiments (implying Lashley's)

ISSN: 2445-0928 DOI: https://doi.org/10.5093/rhp2024a8

gave no indication of how learning occurred; moreover, the results of specialized experiments could not be generalized. Presently, the facts of learning (implying neurology) remained uncertain. This necessarily constrained a theory of learning to the elementary facts, which were well known by the associationist philosophers.

In the psychology of learning, Guthrie said, the role of experiment was merely illustrative. And for purposes of illustration, Guthrie presented Pavlov's research on the conditioned reflex. Guthrie said that Pavlov's research was useful because it fit common knowledge. "That burned children dread fires is accepted before hearing Pavlov" (Guthrie, 1930, p. 412). Guthrie argued, if there was a single concept that could include most of the known facts of learning, it was the ancient principle of association by contiguity, the simultaneous occurrence of the environmental cues with the behavior of interest. Using the principle of contiguity, Guthrie proceeded to interpret Pavlov's categories of the conditioned response as instances of learning by contiguity, of a stimulus-response association creating a new habit. Guthrie acknowledged there was one problem, Pavlov's experiments indicated the stimulus proceeded the response in the learning process. The associative function was not simultaneous. To dispute Pavlov's interpretation, Guthrie argued that Pavlov had insufficiently analyzed his experiments in the context of the total activity of the nervous system.

In his conclusion, after demeaning Pavlov, Guthrie damned the esteemed president of the American Psychological Association with faint praise, "This paper should be followed by some consideration of Lashley's work which appears at first sight a challenge to a general theory of conditioning. … " (Guthrie, 1930, p. 428).

Pavlov

At this point the discourse was personal, and Pavlov had two critics: Lashley was convinced that his own experiments had refuted the cortical conditioned reflex and nullified thirty years of Pavlov's subsequent research, and Guthrie who said that Pavlov's conditioning experiments were only useful to psychology as illustrations to demonstrate what was already known. Also, Guthrie, a professor in an undergraduate psychology program, accused the Noble Prize winning physiologist of failing to understand the nervous system.

1932 Pavlov published "The Reply of a Physiologist to Psychologists." This was Pavlov's first publication in an American psychology journal, and although he was at the conference, it was undoubtedly a surprise for all concerned. How was Pavlov even aware of Guthrie's critical article? And why would Pavlov bother to reply to this undistinguished American? Pavlov began his reply by reminding the reader that science was an assessment of the internal and external conditions necessary for the existence of systems. As his readers were psychologists, this pedantic information seems intended to insult. Science, he instructed the psychologist, proceeded by decomposing the system into parts, studying the significance of each part, their connections, and finally investigating the relationship of the whole system with its environment. The human was a system, and the vital organs were synchronized by the nervous system. Neural physiology mediated the survival for complex organisms in the changing environment through the cerebral functions. Pavlov was adamant in his conviction, the scientific investigation of the psychic had reached firm ground in physiology, and this was possible because of the conditioned reflex. Pavlov's opening shot was directed at both Guthrie and Lashley. Where Lashley opposed localization and cerebral reflex, Pavlov emphasized parts, that is specialized parts, and that denoted the localization of function made possible by cerebral reflexes.

Pavlov began by addressing Guthrie, at first he praised Guthrie for using physiology to illustrate the psychological. Pavlov stated the physiology of the psychic was the most important scientific undertaking of the day. He then turned on Guthrie to criticize him for making associative conditioning the guiding principle of psychology without further research. Guthrie, by failing to verifying every step of his analysis with facts, had relapsed to philosophy. Pavlov stood for science, Guthrie was practicing philosophy.

In response to Guthrie's accusation of failing to understand neurology, Pavlov instructed Guthrie,"On page 360 of my book "Conditioned Reflexes" one can see that I not only take into account the centripetal impulses from skeletal musculature, … (and furthermore) there is absolutely no ground for accepting a continuous action of the stimuli of which Guthrie speaks" (Pavlov, 1932, p. 94). Pavlov had finished with Guthrie.

As things then stood with Guthrie, Lashley, the esteemed president of the American Psychological Association, said his textbook was full of misinformation and an obstacle to progress, and Pavlov, the world famous physiologist, accused him of practicing philosophy. In the context of American psychology of that time, bad science was unfortunate, philosophy was inexcusable.

After his brief treatment of Guthrie, Pavlov devoted considerably more time for Lashley. Lashley implied that 30 years of Pavlov's research was now obstructing the development of cerebral science. Pavlov was blunt, "No one has the right to say that" (Pavlov, 1932, p. 101). Pavlov reminded the reader of his many accomplishments investigating cerebral processes, all of which were based on the concept of reflexes. Pavlov said that the conditioned reflex research was supported by 3 principles of scientific investigation: First, determinism, a cause for every action. Secondly, the initial decomposition of the whole into parts followed by re-constructing the whole from the parts. Thirdly, the adaptation of function to structure. Pavlov argued that the reflex theory made it possible to determine dynamic phenomena that emerged from elements of anatomy. In Pavlov's opinion, the only reasonable explanation for Lashley's rejection of the reflex was either his failure to understand it, or there was an unexpressed personal bias against it (Pavlov, 1932, p. 102). Pavlov proved insightful on this last point.

Pavlov was adamant, the highest level of cerebral research was being accomplished by himself and his co-workers. For example, using the conditioned reflex, they had successfully demonstrated that a stimulus could produce a pathological effect and then restore the subject's functioning to normal. This can be interpreted as an insult; Pavlov implied that Lashley had insignificant control over his subjects for a reliable interpretation of the results. Surgical damage to the brain permitted no restoration to normal for a single subject comparison-controlled experiment (sometimes expressed as the ABA design). Then Pavlov pointed out that the brain consisted of billions

ISSN: 2445-0928 DOI: https://doi.org/10.5093/rhp2024a8

of neurons that produced different phenomena. This meant that there was insufficient knowledge of brain histology to be poking it with needles and slicing off parts. Pavlov indirectly questions Lashley's surgical competency given the complexity of the organ. Moreover, in experiments based on vivisection, there was the problem of the automatic selfdefense regulating mechanism that resulted in compensating functions, which must be accounted for but could not be experimentally controlled for.

Pavlov, who it must be remembered was responsible for managing a substantial government medical research institution, concluded by saying, "A real and useful scientific theory must not only embody all existing material, but must also open up a wide possibility of further study and, one can say, of unlimited experimentation" (Pavlov, 1932, p. 121). Did Lashley have a program to replace reflex theory for guiding experiments? No. Did Lashley have a program that could bring progress in the understanding cerebral functions? No. Pavlov left his psychologist reader with the idea that Lashley had nothing substantial to offer.

Section 2: A Brief History of the Reflex

The origin of the reflex concept is generally attributed to René Descartes (1596-1650). Descartes's era was fascinated with novel machines, the clock-work statues and miniature automata that produced life-like movements that amazed people. Influenced by technology, physical science, and the increased knowledge of anatomy, Descartes proposed a material explanation for animal motion; animals moved similar to machines. In Decartes's *Traité de l'Homme*, published in 1662, he described bodily movements in terms of neuro-muscular structures. The observed motion of a living organism was interpreted as a reaction made possible by a nervous system that connected the muscles to events in the immediate environment. Descartes's pathway theory of the nervous system was similar to the modern theory of the reflex (Boring, 1957, p. 165). Descartes machine analogy marked the beginning of today's physiological based psychology (Fearing, 1930).

Boring attributed the term 'reflex' to Astrue, who in 1736 used it to describe how sensations are 'reflected' by the spinal cord, or brain, to produce movement (Boring, 1957, p. 35). In 1751, Robert Whytt (1714-1766) published *An Essay on the Vital and Other Involuntary Motions of Animals*. With experiments using decapitated frogs, Whytt demonstrated that the spinal cord was both necessary and sufficient for the integration of complex purposive movements. Whytt believed that the spinal cord movements were, "independent of reason and will…" (Boring, 1957, p. 35). This interpretation was important because evidence of a material explanation for motion contradicted the traditional belief that activity was the result of consciousness and volition; these discoveries had revolutionary implications for beliefs about human nature (Fearing, 1930, p. 107).

During the 18th century knowledge of the nervous system developed to a point where a an adequate statement of the principles of reflex action could be made, and with it a mechanistic explanation of human science became increasingly acceptable. Additional evidence for a mechanistic interpretation of movement came from the fact that animals automatically performed complex purposive behaviors at birth. Also, the automatically performed habit and the mental philosophy of associationism, supported a mechanistic explanation. During the 17th and 18th centuries, the nervous system controlled the body through the mind-soul; in the 19th and 20th centuries the nervous system was the integrative and adaptive mechanism (Fearing, 1930).

In the 19th century, the experimental psychology founded in Germany by Wilhelm Wundt was enthusiastically received in the United States (Clark, 2023). At that time mind was synonymous with consciousness, and empirical psychology was the analysis of conscious elements, sensationalism. William James criticized this approach in *The Principles of Psychology*. James promoted Herbert Spencer's (1820-1903) evolutionary based psychology of adjustment, the theory that new actions could arise as a consequence of changes in the immediate environment. In a relatively short time, a characteristically American psychology emerged, functionalism. Function, borrowed from physiology, had three meanings: the usefulness of the organ, how the organ worked in terms of cause and effect, and, from mathematics, X was a function of Y, which permitted qualification.

Functional psychology retained consciousness, but foremost it was now adjustment psychology, and the conditioned reflex was the conceptual key to the individual organism's capacity to adapt and survive. For comparison: In Germany, modern psychology began as psycho-physics when the mental philosophy of the day was focused on sensations, sensations connected the mind to the environment. In the context of anatomy, the world entered through sensory nerves to occasion the mental sensation. However, there was another possibility for an experimental psychology. The alternative was similar to Descartes's original interpretation of animal motion, this approach emphasized the motor nerves occasioning movements that were to be interpreted in terms of a discriminatory response to the environment (Boring, 1953).

In 1913 John B. Watson (1878-1958) published *Psychology as a Behaviorist Views It*. With witty exaggeration, Boring said that in 1910 American psychologists included some structuralists and some functionalists, but after *Psychology as a Behaviorist Views it,* there were only behaviorists. Behaviorism assimilated functionalism, but it rejected consciousness. Behaviorism was a mechanical psychology of the nervous system; it was stimulus-response psychology of conditioned reflexes. Approximately 250 years after Descartes put forward a systemized mechanics of body motions, histology had progressed to the point where the reflex theory gave substance to a mechanistic explanation of cerebral functions, and that supported behaviorism as a credible experimental science.

Behaviorism was not without problems. In its founder, John B. Watson, Boring saw an incompetent philosopher who made extravagant claims and left psychology without a satisfactory epistemology. However, there were attempts at a systematic treatment. In 1921 two young professors at the University of Washington, Stevenson Smith (1883-1950) and Edwin Guthrie (1886-1959), published *General Psychology in Terms of Behavior*. Their preface read: "In this book an attempt is made to state in terms of behavior the facts and principles of general psychology…" (Smith & Guthrie, 1927).

Based on the thesis that human behavior was a physical event that could be analyzed as machine, Smith & Guthrie (1927, p. 1) carried behavioristic psychology into higher mental processes. They

ISSN: 2445-0928 DOI: https://doi.org/10.5093/rhp2024a8

illustrated a conceptual anatomy of the conditioned response as cerebral basis for a systematic treatment of memory, learning, and habit. The principle of association was the key to their analysis. "Because of its treatment of the conditioned response as the basic unit of learning, … it established the authors as important contender for a unified theory of learning" (Sheffield, 1959, p. 644). By 1929 the conditioned response underlay most of American psychology (Fearing, 1930).

Section 3: A Psychological Historiography for Science

Several months before Lashley's public assault on the reflex theory, Edwin Boring, the 1928 president of the American Psychological Association, delivered his presidential address to the American Psychological Association, *The Psychology of Controversy*. Nearing the completion of his classic history of experimental psychology, Boring used the special occasion to speak about scientific progress. Boring began with the consensus: Science demanded sober observation and dispassionate logical discussion; science was the product of the human mind. However, there was a paradox. The mind, as psychologists were well aware, was a mixture of "personal prejudice, ambition, and convictions," and these were characteristics that frustrated unbiased observation and reasonable discussion. In his historical research, Boring observed that "psychology has not been above personal bias" (Boring, 1929a, p. 97). Boring argued that the fundamental method of science was in fact conflict, and this offered interesting insights into important features of the debate that otherwise would remain unstated.

In his extensive research of the history of psychology, Boring worked by identifying significant facts and then attributing those discoveries to individuals whenever possible. Boring found that science was full of paradoxes that were in conflict with the ideals. He conceived of these conflicts as dilemmas, or paradoxes, that inhibited progress. Boring thought that the limits of an individual's attention affected what truth the scientist could ever hope to achieve. Boring reasoned: If an individual was always trying to see the truth (presumably the comprehensive picture), then they had no time to fight for their idea, and if individuals did not fight for their ideas, science did not progress. Boring also noted the fact that scientists had many times rejected significant discoveries because of their personal biases.

Boring succinctly, if not sarcastically, personalized the scientific method as one scientist declaring themselves correct and their opposition wrong. History had shown Boring that scientists had often held tenaciously to lost causes. Also, because there were no rewards for being wrong, scientists where not inclined to admit they could be wrong. Boring found that when two scientists were so committed, each to their own view, neither was willing to understand the other. Boring asked, if science was ideally the dispassionate search for truth, then how could it progress when passion was required for the hard work? He concluded that the same passionate egotism that drove scientists to hours of research, and to endure criticism for their conclusions, was the same trait that kept them from seeing the wider truth, which at best was temporal and partial. Reluctantly, Boring concluded that "… scientific truth, like juristic truth, must come about by controversy" (Boring, 1929a, p. 99).

Next, Boring introduced conflict in a socially dynamic paradox: "… new movements in psychology… that which is presently accepted as progress, is nevertheless most patently an undoing of the progress of the past" (Boring, 1929a, p. 114). In his speech to the APA, Boring referred to an article that he published in 1927, "The Problem of the Originality in Science." In his effort to identify the originators of revolutionary concepts, Boing found that there was little in significant discoveries that was completely new. Undeniably new ideas came from thinking or experimental facts, but often nothing happened for many years. Eventually someone else received credit for the idea after they assimilated it in a concept and founded a movement, which succeeded because the time was right or because the founder had the talent and means to gain the public's attention. Founders of movements who were credited with originality were often, not the originating researchers. They were the promoters of science. Boring argued that historians, " … have therefore to consider the mechanisms of public attention" (Boring, 1929a, p. 114-15).

In Boring's analysis of history, winning over the public's attention relied on the principle of demonstrating progress. Boring reasoned that for the public to see progress, apparent movement was required, and a successful demonstration of movement required a reference point, something to measure the movement against. The scientist-as-promotor had to call public attention to the distance from the old to the new, and this was accomplished by emphasizing the promises of the new idea and the failings of the prevailing idea. The unfortunate result of this process, Boring found, was inevitably exaggerated promises. Boring provided an example from the founding of experimental psychology: Fechner was first with psychophysics, but Wundt was the founder of experimental psychology. Fechner's interest in psychophysics was philosophical; Wundt's interest was experimental psychology. Wundt put it together: He wrote a handbook, he got a chair in philosophy and changed it to experimental psychology, he established a laboratory, he did experiments, and he began a journal for publication. And when Wundt lacked experimental results for his handbook, he exaggerated. In a sense, progress was basically negative, characterized by the destruction of the old order (Boring, 1929a).

Boring concluded by saying that although dialogue was an essential part of scientific work, controversy was more than discussion. Controversy involved emotion, passionate commitment to an idea, and this introduced prejudice into the practice of science. This functioned to fix the debaters more firmly in their options (Boring, 1929a). Unknown to Boring, his 1928 speech predicted in some detail the events after Lashley launched his assault on the reflex theory.

The Personal Equation in a Psychological History

Boring borrowed the concept of the personal equation from astronomy. In astronomy, the personal equation was a measurement of the individual astronomer's personal reaction time that biased the accurate recording of star transits. Boring repurposed the concept of a personal equation to account for personal prejudices, ambitions, and other irrational elements that he found ingrained in scientific

ISSN: 2445-0928 DOI: https://doi.org/10.5093/rhp2024a8

research. This provided the historian with an objective statement of psychological influences to consider when trying to understand scientific progress in the context of the individual's contribution. Boring asked, "…if personalities lie, in part, back of psychology, then what lies back of the personalities?" (Boring, 1929b, p. ix). Boring's problem was answered in part by the intellectual biography, and of interest in this debate are the intellectual histories of Karl Lashley, Edwin Guthrie, and Pavlov.

Lashley

Lashley completed his undergraduate education at the University of West Virginia. He majored zoology and graduated in 1910. In 1911 he attended the University of Pittsburg, where he wrote his master's thesis on bacteriology. Lashley spent the summer of 1911 at the Cold Spring Harbor Marine Laboratory investigating the Stentor's genetics, the Stentor is a large single-cell filter feeder. In the fall of 1911, Lashley entered Johns Hopkins University. Lashley's dissertation was supervised by Herbert Spencer Jennings (1868-1947), a noteworthy zoologist who researched the inherited characteristics of microorganisms in the context of evolutionary biology and comparative psychology.

Jennings believed that behavior served internal regulation, homeostasis; behavior maintained vital internal functions, and Jennings's research emphasized the internal causes of adaptive responses. Organisms that adapted life sustaining behaviors survived to pass this ability to their offspring. Adaptive reactions to the environment became part of the organism's genetic heritage. Internal states determined external movements; behavior was observable for experiments. Jennings's research was conducted in the spirit of comparative psychology; the behavior of micro-organisms was the basis for understanding human behavior. The subject of Lashley's dissertation was the inherited characteristics in Hydra. In 1914, Lashley completed a Ph.D. in genetics.

While a student of Jennings, Lashley was introduced to animal behavior by John B. Watson (1878-1958). Watson must be considered an important influence on Lashley's development, but Watson's influence was complicated because Lashley eventually reacted against stimulus-response psychology and the situational determinants of behavior. Lashley was committed to Jennings's view of the ingrained genetic determinants of behavior. Lashley's commitment to the genetic explanation was also influenced by Shepherd Ivory Franz (1874-1933), a psychologist who investigated brain injuries. Franz was a Columbia University PhD, and he served a post-doc in physiology at Harvard University, where he ablated cats's brains and assessed the effects of injury on habit retention and learning.

In 1914, Lashley began collaborating with Franz on similar experiments using rats. Franz believed that learning was the stimulus-response formation of habits and that re-education after brain damage was establishing connections between a stimulus and response. In their collaboration, Franz and Lashley found that surgically modified rats could establish habits after the loss of parts of the brain. At the time, these results were interpreted as supporting the belief that brain function was compatible with reflex theory, localized pathways, and stimulus-response psychology. Franz taught Lashley surgical techniques and the belief in learning ability despite brain damage.

In 1920, Lashley began a decade of experiments investigating the effects of brain injuries (Lashley, 1929). He destroyed parts of a rat's brain, and then tested for the ability to remember and the ability to learn. His experiments indicated that surgically modified rats often retained previous learning and the ability to acquire new adaptive behaviors. Lashley concluded that mental functions required a certain amount of brain mass, but it did not matter what area was damaged. At first, Lashley interpreted the results in the context of the prevailing reflex theory, but later he concluded that the same evidence falsified the reflex theory. By 1926 Lashley associated the reflex theory as synonymous with the doctrine of brain localization, and he rejected both. From 1926 onwards, Lashley fought reflex based explanations of behavior. Weidman (1999) argued that although Lashley's belief was compatible with the behaviorism of the early 1920s, as behaviorism evolved into radical environmentalism, Lashley's genetics bias motivated him to reject the theory of cerebral reflexes. Lashley was considered the foremost American brain researcher of the first half of the 20th century, and during his lifetime, Lashley " …was celebrated as the author of an innovative and influential theory of brain function" (Weidman, 1999, p. 2),

Guthrie

Guthrie was indirectly accused of misleading psychology students and obstructing the progress of psychology by Lashley; he was accused of being a philosopher by Pavlov. In the context of American psychology of 1929, this amounted to malfeasance and treason. Was Guthrie that easy to dismiss?

Guthrie's professional development began during his undergraduate years at the University of Nebraska. From his undergraduate interest in language, Guthrie progressed to a master's thesis, *The Influence of Mathematics in Greek Philosophy,* which he completed on 28 May 1910. He continued his education at University of Pennsylvania in the philosophy department, where he received his Ph.D. in 1912. Guthrie's department chairman was Edgar Arthur Singer Jr. (1873-1955); Singer was an important influence on Guthrie's development as a psychologist (Clark, 2007).

Singer was among the first 'Made in America' psychologists. Singer received his Ph.D. in 1894 at Pennsylvania. He was George S. Fullerton's (1859-1925) student. Fullerton was a founding member of the American Psychological Association and its 5th president. Singer's dissertation was *On the Composite Nature of Consciousness*. Science was analytic, characterized by reducing phenomenon to elements. But what comes first? The chicken or the egg? In the new German experimental psychology, consciousness came first because consciousness was synonymous with mind, and the mind was considered the integrating principle of the individual. Psychology was the science of mind. What were the elements of consciousness? Sensations. Reacting to Wundt's elements of consciousness, in 1890 William James rejected Wundt and argued that consciousness was indivisible. Singer argued otherwise. Opaque today, this debate was relevant for what American psychology would become in the 20th century.

ISSN: 2445-0928 DOI: https://doi.org/10.5093/rhp2024a8

Influenced by Singer, Guthrie was one step in his academic genealogy from Fullerton and also one step from William James. In 1895-97, Singer did post-doctorate work for James at Harvard where he supervised students in the psychology laboratory. Singer then returned to the University of Pennsylvania and became chairman of philosophy. Soon after Guthrie's arrival in 1910, at the annual meeting of the American Philosophical Association, Singer delivered his paper, *Mind as an Observable* Object. Singer argued that a relatively objective method could be applied to the scientific treatment of mind. Later in life, Guthrie remembered Singer's presentation as the most emotionally stirring event of his academic life.

Empirical science is commonly understood to mean that facts are available to the individual's immediate experience. Empiricism was not Singer's science; Singer's facts were mediated by culture. Singer's facts began by asking: what do we know? and how do we know it? Unfortunately, these two questions took inquiry in opposite directions that made it impossible to arrive at the unadulterated fact. For Singer, all current knowledge was an approximation of the truth; however, as knowledge progressed, it incrementally got closer to the truth.

Guthrie's dissertation was *The Paradoxes of Mr. Russell: with a Brief Account of Their History*. The famous mathematician Gottlob Frege (1848-1915) proposed a logical foundation for arithmetic, Bertrand Russell (1872-1970) challenged Frege's solution. Russell and Alfred North Whitehead (1861-1947) presented an alternative solution with the *Principia Mathematica*. Guthrie began his analysis of the *Principia Mathematica* with the ancient and medieval problems in formal logic. Guthrie analyzed the language, the definitions of key terms, and the history of logic's development. From this scholarship, Guthrie published two papers in 1914, *Formal Logic and Logical Form* and *New Solutions to an Old Problem*. In general, Guthrie concluded that communication was based on rules, and that mathematics was one example of rule governed communication, and that neither mathematics or logic was a perfectly finished system. Also, forms of logic did not represent the psychological process of reasoning.

Guthrie's (1930) criticism of Pavlov was not credible. Pavlov was a Nobel Prize physiologist and the director of a world renown research institution. Guthrie was a juror professor from Seattle, a remote lumber town on the western shores of the United States. Psychology at the University of Washington was governed by an endowment that decreed it maintain a clinic for children. Fortune and circumstances placed Guthrie in the secondary role of undergraduate instruction for psychology. There was no evidence that Guthrie had the resources, time, or the ability to carry out an experimental program. There was no evidence that Guthrie ever dissected more than the Sunday roast beef. Evidence indicates that Guthrie's education was in logical systems. Based on Guthrie's history, Pavlov's accusation of philosopher was not unreasonable; however, understanding Guthrie changes when he is viewed from the point of view of the nervous system. The history of the reflex theory amounted to investigating a mechanism that regulated internal homeostasis. The nervous system synchronized life sustaining functions. And insofar as the nervous system functioned under the principle of determinism, what was the nervous system but an organ of communication with a logical function?

Today, the concept of a 'system' is not trending. In the psychology of the early 20th century, system meant "content and consistency" (Boring, 1953). A system organizes all the available facts with an encompassing theory. Descartes was systematizer when he treated the newly discovered facts of anatomy for his mechanistic explanation of vital animation. In the early 20th century, when psychology was distancing itself from philosophy and distinguishing itself as a science, there was an effort to avoid use of term theory and to emphasize facts. The word theory evoked philosophy; system was preferred, system implied 'coverage and consistency.' The model for psychology was the physics textbook, and psychology textbooks tried to include every topic important to psychology as fact, and they tried do this with a consistent definition of psychology throughout. Guthrie was a systems psychologist, and his education suitably fitted him for this role in this debate. The nervous system had binary properties of neural transmission, in terms of the excitation and inhibition features. Guthrie approached stimulus-response associations as he did the ineffable problems presented by logical systems. He chose a familiar analogy, associationism, which was a mechanical model of mind, and he used it to analyze the experimental results of learning experiments. Guthrie never had the status of experimenter, but as a systems builder, he had a role to play in the reflex debate.

Pavlov

Pavlov, of course, was responsible for discovering the conditioned reflex. The conditioned response provided the experimental methods that gave scientific credibility to the reflex theory of brain functions, and it provided the foundation for a scientific psychology of Behaviorism. Physiology reduced biology to its elements and investigated the cause and effect relationships; however, isolating causality for fleeting phenomena in the complex living organism was extremely difficult and dependent on complex experiments. Compared to brain science based on disease, accidents, and vivisection, the conditioned reflex provided a major advance in experimental investigation of normal cerebral functions.

Important influences on Pavlov's development can be identified (Todes, 2014, Clark, 2022a). Foremost was Pavlov's mentor in physiology, Ilya Fadeevich Tsion (1842-1912). Tsion's education can be traced to Claude Bernard (1813-1878), and Carl Ludwig (1816-1895), two of the most famous physiologists of the 19th century. With Bernard, Tsion investigated the nervous regulation of the vital functions. With Ludwig, Tsion contributed to the discovery of the vasomotor depressor nerve. In 1873, Tsion predicted that some day physiologists might discover the mechanics of cerebral processes, and this prediction proved true in 1901, when Pavlov discovered the conditioned reflex.

Pavlov did post-graduate work with two eminent physiologists, Rudolf Heidenhain (1834-1897) and Karl Ludwig (1816-1995). With Heidenhain, Pavlov investigated the nervous control of the pancreas, and with Ludwig the nervous control of the heart. Heindenhain surgically modified a dog's stomach for analysis of gastric secretion. Ludwig removed a heart from a frog, and connected it to a circulation system for measuring its functions. From lessons learned in his post-graduate experiences, Pavlov began his research with extensive observations, and he insisted on attention to detail and quantifiable

ISSN: 2445-0928 DOI: https://doi.org/10.5093/rhp2024a8

results. In general, Pavlov practiced inductive methods with analytic dissection of the problem. Where English and French science emphasized the hypothetical-deductive approach to science, Pavlov was convinced that physiological processes could not be explained as the simple product of isolated elements. Analysis of a normally functioning organism was the goal of Pavlov's investigations (Todes, 2014). Pavlov's personal equation emphasized the nervous control of vital organ functions, and his ideal subject was a normally functioning animal.

Fortune gave Pavlov a well funded laboratory with a parade of staff and students over decades of research, as well as the talent to effectively administer a large institution towards significant advances, and to promote those achievements convincingly. In the beginning, Pavlov investigated digestion, for which he was awarded the Nobel Prize in 1904. In 1901, he discovered the conditioned reflex, and thereafter Pavlov's research was guided by the conditioned reflex. At the time of his speech to the congress of international psychologists in 1929, Pavlov's current research activity was elaborated in his contribution to Murchenson's anthology, *Psychologies of 1930* (Pavlov, 1930).

In 1930, after investigating cerebral functions with the conditioned reflex for almost 30 years, Pavlov was convinced that both the internal and external activity of a higher functioning animal could be studied in the context of the nervous system (Pavlov, 1930, p. 207). The internal organ processes that constituted the homeostasis necessary for life, Pavlov called the 'lower' nervous activity; the 'higher' nervous activity connected the organism with its environment. Observed as motion, behavior resulted from skeleton-muscular activity accompanied by secreting glands. Stereotyped behavior, like eating, was stimulated by specific internal stimuli ingrained in the brain's subcortical ganglia and the external circumstances. Dogs, surgically deprived of their cerebral hemispheres, continued instinctual behaviors, but they died without a caregiver serving as the brain's executive function. The cerebral hemispheres were necessary for appropriate responses to competing factors in the environment. While there was knowledge of the innate reflexes, nothing was known about the cerebral mechanism that guided behavior in the environment. With the conditioned response, the animal responded to a conditionally associated external stimulus that signaled opportunity for satisfaction of ingrained needs. The associative function was localized in the cerebral hemisphere, and the laboratory conditioned response served as an instrument for the study of the cerebral function. In 1930, when this conflict over the reflex takes place, Pavlov's research interests were focused on three fundamental topics: the unconditioned ingrained reflexive behaviors located in the ganglia of the brain, the functioning within the cortex, and the interaction between the ganglia and the cortex.

Conclusion

"Controversy has always been part of the method of science" (Boring, 1929, p. 98). Boring believed that it was necessary to acknowledge the passionate investigators who at times fought blindly for their ideas, to ignore them would mean exorcizing those who made important contributions. And, as Danziger observed, in the past psychologists had all too often substituted the history of psychologists for the history of psychology; the history of psychology was located in the conflicts, interests, assumptions, and practices "that were shared unequally by various contributors" (Danziger, 2009, p. 116),

Two questions remain. Was the cerebral reflex real? Did Boring's interest in the psychology of science lead to a lasting contribution?

Perhaps Fearing's history of the reflex offered a more comprehensive understanding of the reflex at that time; although a clear and distinct definition of the reflex eluded him, he believed that some form of the reflex concept had played an important role in all physiological and psychological systems. No other principle had eclipsed the reflex for explaining integrated behavior. Fearing was satisfied that he had covered its major points. He summarized the reflex as a 2 by 3 matrix: the two columns represented physiology and psychology, with 3 levels of classification, "Specific," "Genetic," and "Mechanical" (Fearing, 1930, p. 297).

Physiologists who interpreted the reflex as an automatic function of neural pathways were "specific." The specific reflex was localized in the anatomy. Given the right stimulus, the response was invariable. The cortex was not involved, but certain learned behaviors like bicycling could become reflexive. The "genetic" physiologist made no sharp division between simple reflexes and the more complex neuromuscular actions. The reflex was understood as the development of 'lower' types of responses into 'higher' more complex forms of behavior. Reflexes occurred without consciousness; however, they could be brought under conscious control. Habits were developed reflexes. The "mechanical" physiologist was all-inclusive. The simple reflex served as the functional element of analysis for the entire nervous system. It was the basis of all intelligent behavior. Habits became attached to stimuli through conditioning of associations between stimuli and response, and the conditioned reflex was a method for investigating higher nervous centers.

With regard to the debate analyzed here, and with the customary scholarly qualifications due to a complex issue, Lashley represented the 'specific' point of view. Guthrie represented the 'genetic' point of view. And Pavlov represented the 'mechanical,' where reflex was the prototypical action. Biographical details of their intellectual histories provided an insight into the origins of their respective prejudices. Lashley's training was in genetics, and his goal was to establish American psychology as a laboratory science. Pavlov's training was in organ functions related to neurology, and his goal was the investigation of the higher cerebral functions. Guthrie's training was in logical systems, and his goal was a systematic theory of learning.

An alternative answer to the reflex's scientific truth is provided by the theory of 'reification' (Boring, 1953). Reification is a process by which a hypothetical idea becomes real. Science consists of conceptual elements, constructs that denote things and their relationships. Psychology's constructs are generalizations empirically supported by experiments. The difference between theory and fact is a question of how far along the reification process a generalization has progressed. A generalization begins as a construct when it has only one operational definition. If it acquires alternative operational definitions, it begins to be validated. After it acquires many operational definitions, it attains the status of being real by virtue of its versatility and consistency.

ISSN: 2445-0928 DOI: https://doi.org/10.5093/rhp2024a8

Finally, does biographical historiography contribute substantively to psychology's history? In the introduction to his 1929 *A History of Experimental Psychology*, Boring gave two reasons for focusing his narrative on personalities. First, he found that authority made a difference, what Wundt said was important regardless of supporting evidence. And then, as a psychologist, the question haunted Boring, "… if personalities lie, in part, back of psychology, what lies back of the personalities? … I have never been able to get this question out of my mind" (Boring, 1929b, p. X).

Boring's interest in biography developed as he wrote *A History of Experimental Psychology*. In the years prior to completion, there is substantive evidence that Boring was thinking about the dynamic psychological forces that contributed to scientific progress. In 1927 he published *The Problem of the Originality in Science*, and in December of 1928 he addressed the American Psychological Association with his speech *The Psychology of* Controversy, but perhaps the most interesting artifact revealing Boring's thinking was his 1928 letter to Carl Murchison.

Murchison (1930), the editor of *A History of Psychology in Autobiography,* noted in the preface: "The initial idea, which later developed into the general plan was contained in a letter of April 10, 1928 from Edwin G. Boring…" Murchinson launched volume one with Boring's idea: "The author of a recent history of psychology found that it was impossible to get important facts concerning the scientific development of certain individuals except from those individuals themselves. Since a science separated from its history lacks direction and promises a future of uncertain importance, it is a matter of consequence to those who wish to understand psychology for those individuals who have greatly influenced contemporary psychology to put into print as much of their personal histories as bears on their professional careers" (Murchinson, 1930, ix).

The first volume of the autobiographies of scientists who contributed to psychology was published in 1930. The selected individuals were given the following instructions: "… to write their own intellectual histories and criticisms, to transform themselves into philosophical historians, and treat themselves as though they had been dead for a long time" (Murchinson, 1930, p. 123). The first volume in 1930 featured 15 internationally esteemed psychologists. The latest volume was published in 2010.

References

Boring, E. G. (1927). The Problem of Originality in Science. *The American Journal of Psychology, 39*, 70-90.

Boring, E.G. (1929a) The Psychology of Controversy. *The Psychological Review, 36*(2), 97-121.

Boring, E. G. (1929b) *The History of Experimental Psychology*. New York: D. Appleton-Century Co.

Boring, E.G. (1953) The Role of Theory in Experimental Psychology. *The American Journal of Psychology*, *66,* 169-184.

Boring, E. G. (1957). *A History of Experimental Psychology* (2nd ed.). New York: Appleto -Century-Crofts, Inc.

Clark, D. O. (2007). *Philosopher to Psychologist: The Early Career of Edwin Ray Guthrie JR.* Unpublished dissertation. York University: Toronto, Canada.

Clark, D. (2022). Pavlov: Vivsectionist of the Mind. *Revista de Historia de la Psicologia*, *43*(2) 2-9.

Clark, D.O. (2023). A Science of Adaptation: the transnational origins of the American functional behaviorism of the 20th century. *Revista de Historia de la Psicologia, 44*(3), 11-18.

Danziger, K. (2009). Confessions of a Marginal Psychologist. In L.P. Mos (Ed) *History of Psychology in Autobiography* (p. 89-129). New York: Springer Dordrecht.

Duncan, C.P. (1980). A Note on the 1929 International Congress of Psychology. *Journal of the History of the Behavioral Sciences*, *16*, 1-5.

Fearing, F. (1930). *Reflex Action: A Study in the History of Physiological Psychology*. Baltimore, M.: The Williams & Wilkins Co.

Guthrie, E. R. (1930). Conditioning as a Principle of Learning. *The Psychological Review, 37,* 412-428.

Kluckhohn, C. & Murray, H. (Eds), (1948). *Personality in Nature, Society, and Culture*. New York: Alfred A. Knopf, Inc.

Langfeld, H.S. (1929) The Ninth International Congress of Psychology. *Science, New Series. 70* (1816), 364-368.

Lashley, K.S. (1929). *Brain Mechanisms and Intelligence: A Quantitative Study of Injuries to the Brain*. Chicago: The University of Chicago.

Lashley, K.S. (1930). Basic Neural Mechanisms in Behavior. *The Psychological Review*. *37*(1), 1-24.

Murchison, C. (Ed.), (1961). *A History of Psychology in Autobiography* (Vol. 1), New York: Russell & Russel.

Pavlov, I.P. (1927). *Conditioned Reflexes: An Investigation of the Physiological Activity of the Cerebral Cortex* (translated and edited by G.V. Anrep). Oxford University Press, UK.

Pavlov, I.P. (1930) In c. Murchison (Ed.). A Brief Outline of the Higher Nervous Activity. *Psychologies of 1930* (pp. 207-220). Worcester, MA.: Clark University Press.

Pavlov, I.P. (1932). The Reply of a Physiologist to Psychologists. *The Psychological Review*. *39*(2), 91-127.

Sheffield, F. D. (1959). Edwin Ray Guthrie: 1886-1959. *American Journal of Psychology*, *72*,642-50.

Schiller, F.C.S. (1930). The Yale Congress of Psychology. *Mind*. *39*(153), 129-130.

Smith, S. & Guthrie, E. (1927). *General Psychology in Terms of Behavior*. New York: D. Appleton & Co.

Todes, D.P. (2014). *Ivan Pavlov: A Russian Life in Science*. Oxford University Press.

Weidman, N.M. (1999). *Constructing Scientific Psychology: Karl Lashley's Mind-Brain Debates*.Cambridge University Press.

ISSN: 2445-0928 DOI: https://doi.org/10.5093/rhp2024a8