1872 — **Charles Darwin** publishes *The Expression of the Emotions in Men and Animals* arguing that behaviors are evolutionary adaptations.

1898 — Edward Thorndike's **Law of Effect** states that responses which produce satisfying effects are more likely to be repeated.

1913 — John B. Watson publishes *Psychology As The Behaviorist Views It*, which becomes the unofficial **behaviorist manifesto**.

1920 — John B. Watson experiments on "Little Albert," teaching the baby a **conditioned emotional response**.

1927 — Ivan Pavlov demonstrates **classical conditioning** in his experiments on dogs.

1929 — Karl Lashley's experiments in brain dissection show that **the whole brain is involved in learning**.

1930 — Zing-Yang Kuo's experiments with cats and rats attempt to show that **there is no such thing as instinct**.

1930 — B.F. Skinner demonstrates the effects of **"operant conditioning"** in experiments on rats.

By the 1890s, psychology was accepted as a scientific subject separate from its philosophical origins. Laboratories and university departments had been established in Europe and the US, and a second generation of psychologists was emerging.

In the US, psychologists anxious to put the new discipline on an objective, scientific footing reacted against the introspective, philosophical approach taken by William James and others. Introspection, they felt, was by definition subjective, and theories based on it could be neither proved nor disproved; if psychology was to be treated as a science, it would have to be based on observable and measurable phenomena. Their solution was to study the manifestation of the workings of the mind—behavior—under strictly controlled laboratory conditions. As John B. Watson put it, psychology is "that division of Natural Science which takes human behavior—the doings and sayings, both learned and unlearned—as its subject matter." Early "behaviorists," including Edward Thorndike, Edward Tolman, and Edwin Guthrie, designed experiments to observe the behavior of animals in carefully devised situations, and from these tests inferred theories about how humans interact with their environment, as well as about learning, memory, and conditioning.

Conditioning responses

Behaviorist experiments were influenced by similar experiments devised by physiologists studying physical processes, and it was a Russian physiologist, Ivan Pavlov, who unwittingly provided a basis for the emergent behaviorist psychology. In his now famous study of salivation in dogs, Pavlov described how an animal responds to a stimulus in the process of conditioning, and gave psychologists the foundation on which to build the central idea of behaviorism. The notion of conditioning, often referred to as "stimulus–response" (S–R) psychology, shaped the form behaviorism was to take.

The behaviorist approach concentrated on observing responses to external stimuli, ignoring inner mental states and processes, which were thought to be impossible to examine scientifically and therefore could not be included in any analysis of

1935 Konrad Lorenz discovers the phenomenon of **imprinting**, where baby animals assume a parent because of sensory information received at a critical time.

1938 Edwin Guthrie suggests that **"single-trial learning"** is adequate; conditioning need not rely on repetition.

1943 Clark L. Hull states that **drive reduction** (satisfying our basic human needs) is the only true basis of reinforcement.

1948 *Cognitive Maps in Rats and Men* by Edward Tolman suggests that we develop **cognitive maps** while we go about our daily lives.

1957 B.F. Skinner publishes *Verbal Behavior*, in which he claims that speech is a product of past **behavioral and genetic history**.

1958 Joseph Wolpe conducts **desensitization techniques** on war veterans suffering from "war neurosis."

1959 Noam Chomsky writes a critical review of *Verbal Behavior* that helps spark the **cognitive revolution**.

1960s Neal Miller's experiments lead to the discovery of **biofeedback** techniques.

behavior. The shift from "mind" to "behavior" as a basis for the study of psychology was revolutionary, and was even accompanied by a "behaviorist manifesto"—the paper *Psychology as the Behaviorist Views It*, delivered in 1913 by Watson.

In the US, which was leading the field in psychology, behaviorism became the dominant approach for the next 40 years. Evolving from the idea of Pavlovian or classical conditioning came Watson's assertion that environmental stimuli alone shape behavior; innate or inherited factors are not involved. The next generation included the "radical behaviorist" B.F. Skinner, who proposed a rethink of the stimulus–response notion in his theory of "operant conditioning"—which stated that behavior was shaped by consequences, not by a preceding stimulus. Although the concept was similar to ideas proposed by William James, it radically altered the course of behaviorism, taking into account genetic factors and explaining mental states as a result (rather than as a cause) of behavior.

The cognitive revolution

By the mid-20th century, however, psychologists were questioning the behaviorist approach. Ethology, the study of animal behavior, showed the importance of instinctive as well as learned behavior—a finding that sat uncomfortably with strict ideas of conditioning. A reaction to Skinner's ideas also sparked the "cognitive revolution," which turned attention once again from behavior back to the mind and mental processes. A key figure at this time was Edward Tolman, a behaviorist whose theories had not dismissed the importance of perception and cognition, due to his interest in German-based Gestalt psychology. Advances in neuroscience, explored by another behaviorist, Karl Lashley, also played a part in shifting the emphasis from behavior to the brain and its workings.

Behaviorism had now run its course, and was superseded by the various branches of cognitive psychology. However, its legacy, particularly in establishing a scientific methodology for the subject, and in providing models that could be used in psychological experimentation, was a lasting one. Behavioral therapy is also still in use today, as an essential part of cognitive-behavioral therapy. ■

THE SIGHT OF TASTY FOOD MAKES A HUNGRY MAN'S MOUTH WATER

IVAN PAVLOV (1849–1936)

IN CONTEXT

APPROACH
Classical conditioning

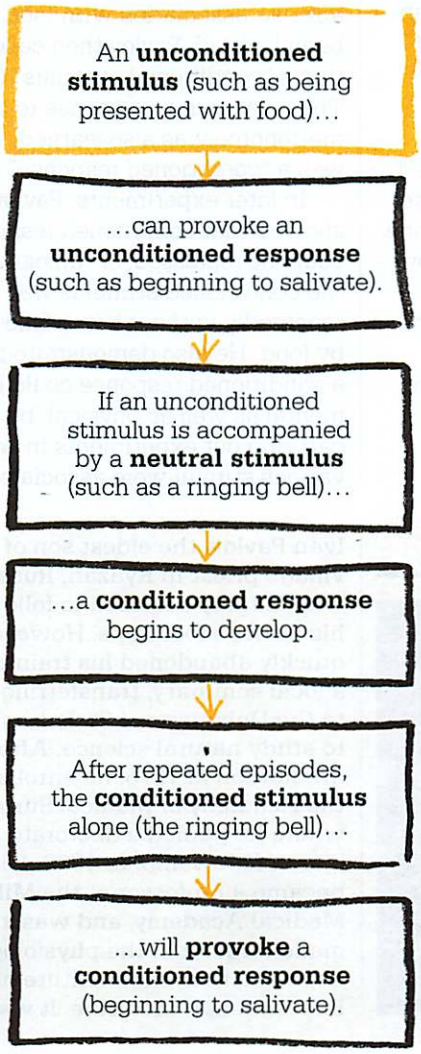
BEFORE
Early 12th century Arab physician Avenzoar (Ibn Zuhr) performs experiments on animals in order to test surgical procedures.

1890 In *Principles of Psychology,* William James states that in animals "the feeling of having executed one impulsive step is an indispensable part of the stimulus of the next one."

AFTER
1920 John B. Watson's "Little Albert" experiment demonstrates classical conditioning in humans.

1930s B.F. Skinner shows that rats can be "conditioned" to behave in a specific way.

1950s Psychotherapists employ "conditioning" as part of behavior therapy.



Many of the key discoveries made when modern psychology was still in its infancy were the result of research by scientists working in other fields. Ivan Pavlov, a Russian physiologist, is one of the best known of these early pioneers, whose investigations into the secretion of saliva during digestion in dogs led him to some unexpected conclusions.

During the 1890s, Pavlov carried out a series of experiments on dogs, using various surgically implanted devices to measure the flow of saliva when these animals were being fed. He noted that the dogs salivated not only when they were actually eating, but also whenever they could just smell or see some appetizing food. The dogs would even salivate, in anticipation of food being produced, when they were simply being approached by one of their keepers.

Pavlov's observations led him to investigate the links between various stimuli and the responses they elicited. In one experiment, he set off a clicking metronome just before offering food to the dogs, repeating this process until the animals always associated the sound with a good meal. This

See also: William James 38–45 ▪ John B. Watson 66–71 ▪ B.F. Skinner 78–85 ▪ Stanley Schachter 338

Pavlov's dogs would salivate simply at the sight of someone in a white lab coat. They had become "conditioned" to associate the coat with eating, as whoever fed them always wore one.

"conditioning" eventually resulted in the dogs salivating in response to the click of the metronome alone.

In further experiments, Pavlov replaced the metronome with a bell or buzzer, a flashing light, and whistles of different pitches. However, regardless of the nature of the stimulus used, the result was the always same: once an association between the neutral stimulus (bell, buzzer, or light) and food had been established, the dogs would respond to the stimulus by salivating.

Conditioned response

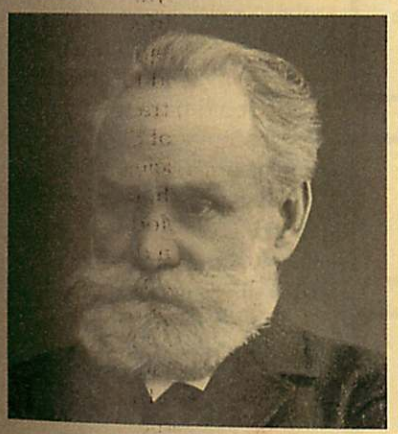
Pavlov concluded that the food offered to the dogs was an "unconditioned stimulus" (US), because it led to an unlearned, or "unconditioned" response (UR)—in this case, salivation. The click of the metronome, however, only became a stimulus to salivation after its association with food had been learned. Pavlov then called this a "conditioned stimulus" (CS). The salivation in response to the metronome was also learned, so was a "conditioned response" (CR).

In later experiments, Pavlov showed that conditioned responses could be repressed, or "unlearned," if the conditioned stimulus was given repeatedly without being followed by food. He also demonstrated that a conditioned response could be mental as well as physical, by carrying out experiments in which various stimuli were associated with pain or some form of threat and began to elicit a conditioned response of fear or anxiety.

The principle of what is now known as classical or Pavlovian conditioning, as well as Pavlov's experimental method, marked a groundbreaking step in the emergence of psychology as a truly scientific, rather than philosophical, discipline. Pavlov's work was to be hugely influential, particularly on US behaviorist psychologists, such as John B. Watson and B.F. Skinner. ■

> "Facts are the air of science. Without them a man of science can never rise."
> **Ivan Pavlov**

Ivan Pavlov



Ivan Pavlov, the eldest son of a village priest in Ryazan, Russia, was initially destined to follow in his father's footsteps. However, he quickly abandoned his training at a local seminary, transferring to the University of St. Petersburg to study natural science. After graduation in 1875, he enrolled at the Academy of Medical Surgery, where he gained a doctorate and later a fellowship. In 1890, Pavlov became a professor at the Military Medical Academy, and was also made director of the physiology department at the Institute of Experimental Medicine. It was here that he carried out his famous research into the digestive secretions of dogs, which won him the Nobel Prize in 1904. Pavlov retired officially in 1925, but continued his experiments until his death from pneumonia in February 1936.

Key works

1897 *Lectures on the Work of the Principal Digestive Glands*
1928 *Lectures on Conditioned Reflexes*
1941 *Conditioned Reflexes and Psychiatry*

PROFITLESS ACTS ARE STAMPED OUT

EDWARD THORNDIKE (1874–1949)

IN CONTEXT

APPROACH
Connectionism

BEFORE
1885 In his book *On Memory*, Hermann Ebbinghaus describes the "forgetting curve"—the rate at which human memories fade.

1890s Ivan Pavlov establishes the principle of classical conditioning.

AFTER
1918 John B. Watson's "Little Albert" experiments apply conditioning to a human baby.

1923 English psychologist Charles Spearman proposes a single general factor—the "g factor"—in measurements of human intelligence.

1930s B.F. Skinner develops a theory of conditioning from consequences—"operant conditioning".

At much the same time as Pavlov was conducting his experiments on dogs in Russia, Edward Thorndike began researching animal behavior for his doctoral thesis in the US. He was perhaps the first true "behaviorist" psychologist, although his research took place long before the term was adopted.

Scientific psychology was emerging as a fresh field of study in universities when Thorndike graduated in the 1890s, and he was attracted by the prospect of applying this new science to his interest in education and learning. Thorndike's original intention had been to study learning in humans,

See also: Hermann Ebbinghaus 48–49 ▪ Ivan Pavlov 60–61 ▪ John B. Watson 66–71 ▪ Edward Tolman 72–73 ▪ B.F. Skinner 78–85 ▪ Donald Hebb 163 ▪ Hans Eysenck 316–21

> Psychology helps to measure the probability that an aim is attainable.
> **Edward Thorndike**

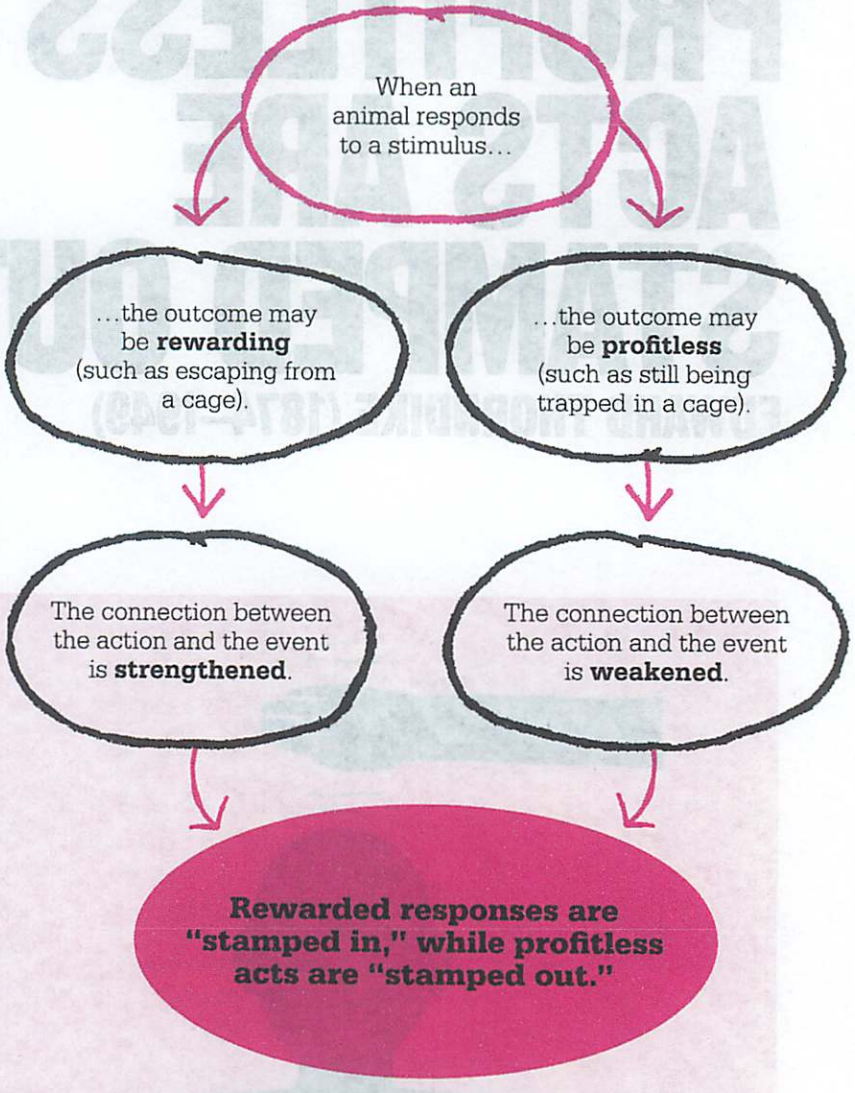
but when he was unable to obtain a suitable subject for his research, he turned his attention to animals, with the aim of examining the processes of intelligence and learning through observation in a series of controlled experiments. Thorndike's results went much further than this, however, laying down the foundations of behaviorist psychology.

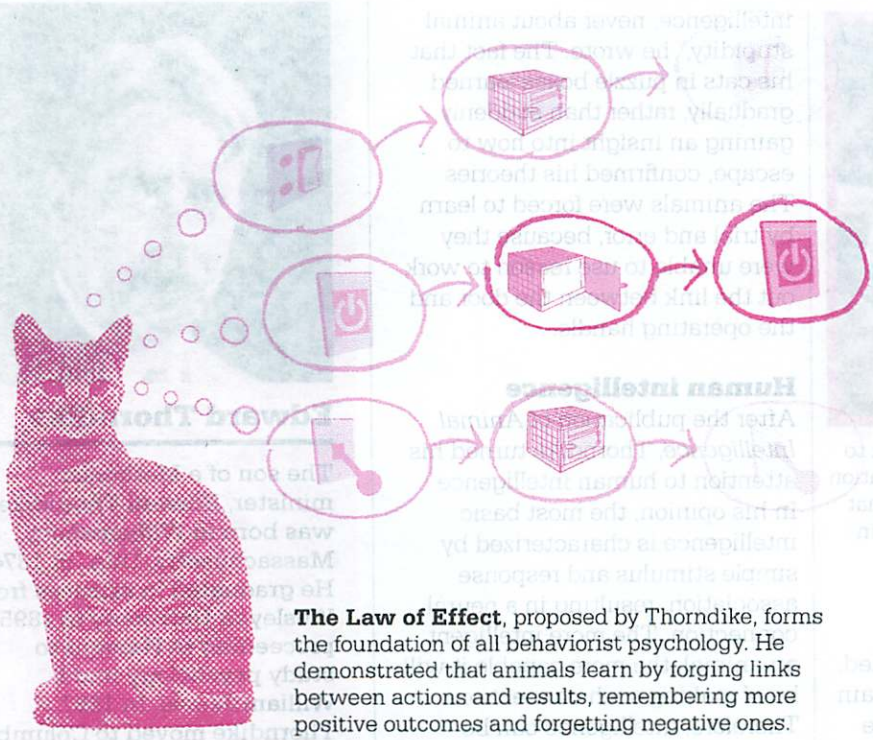
Learning environments

Thorndike's first studies were of chicks learning to negotiate mazes that he designed and built specifically for his experiments. This later became a hallmark of behaviorist experimental technique—the use of a specially created environment in which a subject is given specific stimuli or tasks, now known as "instrumental conditioning" or "instrumental learning." As his research progressed, Thorndike turned his attention to cats, inventing "puzzle boxes" to observe their ability to learn mechanisms for escape.

A hungry cat was locked inside a puzzle box, and by exploring its environment would come across various devices, such as a loop of string, or a ring, or a button or panel to be pressed, only one of which would be connected to the latch that would open the door of the box. In time, the cat would discover the device, which would allow it to escape and receive a reward of food. The process was repeated and it was noted how long it took for the cat to open the puzzle box each time; this indicated how quickly the animal was learning about its environment.

The experiment was carried out using several different cats, placing each one in a series of puzzle boxes that were opened by different devices. What Thorndike noticed was that although the cats had all discovered the escape mechanism by trial and error in their first »





The Law of Effect, proposed by Thorndike, forms the foundation of all behaviorist psychology. He demonstrated that animals learn by forging links between actions and results, remembering more positive outcomes and forgetting negative ones.

attempt, on successive occasions the amount of trial and error gradually decreased as the cats learned which actions were going to be fruitless and which would lead to a reward.

The Law of Effect

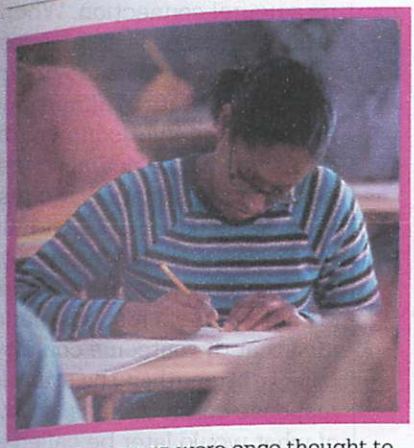
As a result of these experiments Thorndike proposed his Law of Effect, which states that a response to a situation that results in a satisfying outcome is more likely to occur again in the future; and conversely, that a response to a situation that results in an unsatisfying outcome is less likely to occur again. This was the first formal statement of an idea that lies behind all behavorist psychology, the connection between stimulus and response and its relevance to the process of learning and behavior. Thorndike proposed that when a connection is made between a stimulus (S) and a response (R), a corresponding neural connection is made in the brain. He referred to his brand of S-R learning as "connectionism," asserting that the connections made during learning are "stamped in" the circuitry of the brain.

What Thorndike proposed was that it is the outcome of an action that determines how strongly or weakly the stimulus-response connection is stamped in; in the case of the puzzle boxes, whether pulling a string or pushing a panel resulted in escape or frustration. In other words, when particular stimulus-response sequences are followed by a satisfying or pleasant state of affairs (such as escape or a reward), those responses tend to become "more firmly connected with the situation, so that, when it recurs, they will be more likely to recur." They become "stamped in" as a neural connection. When stimulus-response sequences are followed by an annoying or unpleasant state of affairs (such as continued imprisonment or punishment), the neural connections between the situation and response are weakened, until eventually "profitless acts are stamped out."

This focus on the outcome of a stimulus and its response, and the idea that the outcome could work back to strengthen the stimulus-response connection, is an example of what would later be called a reinforcement theory of learning. Reinforcement, and the importance of outcomes, was virtually ignored by psychologists in the next generation of behaviorists, such as John B. Watson, but the Law of Effect brilliantly anticipated the work of B.F. Skinner and his theory of "operant conditioning."

In later research, Thorndike refined the Law of Effect to take into account other variables, such as the delay between response and reward, the effect of repetition of a task, and how quickly a task was forgotten when it was not repeated. From this, he derived his Law of Exercise, which states that

> "The intellect, character, and skill possessed by any man are the product of certain original tendencies and the training which they have received."
>
> **Edward Thorndike**



Adult learners were once thought to be less capable of retaining information than children. Thorndike showed that the only significant difference was in speed of learning, not memory.

stimulus-response connections that are repeated are strengthened, while those that are not used again are weakened. Moreover, the rate at which connections strengthen or weaken can vary. According to Thorndike, "the greater the satisfaction or discomfort, the greater the strengthening or weakening of the bond."

Interestingly, although Thorndike was studying animal behavior using what were to become standard behaviorist methods—and authoring a book, *Animal Intelligence* (1911), which was to become a classic of early behaviorism—he considered himself primarily an educational psychologist. He had originally intended to examine animal intelligence, not behavior. He wanted to show, for example, that animals learned by simple trial and error rather than by using a faculty of insight, an idea that was prevalent in psychology at the time: "In the first place, most of the books do not give us a psychology, but rather a eulogy of animals. They have all been about animal intelligence, never about animal stupidity," he wrote. The fact that his cats in puzzle boxes learned gradually, rather than suddenly gaining an insight into how to escape, confirmed his theories. The animals were forced to learn by trial and error, because they were unable to use reason to work out the link between the door and the operating handle.

Human intelligence

After the publication of *Animal Intelligence*, Thorndike turned his attention to human intelligence. In his opinion, the most basic intelligence is characterized by simple stimulus and response association, resulting in a neural connection. The more intelligent an animal, the more capable it will be of making such connections. Therefore, intelligence can be defined in terms of the ability to form neural bonds, which is dependent not only on genetic factors, but also on experience.

To find a measurement of human intelligence, Thorndike devised his CAVD (Completion, Arithmetic, Vocabulary, and Directions) test. It became the model for all modern intelligence tests, and assessed mechanical intelligence (understanding of how things work), as well as abstract intelligence (creative ability) and social intelligence (interpersonal skills). Thorndike was especially interested in how age might affect learning, and also proposed a theory of learning that remains at the heart of educational psychology to this day, a contribution that is perhaps what Thorndike would have wished more than anything else to be remembered for. However, it is for his enormous influence on the behaviorist movement that Thorndike is most often lauded. ■

Edward Thorndike

The son of a Methodist minister, Edward Thorndike was born in Williamsburg, Massachusetts, USA, in 1874. He graduated in sciences from Wesleyan University in 1895, proceeding to Harvard to study psychology under William James. In 1897, Thorndike moved to Columbia University in New York City, where he completed his doctorate thesis in 1898.

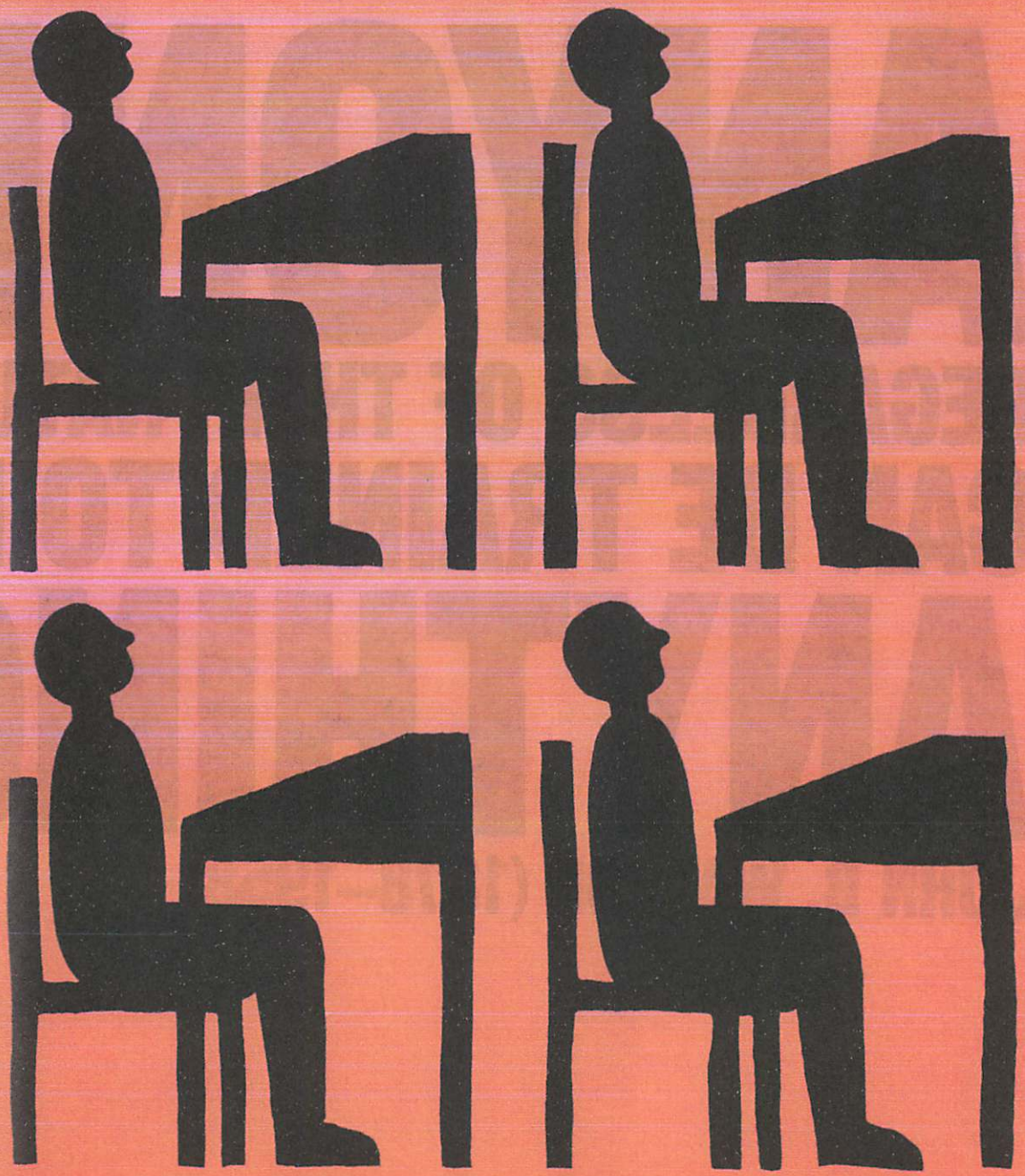
Thorndike's interest in educational psychology led to a teaching post at the College for Women of Case Western Reserve in Cleveland, Ohio, but he returned to Columbia just a year later, in 1899, teaching there until his retirement in 1939. In 1912, his peers elected him President of the American Psychological Association. Thorndike continued to research and write until his death, aged 74, in Montrose, New York.

Key works

1905 *The Elements of Psychology*
1910 *The Contribution of Psychology to Education*
1911 *Animal Intelligence*
1927 *The Measurement of Intelligence*

ANYONE REGARDLESS OF THEIR NATURE CAN BE TRAINED TO BE ANYTHING

JOHN B. WATSON (1878–1958)



IN CONTEXT

APPROACH
Classical behaviorism

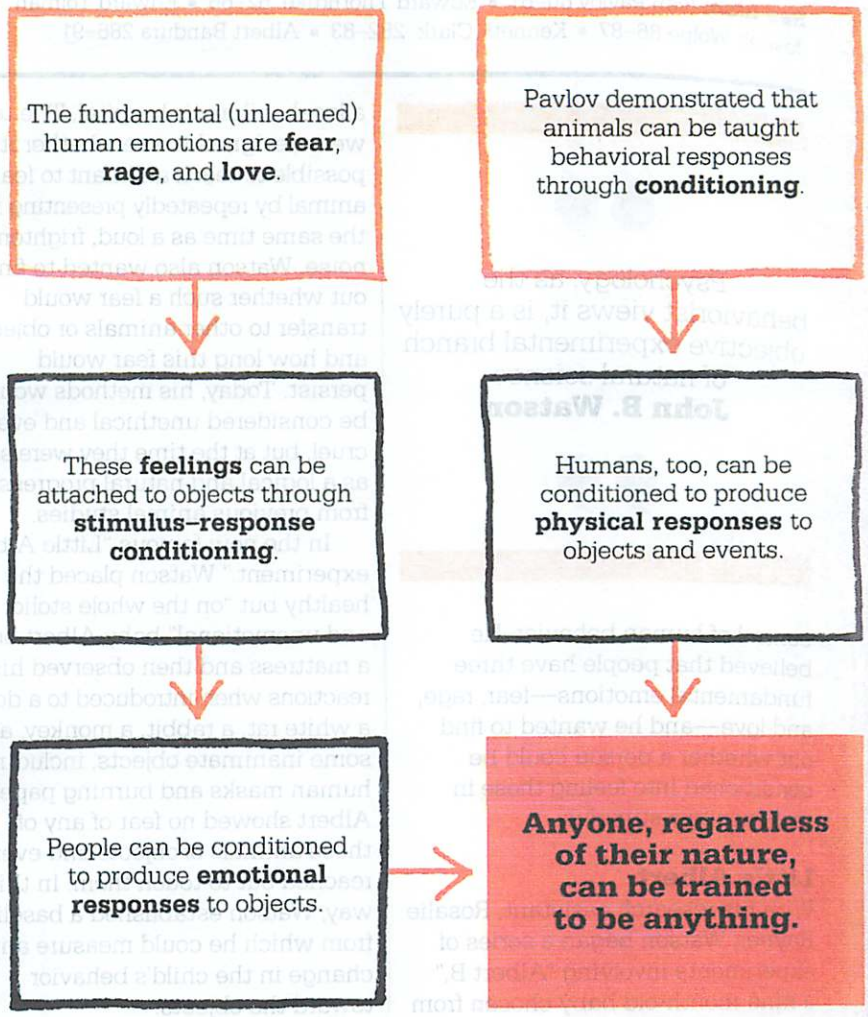
BEFORE
1890s German-born biologist Jacques Loeb (one of Watson's professors) explains animal behavior in purely physical-chemical terms.

1890s The principle of classical conditioning is established by Ivan Pavlov using experiments on dogs.

1905 Edward Thorndike shows that animals learn through achieving successful outcomes from their behavior.

AFTER
1932 Edward Tolman adds cognition into behaviorism in his theory of latent learning.

1950s Cognitive psychologists focus on understanding the mental processes that both lie behind and produce human behavior.



By the beginning of the 20th century, many psychologists had concluded that the human mind could not be adequately studied through introspective methods, and were advocating a switch to the study of the mind through the evidence of behavior in controlled laboratory experiments.

John Watson was not the first advocate of this thoroughgoing behaviorist approach, but he was certainly the most conspicuous. In a career cut short by his marital infidelity, he became one of the most influential and controversial psychologists of the 20th century. Through his work on the stimulus–response learning theory that had been pioneered by Thorndike, he became regarded as the "founding father" of behaviorism, and he did much to popularize the use of the term. His 1913 lecture, *Psychology as the Behaviorist Views It*, put forward the revolutionary idea that "a truly scientific psychology would abandon talk of mental states... and instead focus on prediction and control of behavior." This lecture became known to later psychologists as the "behaviorist manifesto."

Before Watson's research at Johns Hopkins University, in Baltimore, Maryland, the majority of experiments on behavior had concentrated on animal behavior, with the results extrapolated to human behavior. Watson himself studied rats and monkeys for his doctorate but (perhaps influenced by his experience working with the military during World War I) was keen to conduct experiments using human subjects. He wanted to study the stimulus–response model of classical conditioning and how it applied to the prediction and

See also: Ivan Pavlov 60–61 ▪ Edward Thorndike 62–65 ▪ Edward Tolman 72–73 ▪ B.F. Skinner 78–85 ▪ Joseph Wolpe 86–87 ▪ Kenneth Clark 282–83 ▪ Albert Bandura 286–91

> Psychology, as the behaviorist views it, is a purely objective experimental branch of natural science.
> **John B. Watson**

control of human behavior. He believed that people have three fundamental emotions—fear, rage, and love—and he wanted to find out whether a person could be conditioned into feeling these in response to a stimulus.

Little Albert

With his research assistant, Rosalie Rayner, Watson began a series of experiments involving "Albert B," a nine-month-old baby chosen from a local children's hospital. The tests were designed to see whether it is possible to teach an infant to fear an animal by repeatedly presenting it at the same time as a loud, frightening noise. Watson also wanted to find out whether such a fear would transfer to other animals or objects; and how long this fear would persist. Today, his methods would be considered unethical and even cruel, but at the time they were seen as a logical and natural progression from previous animal studies.

In the now famous "Little Albert experiment," Watson placed the healthy but "on the whole stolid and unemotional" baby Albert on a mattress and then observed his reactions when introduced to a dog, a white rat, a rabbit, a monkey, and some inanimate objects, including human masks and burning paper. Albert showed no fear of any of these animals or objects and even reached out to touch them. In this way, Watson established a baseline from which he could measure any change in the child's behavior toward the objects.

On a separate occasion, while Albert was sitting on the mattress, Watson struck a metal bar with a hammer to make a sudden loud noise; unsurprisingly, Albert became frightened and distressed, bursting into tears. Watson now had an unconditioned stimulus (the loud noise) that he knew elicited a response of fear in the child. By pairing this with the sight of the rat, he hypothesized that he would be able to condition little Albert to become afraid of the animal.

When Albert was just over 11 months old, Watson carried out the experiment. The white rat was placed on the mattress with Albert, then Watson hit the hammer on the steel bar when the child touched the rat. The child burst into tears. This procedure was repeated seven times over two sessions, one week apart, after which Albert became distressed as soon as the rat was brought into the room, even when it was not accompanied by the noise.

By repeatedly pairing the rat with the loud noise, Watson was applying the same kind of classical »

John B. Watson

Born into a poor family in South Carolina, John Broadus Watson's childhood was unhappy; his father was an alcoholic womanizer who left when Watson was 13, and his mother was devoutly religious. Watson became a rebellious and violent teenager, but was a brilliant scholar, attending nearby Furman University at the age of 16. After gaining a PhD from the University of Chicago, he became associate professor at Johns Hopkins University, where his 1913 lecture became known as the "behaviorist manifesto." He worked briefly for the military during World War I, then returned to Johns Hopkins. Forced to resign after an affair with his research assistant, Rosalie Rayner, he turned to a career in advertising while still publishing books on psychology. After Rayner's death in 1935 aged 37, he became a recluse.

Key works

1913 *Psychology as the Behaviorist Views It*
1920 *Conditioned Emotional Reactions* (with Rosalie Rayner)
1924 *Behaviorism*

conditioning as Pavlov had in his experiments with dogs. The child's natural response to the noise—fear and distress—had now become associated with the rat. The child had become conditioned to respond to the rat with fear. In terms of classical conditioning, the rat was initially a neutral stimulus eliciting no particular response; the loud noise was an "unconditioned stimulus" (US) that elicited an "unconditioned response" (UR) of fear. After conditioning, the rat had become a "conditioned stimulus" (CS), eliciting the "conditioned response" (CR) of fear.

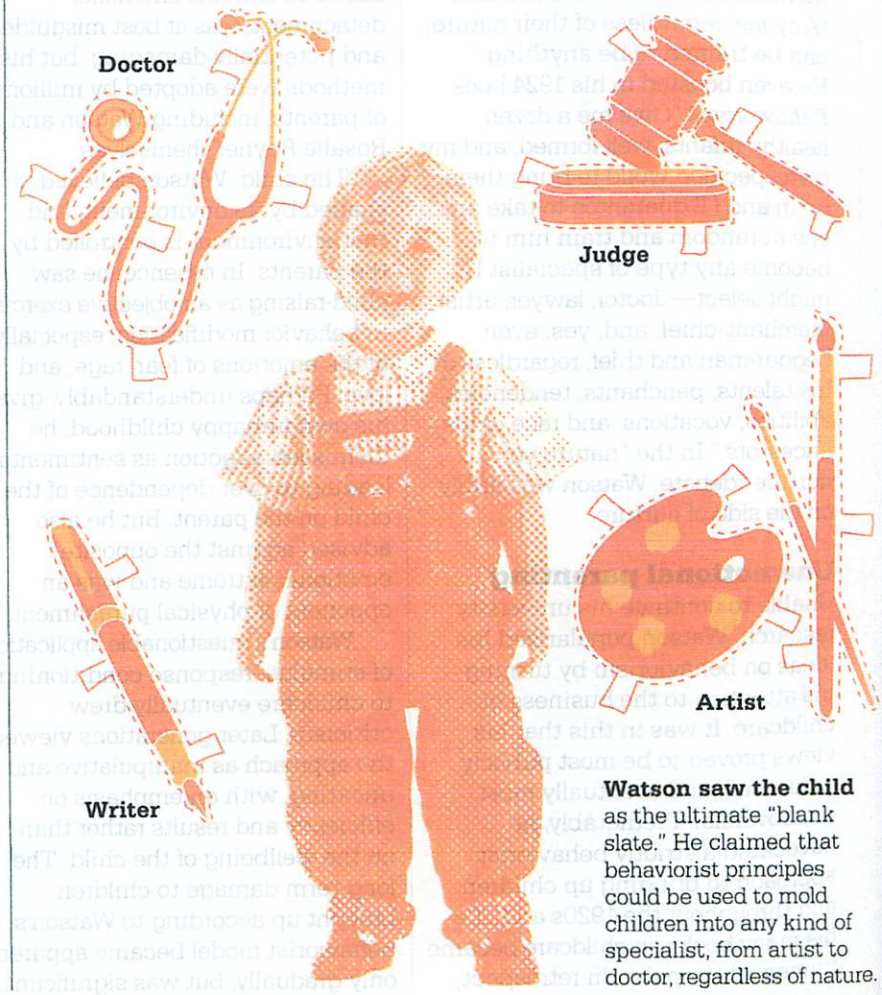
However, this conditioning seemed to go deeper than simply a fear of the white rat, and appeared to be far from temporary. In order to test whether Albert's fear had "generalized," or spread to other, similar objects, he was reintroduced to white furry things—including a rabbit, a dog, and a sheepskin coat—five days after the original conditioning. Albert showed the same distressed and fearful response to these as to the rat.

In these experiments, Watson demonstrated that human emotions are susceptible to classical conditioning. This was a new finding, because previous stimulus–response experiments had focused on testing the learning of physical behaviors. Watson had discovered that not only can human behavior be predicted—given certain stimuli and conditions—it can also be controlled and modified. A further check of Albert's reactions to the rat, rabbit, and dog one month later suggested that the effects of this conditioning were long-lasting, but this could not be proven as Albert was soon after removed from the hospital by his mother. It has been suggested that this was a sign of the mother's distress, but according to Watson and Rayner's own account, it occurred on a prearranged date.

> "I shall never be satisfied until I have a laboratory in which I can bring up children... under constant observation."
> **John B. Watson**

Infinitely malleable

Watson's career was abruptly brought to an end shortly after the Little Albert experiments when he was forced to resign his professorship amid the scandal of his affair with his researcher, Rosalie Rayner. Despite the incompleteness of his research, Watson felt vindicated in his belief in behaviorism, and more particularly the application of classical stimulus–response conditioning to humans. Perhaps



Watson saw the child as the ultimate "blank slate." He claimed that behaviorist principles could be used to mold children into any kind of specialist, from artist to doctor, regardless of nature.

because of his forced ejection from the academic world (into advertising, where he was hugely successful) he developed a tendency to overstate the scope of his findings, and with a natural gift for self-publicity continued to publish books on the subject of psychology.

Not content, for example, to claim that it is possible to condition emotional responses, he boasted that on the same principle it would be possible to control or modify almost any aspect of human behavior, no matter how complex. Just as Little Albert had been conditioned to fear certain white furry objects against his natural inclination, Watson believed that "Anyone, regardless of their nature, can be trained to be anything." He even boasted in his 1924 book *Behaviorism*: "Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I'll guarantee to take any one at random and train him to become any type of specialist I might select—doctor, lawyer, artist, merchant-chief, and, yes, even beggar-man and thief, regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors." In the "nature versus nurture" debate, Watson was firmly on the side of nurture.

Unemotional parenting

Unable to continue his university research, Watson popularized his ideas on behaviorism by turning his attention to the business of childcare. It was in this that his views proved to be most publicly influential, and eventually most controversial. Predictably, he advocated a strictly behaviorist approach to bringing up children, and throughout the 1920s and 30s his many books on childcare became immensely popular. In retrospect,

> Watsonism has become gospel and catechism in the nurseries and drawing rooms of America.
> **Mortimer Adler**

it is easy to see that his approach, based on extreme emotional detachment, was at best misguided and potentially damaging, but his methods were adopted by millions of parents, including Watson and Rosalie Rayner themselves.

The child, Watson believed, is shaped by its environment, and that environment is controlled by the parents. In essence, he saw child-raising as an objective exercise in behavior modification, especially of the emotions of fear, rage, and love. Perhaps understandably, given his own unhappy childhood, he dismissed affection as sentimental, leading to over-dependence of the child on the parent. But he also advised against the opposite emotional extreme and was an opponent of physical punishment.

Watson's questionable application of stimulus–response conditioning to childcare eventually drew criticism. Later generations viewed the approach as manipulative and uncaring, with an emphasis on efficiency and results rather than on the wellbeing of the child. The long-term damage to children brought up according to Watson's behaviorist model became apparent only gradually, but was significant. The popularity of his books as childcare "bibles" meant that a whole generation was affected by what can now be seen as a dysfunctional upbringing. Even Watson's own family suffered: Rosalie eventually saw the flaws in her husband's child-rearing theories and wrote a critical article for *Parents' Magazine* entitled "I Am the Mother of a Behaviorist's Sons," and Watson's granddaughter, the actor Mariette Hartley, gave an account of her disturbed family background in her autobiographical book *Breaking the Silence*.

Alternative approaches to childcare soon appeared, even among committed behaviorists. While accepting the basic principle of conditioning established by Watson (despite the dubious ethics of the Little Albert experiment), and using that as a starting point for his own "radical behaviorism," the psychologist B.F. Skinner was to apply behaviorism to the business of childcare in a much more benign (if eccentric) manner. ■

Watson applied his understanding of human behavior to advertising in the 1920s, demonstrating that people can be influenced into buying products through their image, not content.

THAT GREAT GOD-GIVEN MAZE WHICH IS OUR HUMAN WORLD

EDWARD TOLMAN (1886–1959)

IN CONTEXT

APPROACH
Cognitive ("purposive") behaviorism

BEFORE
1890s Ivan Pavlov's experiments with dogs establish the theory of classical conditioning.

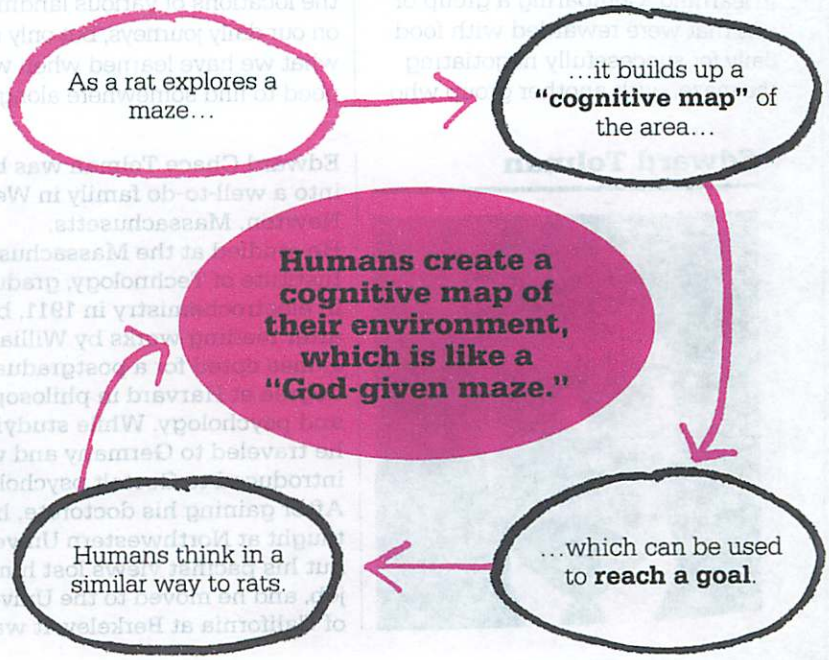
1920 John B. Watson conducts behaviorist experiments on humans, notably "Little Albert."

AFTER
1938 B.F. Skinner's research into operant conditioning uses pigeons in place of rats, and becomes more sophisticated.

1950s Cognitive psychology replaces behaviorism as the dominant movement in psychology.

1980s Joseph Wolpe's behavioral therapy and Aaron Beck's cognitive therapy merge into cognitive behavioral therapy.

Although considered one of the leading figures of US behaviorist psychology, Edward Tolman took a very different approach from that of Thorndike and Watson. He agreed with the basic methodology of behaviorism—that psychology could only be studied by objective, scientific experiments—but was also interested in ideas about mental processes, including perception, cognition, and motivation, which he had encountered while studying Gestalt psychology in Germany. By bridging these two previously separate approaches, he developed a new theory about the role of conditioning, and created what he called "purposive behaviorism," now called cognitive behaviorism.



See also: Ivan Pavlov 60–61 ▪ Edward Thorndike 62–65 ▪ John B. Watson 66–71 ▪ B.F. Skinner 78–85 ▪ Joseph Wolpe 86–87 ▪ Wolfgang Köhler 160–61 ▪ Daniel Kahneman 193

> There is more than one kind of learning.
> **Edward Tolman**

Tolman questioned the basic premise of conditioned learning (that behavior was learned simply by an automatic response to a stimulus). He believed that animals could learn about the world around them without the reinforcement of a reward, and later use that knowledge in decision-making.

He designed a series of experiments using rats in mazes to examine the role of reinforcement in learning. Comparing a group of rats that were rewarded with food daily for successfully negotiating the maze, with another group who were only rewarded after six days, and a third group rewarded after two days, Tolman's ideas were confirmed. The second and third groups made fewer errors when running the maze the day after they had been rewarded with food, demonstrating that they already "knew" their way around the maze, having learned it prior to receiving rewards. Once rewards were on offer, they were able to use the "cognitive map" they had built in order to negotiate the maze faster.

Latent learning

Tolman referred to the rats' initial learning period, where there was no obvious reward, as "latent learning." He believed that as all animals, including humans, go about their daily lives, they build up a cognitive map of the world around them—the "God-given maze"—which they can apply to locate specific goals. He gave the example of how we learn the locations of various landmarks on our daily journeys, but only realize what we have learned when we need to find somewhere along the route. Further experiments showed that the rats learned a sense of location rather than merely the turns required to reach a particular place.

In *Purposive Behavior in Animals and Men*, Tolman outlined his theory of latent learning and cognitive maps, bringing together the methodology of behaviorism with Gestalt psychology, and introducing the element of cognition. ■

A cognitive map of our surroundings develops in the course of our daily lives. We may not be aware of this until we need to find somewhere that we have passed without noticing.

Edward Tolman

Edward Chace Tolman was born into a well-to-do family in West Newton, Massachusetts. He studied at the Massachusetts Institute of Technology, graduating in electrochemistry in 1911, but after reading works by William James opted for a postgraduate degree at Harvard in philosophy and psychology. While studying, he traveled to Germany and was introduced to Gestalt psychology. After gaining his doctorate, he taught at Northwestern University, but his pacifist views lost him his job, and he moved to the University of California at Berkeley. It was here that he experimented with rats in mazes. During the McCarthy period, he was threatened with dismissal for not signing a loyalty oath that he felt restricted academic freedom. The case was overturned in 1955. He died in Berkeley, aged 73, in 1959.

Key works

1932 *Purposive Behavior in Animals and Men*
1942 *Drives Toward War*
1948 *Cognitive Maps in Rats and Men*

ONCE A RAT HAS VISITED OUR GRAIN SACK WE CAN PLAN ON ITS RETURN

EDWIN GUTHRIE (1886–1959)

IN CONTEXT

APPROACH
Learning theory

BEFORE
1890s Ivan Pavlov shows "classical conditioning" in dogs.

1890s Edward Thorndike designs the "puzzle box" for his experiments on cats.

1920s Edward Tolman queries the role of reinforcement in conditioning.

AFTER
1938 B.F. Skinner's *The Behavior of Organisms* presents the idea of operant conditioning, emphasizing the role of consequences in behavior.

1940s Jean Piaget develops a theory of learning that claims children are naturally driven to explore and acquire knowledge.

1977 Albert Bandura's *Social Learning Theory* states that behavior is learned from observing and copying the behavior of others.

By the 1920s, when American philosopher Edwin Guthrie turned his attention to psychology, the stimulus–response model of learning formed the basis of almost all behaviorist theories. Derived from Ivan Pavlov's idea of "classical conditioning," it claimed that repeatedly exposing subjects to particular stimuli combinations (such as being given food and ringing a bell) could eventually provoke conditioned responses (such as salivating when a bell is rung).

Although Guthrie was a strict behaviorist, he did not agree that conditioning needed reinforcement to be successful. He believed that a full association between a specific stimulus and response is made in their very first pairing. Guthrie's theory of one-trial learning was based on a study in which he observed cats trapped in "puzzle boxes." The cats, once they had discovered the mechanism for escape, made the association between escape and their action, which they would then repeat on subsequent occasions. In the same way, Guthrie said, once a rat has discovered a source of food, it knows where to come when it is hungry.

Guthrie expanded his idea into a theory of "contiguity," stating that "a combination of stimuli, which has accompanied a movement, will on its reoccurrence tend to be followed by that movement." A movement, not behavior, is learned from stimulus–response association. Related movements combine to form an act; repetition does not reinforce the association but leads to the formation of acts, which combine to form behavior. ■

> We expect one quarrel to change attitudes.
> **Edwin Guthrie**

See also: Ivan Pavlov 60–61 ▪ Edward Thorndike 62–65 ▪ Edward Tolman 72–73 ▪ B.F. Skinner 78–85 ▪ Jean Piaget 262–69 ▪ Albert Bandura 286–91

NOTHING IS MORE NATURAL THAN FOR THE CAT TO "LOVE" THE RAT

ZING-YANG KUO (1898–1970)

IN CONTEXT

APPROACH
Behavioral epigenetics

BEFORE
1874 Francis Galton addresses the nature–nurture controversy in *English Men of Science: Their Nature and Nurture.*

1924 John B. Watson makes his famous "dozen infants" boast that anyone, regardless of their basic nature, can be trained to be anything.

AFTER
1938 B.F. Skinner in *The Behavior of Organisms* explains his radical behaviorist ideas, claiming that circumstances, not instinct, govern behavior.

1942 Edward Tolman publishes *Drives Toward War*, which examines whether aggression is conditioned or instinctive.

1966 Konrad Lorenz publishes *On Aggression*, explaining aggressive behavior as an innate response.

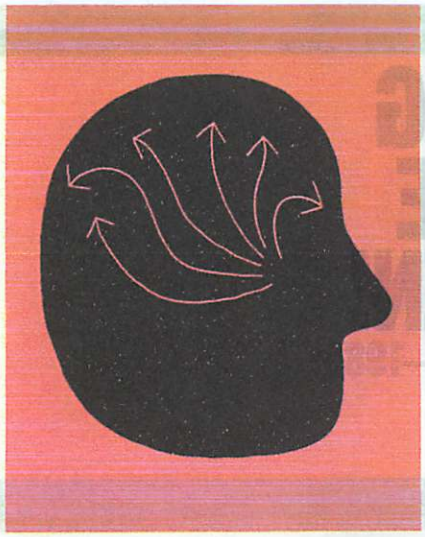
In the 1920s, behaviorist John B. Watson was claiming that even innate behavior could be altered by conditioning. But it was the Chinese psychologist Zing-Yang Kuo who took the behaviorist idea to its extreme, denying the existence of instinct as an explanation for behavior.

Kuo felt that instinct was just a convenient way for psychologists to explain behavior that did not fit current theory: "Our behavior researches in the past have been in the wrong direction, because, instead of finding how we could build nature into the animal, we have tried to find nature in the animal." Kuo's most well-known experiments involved rearing kittens—some raised from birth in cages with rats, others introduced to rats at later stages. He found that "if a kitten was raised in the same cage with a rat since it was very young, it, when grown-up, became tolerant of rats: not only would it never attack a rat, but it adopted the rat as its 'mate', played with it, and even became attached to it."

Harmonious relationships, Kuo proved, can exist between animals that are traditionally regarded as enemies. He concluded that there is no "innate mechanism" driving them to fight.

Kuo's work was cut short by political events in China, which forced him to flee first to the US, then Hong Kong. His ideas only became known in the West as behaviorism was beginning to wane and cognitive psychology was in the ascendant. However, his theory of ongoing development without innate mechanisms was influential as a counter to the instinct-based psychology of Konrad Lorenz. ■

See also: Francis Galton 28–29 ▪ John B. Watson 66–71 ▪ Edward Tolman 72–73 ▪ Konrad Lorenz 77 ▪ B.F. Skinner 78–85



LEARNING IS JUST NOT POSSIBLE

KARL LASHLEY (1890–1958)

IN CONTEXT

APPROACH
Neuropsychology

BEFORE
1861 French anatomist Paul Broca locates the area of the brain responsible for speech.

1880s Spanish pathologist and neuroscientist Santiago Ramón y Cajal develops the theory that the body's nervous system is made up of cells, which German anatomist Heinrich Waldeyer-Hartz later calls "neurons."

AFTER
1949 Donald Hebb describes the formation of cell assemblies and phase sequences in the process of associative learning.

From 1980 Modern brain-imaging techniques such as CT, fMRI (functional magnetic resonance imaging) and PET (positron emission tomography) scanning allow neuroscientists to map specific brain functions.

American physiologist-turned-psychologist Karl Lashley was interested in what happens physically in the brain during the learning process. Pavlov and other behaviorists had suggested that conditioning causes chemical or electrical changes in the brain, and Lashley wanted to pinpoint exactly what these were.

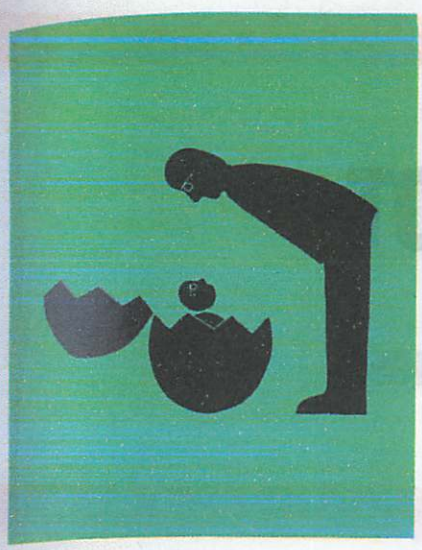
In particular, Lashley wanted to locate the memory trace, or "engram," the specific place in the brain responsible for memory. Like many behaviorists, he used rats in mazes as the basis of a learning experiment. First, the rats learned to find their way through the maze to reach a food reward. Then, Lashley performed surgery on them to remove specific but different parts of the cerebral cortex from each one. After this, the rats were replaced in the maze to test their memory and learning abilities.

> There is no great excess of cells which can be reserved as the seat of special memories.
> **Karl Lashley**

No place for memory

What Lashley found was that no matter which part of the brain he removed, the rats' memory of the task remained. Their learning and retention of new tasks was impaired, but the amount of impairment depended on the extent, not the location, of the damage. He came to the conclusion that the memory trace is not localized in a particular place, but distributed evenly throughout the cerebral cortex; each part of the brain is therefore equally important, or equipotential. Decades later, he said that his experiment had led him to "sometimes feel… that the necessary conclusion is that learning is just not possible." ■

See also: John B. Watson 66–71 ▪ Donald Hebb 163 ▪ George Armitage Miller 168–73 ▪ Daniel Schacter 208–09 ▪ Roger Brown 237



IMPRINTING CANNOT BE FORGOTTEN!

KONRAD LORENZ (1903–1989)

IN CONTEXT

APPROACH
Ethology

BEFORE
1859 English biologist Charles Darwin publishes *On the Origin of Species*, describing the theory of natural selection.

1898 Lorenz's mentor, German biologist Oskar Heinroth, begins his study of duck and goose behavior, and describes the phenomenon of imprinting.

AFTER
1959 Experiments by the German psychologist Eckhard Hess show that in imprinting, what has been learned first is remembered best; whereas in association learning, recent learning is remembered best.

1969 John Bowlby argues that the attachment of newborn babies to their mothers is a genetic predisposition.

The Austrian zoologist and doctor Konrad Lorenz was one of the founding fathers of ethology—the comparative study of animal behavior in the natural environment. He began his work observing geese and ducks at his family's summer house in Altenberg, Austria. He noticed that the young birds rapidly made a bond with their mother after hatching, but could also form the same attachment to a foster parent if the mother was absent. This phenomenon, which Lorenz called "imprinting," had been observed before, but he was the first to study it systematically. Famously, he even persuaded young geese and ducks to accept him (by imprinting his Wellington boots) as a foster parent.

What distinguishes imprinting from learning, Lorenz discovered, is that it happens only at a specific stage in an animal's development, which he called the "critical period." Unlike learning, it is rapid, operates independently of behavior, and appears to be irreversible; imprinting cannot be forgotten.

Lorenz went on to observe many other stage-linked, instinctive behaviors, such as courtship behavior, and described them as "fixed-action patterns." These remain dormant until triggered by a specific stimulus at a particular critical period. Fixed-action patterns, he emphasized, are not learned but genetically programed, and as such have evolved through the process of natural selection. ■

Lorenz discovered that geese and other birds follow and become attached to the first moving object they encounter after emerging from their eggs—in this case, his boots.

See also: Francis Galton 28–29 ▪ Ivan Pavlov 60–61 ▪ Edward Thorndike 62–65 ▪ Karl Lashley 76 ▪ John Bowlby 274–77

BEHAVIOR IS SHAPED BY POSITIVE AND NEGATIVE REINFORCEMENT

B.F. SKINNER (1904–1990)

IN CONTEXT

APPROACH
Radical behaviorism

BEFORE
1890 William James outlines the theories of behaviorism in *The Principles of Psychology*.

1890s Ivan Pavlov develops the concept of conditioned stimulus and response.

1924 John B. Watson lays the foundations for the modern behaviorist movement.

1930s Zing-Yang Kuo claims that behavior is continually being modified throughout life, and that even so-called innate behavior is influenced by "experiences" as an embryo.

AFTER
1950s Joseph Wolpe pioneers systematic desensitization as part of behavior therapy.

1960s Albert Bandura's social learning theory is influenced by radical behaviorism.

Burrhus Frederic Skinner, better known as B.F. Skinner, is possibly the most widely known and influential behaviorist psychologist. He was not, however, a pioneer in the field, but developed the ideas of his predecessors, such as Ivan Pavlov and John B. Watson, by subjecting theories of behaviorism to rigorous experimental scrutiny in order to arrive at his controversial stance of "radical behaviorism."

Skinner proved to be an ideal advocate of behaviorism. Not only were his arguments based on the results of scrupulous scientific methodology (so they could be proved), but his experiments tended to involve the use of novel contraptions that the general public found fascinating. Skinner was an inveterate "gadget man" and a provocative self-publicist. But behind the showman image was a serious scientist, whose work helped to finally sever psychology from its introspective philosophical roots and establish it as a scientific discipline in its own right.

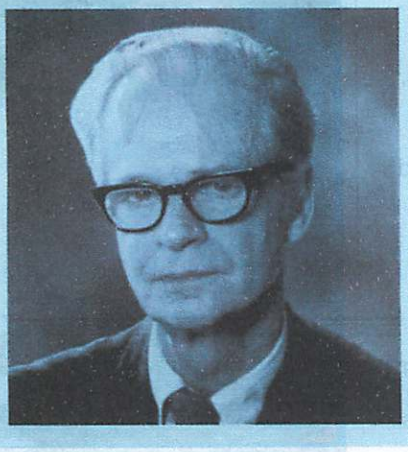
Skinner had once contemplated a career as an author, but he had little time for the philosophical

> The ideal of behaviorism is to eliminate coercion, to apply controls by changing the environment.
> **B.F. Skinner**

theorizing of many of the early psychologists. Works by Pavlov and Watson were his main influence; he saw psychology as following in the scientific tradition, and anything that could not been seen, measured, and repeated in a rigorously controlled experiment was of no interest to him.

Processes purely of the mind, therefore, were outside Skinner's interest and scope. In fact, he reached the conclusion that they must be utterly subjective, and did not exist at all separately from the body. In Skinner's opinion,

B.F. Skinner

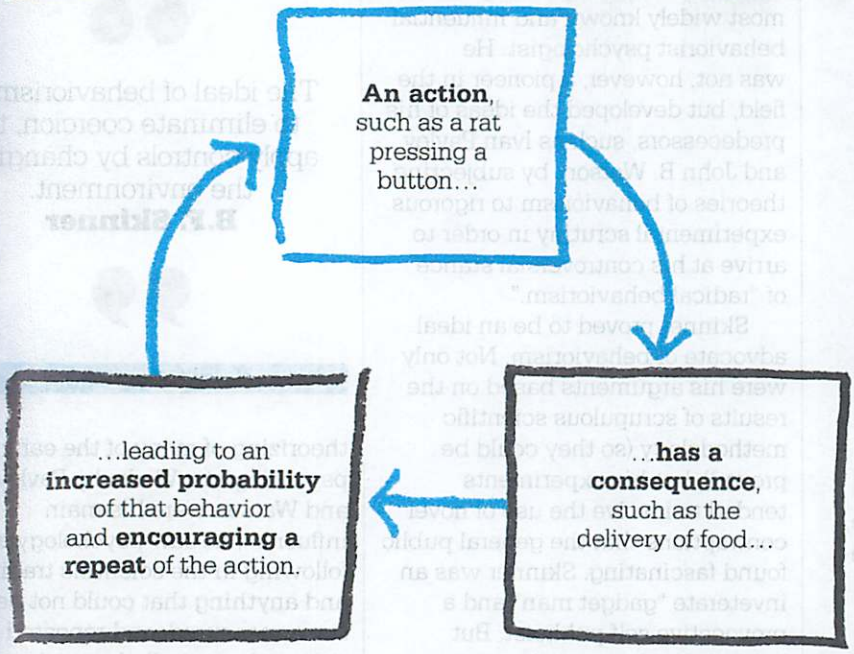


Burrhus Frederic Skinner was born in 1904 in Susquehanna, Pennsylvania. He studied English at Hamilton College, New York, intending to be a writer, but soon realized that the literary life was not for him. Influenced by the works of Ivan Pavlov and John B. Watson, he studied psychology at Harvard, gaining his doctorate in 1931 and becoming a junior fellow. He moved to the University of Minnesota in 1936, and from 1946 to 1947 ran the psychology department at Indiana University. In 1948, Skinner returned to Harvard, where he remained for the rest of his life. He was diagnosed with leukemia in the 1980s, but continued to work, finishing an article from his final lecture on the day he died, August 18, 1990.

Key works

1938 *The Behavior of Organisms: An Experimental Analysis*
1948 *Walden Two*
1953 *Science and Human Behavior*
1957 *Verbal Behavior*
1971 *Beyond Freedom and Dignity*

See also: William James 38–45 ▪ Ivan Pavlov 60–61 ▪ John B. Watson 66–71 ▪ Zing-Yang Kuo 75 ▪ Joseph Wolpe 86–87 ▪ Albert Bandura 286–91 ▪ Noam Chomsky 294–97



the way to carry out psychological research was through observable behavior, rather than through unobservable thoughts.

Although a strict behaviorist from the outset of his career, Skinner differed from earlier behaviorists in his interpretation of conditioning, in particular, the principle of "classical conditioning" as described by Pavlov. While not disagreeing that a conditioned response could be elicited by repeated training, Skinner felt that this was something of a special case, involving the deliberate, artificial introduction of a conditioning stimulus.

To Skinner, it seemed that the consequences of an action were more important in shaping behavior than any stimulus that had preceded or coincided with it. He concluded from his experiments that behavior is primarily learned from the results of actions. As with so many great insights, this may appear to be self-evident, but it marked a major turning point in behaviorist psychology.

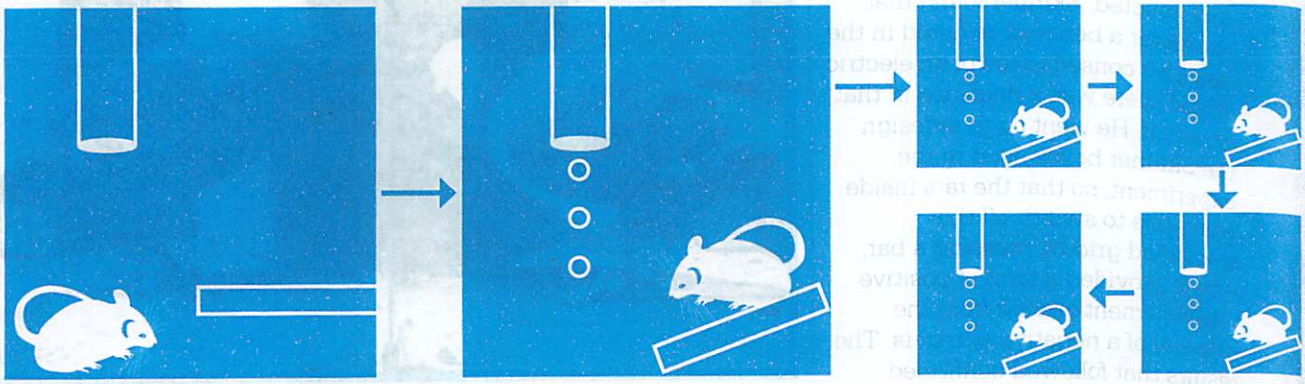
Skinner boxes

While working as a research fellow at Harvard, Skinner carried out a series of experiments on rats, using an invention that later became known as a "Skinner box." A rat was placed in one of these boxes, which had a special bar fitted on the inside. Every time the rat pressed this bar, it was presented with a food pellet. The rate of bar-pressing was automatically recorded. Initially, the rat might press the bar accidentally, or simply out of curiosity, and as a consequence receive some food. Over time, the rat learned that food appeared whenever the bar was pressed, and began to press it purposefully in order to be fed. Comparing results from rats given the "positive reinforcement" of food for their bar-pressing behavior with those that were not, or were presented with food at different rates, it became clear that when food appeared as a consequence of the rat's actions, this influenced its future behavior.

Skinner concluded that animals are conditioned by the responses they receive from their actions and environment. As the rats explored the world around them, some of their actions had a positive consequence (Skinner was careful to avoid the word "reward" with its connotations of being given for "good" behavior), which in turn encouraged them to repeat that behavior. In Skinner's terms, an "organism" operates on its environment, and encounters a »

Skinner boxes were one of many ingenious devices that the psychologist created, giving him total control over the environment of the animals whose behavior he was observing.

Positive reinforcement can stimulate particular patterns of behavior, as Skinner demonstrated by placing a rat in one of his specially designed boxes, fitted with a lever or bar. Pellets of food appeared every time the animal pressed the bar, encouraging it to perform this action again and again.



stimulus (a food pellet), which reinforces its operant behavior (pressing on the bar). In order to distinguish this from classical conditioning, he coined the term "operant conditioning;" the major distinction being that operant conditioning depends not on a preceding stimulus, but on what follows as a consequence of a particular type of behavior. It is also different in that it represents a two-way process, in which an action, or behavior, is operating on the environment just as much as the environment is shaping that behavior.

In the course of his experiments, Skinner began to run short of food pellets, forcing him to reschedule the rate at which they were being given to the rats. Some rats now received a food pellet only after they had pressed the bar a number of times repeatedly, either at fixed intervals or randomly. The results of this variation reinforced Skinner's original findings, but they also led to a further discovery: that while a reinforcing stimulus led to a greater probability of a behavior occurring, if the reinforcing stimulus was then stopped, there was a decrease in the likelihood of that behavior occurring.

Skinner continued making his experiments ever more varied and sophisticated, including changes of schedule to establish whether the rats could distinguish and respond to differences in the rate of delivery of food pellets. As he suspected, the rats adapted very quickly to the new schedules.

Negative reinforcement

In later experiments, the floors of the Skinner boxes were each fitted with an electric grid, which would give the rats an unpleasant shock whenever they were activated. This allowed for the investigation of the effect of negative reinforcement on behavior. Again, just as Skinner avoided the word "reward," he was careful not to describe the electric shock as "punishment," a distinction that became increasingly important as he examined the implications of his research.

Negative reinforcement was not a new concept in psychology. As early as 1890, William James had written in *Principles of Psychology*: "Animals, for example, awaken in a child the opposite impulses of fearing and fondling. But if a child, in his first attempts to pat a dog, gets snapped at or bitten, so that the impulse of fear is strongly aroused, it may be that for years to come no dog will excite in him the

Winning at gambling often boosts the compulsion to try again, while losing lessens it, just as changes in the rate at which Skinner's rats were fed made them modify their behavior.

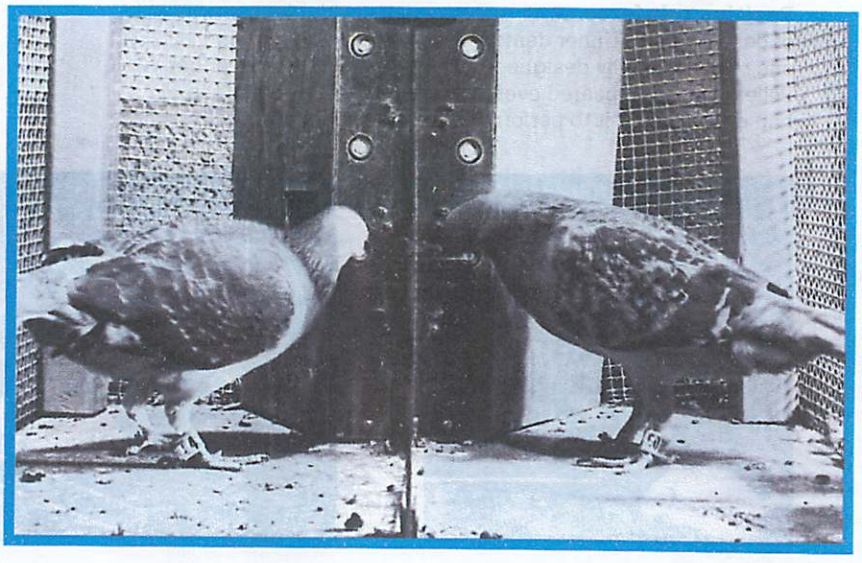
impulse to fondle again." Skinner was to provide the experimental evidence for this idea.

Positive reinforcement

As expected, Skinner found that whenever a behavior resulted in the negative consequence of an electric shock, there was a decrease in that behavior. He went on to redesign the Skinner boxes used in the experiment, so that the rats inside were able to switch off the electrified grid by pressing a bar, which provided a form of positive reinforcement arising from the removal of a negative stimulus. The results that followed confirmed Skinner's theory—if a behavior leads to the removal of a negative stimulus, that behavior increases.

However, the results also revealed an interesting distinction between behavior learned by positive reinforcement and behavior elicited by negative stimuli. The rats responded better and more quickly to the positive stimuli (as well as the removal of negative stimuli), than when their behavior resulted in a negative response. While still careful to avoid the notions of "reward" and "punishment," Skinner concluded that behavior was shaped much more efficiently by a program of positive reinforcement. In fact, he came to believe that negative reinforcement could even be counter-productive, with the subject continuing to seek positive responses for a specific behavior, despite this leading to a negative response in the majority of cases.

This has implications in various areas of human behavior too; for example, in the use of disciplinary measures to teach children. If a boy is continually being punished for something he finds enjoyable, such as picking his nose, he is likely to avoid doing so when adults are around. The child may modify his behavior, but only so far as it enables him to avoid punishment. Skinner himself believed that ultimately all forms of punishment were unsuitable for controlling children's behavior.



Skinner's pigeon experiments proved that the positive reinforcement of being fed on the achievement of a task helped to speed up and reinforce the learning of new behavior patterns.

Genetic predisposition

The "shaping" of behavior by operant conditioning has striking parallels with Charles Darwin's theory of natural selection—in essence, that only organisms suited by their genetic make-up to a particular environment will survive to reproduce, ensuring the "success" of their species. The likelihood of a rat behaving in a way that will result in a reinforcing stimulus, triggering the process of operant conditioning, is dependent on the level of its curiosity and intelligence, both of which are determined by genetic make-up. It was this combination of predisposition and conditioning that led Skinner to conclude that "a person's behavior is controlled by his genetic and environmental histories"—an idea that he explored further in his article *The Selection by Consequences,* written for the journal *Science* in 1981.

In 1936, Skinner took up a post at the University of Minnesota, where he continued to refine his experimental research in operant conditioning and to explore practical applications for his ideas, this time using pigeons instead of rats. With the pigeons, Skinner found that he was able to devise more subtle experiments. Using what he described as a "method of successive approximations," he could elicit and investigate more complex patterns of behavior.

Skinner gave the pigeons positive reinforcement for any behavior that was similar to that he was trying to elicit. For example, if he was trying to train a pigeon to fly in a circle clockwise, food would be given for any movement the pigeon made to the right, however small. Once this behavior had »

been established, the food was only given for longer flights to the right, and the process was repeated until the pigeon had to fly a full circle in order to receive some food.

Teaching program

Skinner's research led him to question teaching methods used in schools. In the 1950s, when his own children were involved in formal education, students were often given long tasks that involved several stages, and usually had to wait until the teacher had graded work carried out over the entire project before finding out how well they had done. This approach ran contrary to Skinner's findings about the process of learning and, in his opinion, was holding back progress. In response, Skinner developed a teaching program that gave incremental feedback at every stage of a project—a process that was later incorporated into a number of educational systems. He also invented a "teaching machine" that gave a student encouraging feedback for correct answers given at every stage of a long series of test questions, rather than just at the end. Although it only achieved limited approval at the time, the principles embodied in Skinner's teaching machine resurfaced decades later in self-education computer programs.

It has to be said that many of Skinner's inventions were misunderstood at the time, and gained him a reputation as an eccentric. His "baby tender," for example, was designed as a crib alternative to keep his infant daughter in a controlled, warm, and draft-free environment. However, the public confused it with a Skinner box, and it was dubbed the "heir conditioner" by the press, amid rumors that Skinner was experimenting on his own children. Nevertheless, the baby tender attracted publicity, and Skinner was never shy of the limelight.

War effort

Yet another famous experiment called "Project Pigeon" was met with skepticism and some derision. This practical application of Skinner's work with pigeons was intended as a serious contribution to the war effort in 1944. Missile guidance systems were yet to be invented, so Skinner devised a nose cone that could be attached to a bomb and steered by three pigeons placed inside it. The birds had been trained, using operant conditioning, to peck at an image of the bomb's target, which was projected into the nose cone via a lens at the front. This pecking controlled the flight-path of the missile. The National Defense Research Committee helped fund the project, but it was never used in combat, because it was considered too eccentric and impractical. The suspicion was that Skinner, with his passion for gadgets, was more interested in the invention than in its application. When asked if he thought it right to involve animals in warfare, he replied that he thought it was wrong to involve humans.

In later life as an academic at Harvard, Skinner also expanded on the implications of his findings in numerous articles and books.

> The objection to inner states is not that they do not exist, but that they are not relevant in a functional analysis.
> **B.F. Skinner**

Praise or encouragement given at frequent intervals during the progress of a piece of work, rather than one large reward at the end, has been shown to boost the rate at which children learn.

Walden Two (1948) describes a utopian society based on behavior learned with operant conditioning. The book's vision of social control achieved by positive reinforcement caused controversy, and despite its benign intent was criticized by many as totalitarian. This was not a surprising reaction, given the political climate in the aftermath of World War II.

Radical behaviorism

Skinner remained true to his behaviorist approach, coining the term "radical behaviorism" for the branch of psychology he espoused. Although he did not deny the existence of thought processes and mental states, he believed that psychology should be concerned solely with the study of physical responses to prevailing conditions or situations.

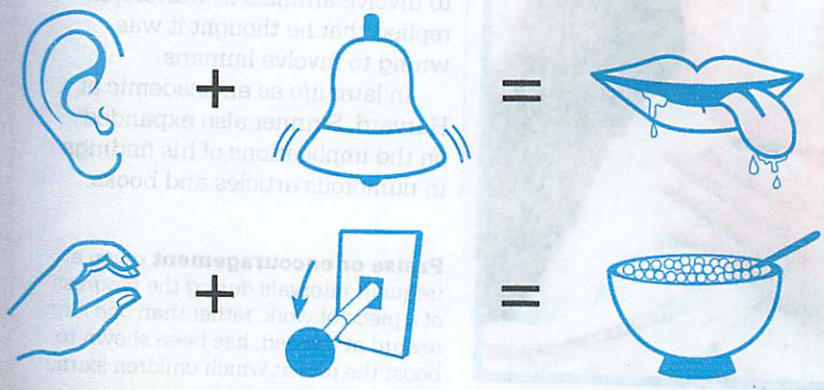
In his book, *Beyond Freedom and Dignity*, Skinner took the concept of shaping behavior even further, resurrecting the philosophical debate between free will and determinism. For the radical behaviorist Skinner, free will is an illusion; selection by consequences controls all of our behavior, and hence our lives. Attempts to escape this notion are doomed to failure and chaos. As he put it: "When Milton's Satan falls from heaven, he ends in hell. And what does he say to reassure himself? 'Here, at least, we shall be free.' And that, I think, is the fate of the old-fashioned liberal. He's going to be free, but he's going to find himself in hell."

Views such as these gained him notoriety, and prompted some of his fiercest critics. In particular, the application of his behaviorist ideas to the learning of language in *Verbal Behavior* in 1957 received a scathing review from Noam Chomsky, which is often credited as launching the movement known as cognitive psychology.

Some criticism of Skinner's work, however, has been based on misunderstanding the principles of operant conditioning. Radical behaviorism has often been linked erroneously to the European philosophical movement of logical positivism, which holds the view that statements or ideas are only meaningful if they can be verified by actual experience. But it has in fact much more in common with American pragmatism, which measures the importance or value of actions according to their consequences. It has also been misinterpreted as presenting all living beings as the passive subjects of conditioning, whereas to Skinner operant conditioning was a two-way process, in which an organism operates on its environment and that environment responds, with the consequence often shaping future behavior.

> Skinner has an unbounded love for the idea that there are no individuals, no agents—there are only organisms.
> **Thomas Szasz**

In the 1960s, the focus in psychology swung away from the study of behavior to the study of mental processes, and for a time Skinner's ideas were discredited, or at least ignored. A reappraisal of behaviorism soon followed, however, and his work found an appreciative audience in many areas of applied psychology, especially among educationalists and clinical psychologists—the approach of cognitive behavioral therapy owes much to his ideas. ■



Classical conditioning creates an automatic behavioral response to a neutral stimulus, such as salivating in expectation of food when a bell is rung.

Operant conditioning creates a higher probability of repeated behavior through positive reinforcement, such as releasing food by pulling a lever.

STOP IMAGINING THE SCENE AND RELAX

JOSEPH WOLPE (1915–1997)

IN CONTEXT

APPROACH
Reciprocal inhibition

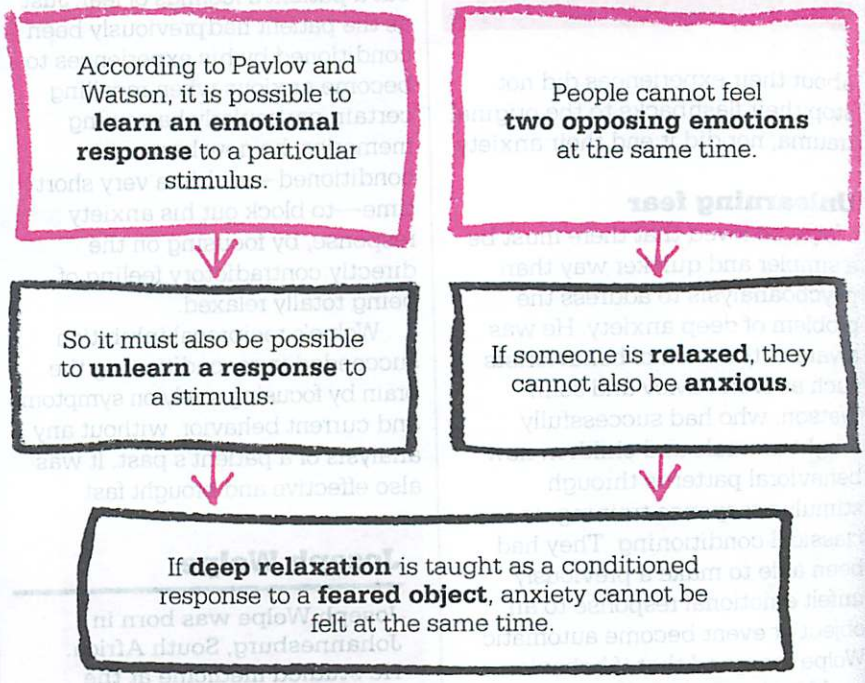
BEFORE
1906 Ivan Pavlov publishes the first studies on stimulus-response techniques, showing that behavior can be learned through conditioning.

1913 John B. Watson publishes *Psychology as a Behaviorist Views It*, establishing the basic tenets of behavioral psychology.

1920 John B. Watson's Little Albert experiments demonstrate that emotions can be classically conditioned.

1953 B.F. Skinner publishes *The Behavior of Organisms*, presenting his theories on how human behavior relates to biology and the environment.

AFTER
1961 Wolpe introduces the concept of systematic desensitization.



For most of the first half of the 20th century, psychotherapy was dominated by Freudian psychoanalysis, which assumes that anxiety results from conflicting forces deep within the psyche. This conflict can only be alleviated through a lengthy, introspective analysis of both the individual's conscious and subconscious thoughts, including their formative experiences. But South African-born psychiatrist Joseph Wolpe had treated soldiers for anxiety brought on by post-traumatic stress disorder (then known as "war neurosis") during World War II, and had found these psychotherapeutic practices ineffective in helping his patients. Talking to these men

See also: Ivan Pavlov 60–61 ▪ John B. Watson 66–71 ▪ B.F. Skinner 78–85 ▪ Aaron Beck 174–77 ▪ W.H.R. Rivers 334

> Behavior depends upon the paths that neural excitation takes.
> **Joseph Wolpe**

about their experiences did not stop their flashbacks to the original trauma, nor did it end their anxiety.

Unlearning fear

Wolpe believed that there must be a simpler and quicker way than psychoanalysis to address the problem of deep anxiety. He was aware of the work of behaviorists such as Ivan Pavlov and John Watson, who had successfully taught animals and children new behavioral patterns through stimulus-response training, or classical conditioning. They had been able to make a previously unfelt emotional response to an object or event become automatic. Wolpe reasoned that if behavior could be learned in this way, it could also be unlearned, and he proposed to find a method of using this to help disturbed war veterans.

Wolpe had discovered that a human being is not capable of experiencing two contradictory states of emotion at the same time. It is not possible, for example, to feel great anxiety of any kind, when you are feeling very relaxed. This inspired him to teach his patients deep-muscle relaxation techniques, which he went on to pair with simultaneous exposure to some form of anxiety-inducing stimuli—a technique that became known as reciprocal inhibition.

Wolpe's patients were asked to imagine the thing or event that they found disturbing. If they started to become anxious, they would be encouraged to "stop imagining the scene and relax." This approach gradually blocked out a patient's feelings of fear. Just as the patient had previously been conditioned by his experiences to become anxious when recalling certain particularly harrowing memories, he now became conditioned—within a very short time—to block out his anxiety response, by focusing on the directly contradictory feeling of being totally relaxed.

Wolpe's reciprocal inhibition succeeded in reconditioning the brain by focusing solely on symptoms and current behavior, without any analysis of a patient's past. It was also effective and brought fast results, and led to many important new techniques in the field of behavioral therapy. Wolpe himself used it to develop a systematic desensitization program to cure phobias, such as fear of mice or flying, which is still widely used. ■

Phobias such as fear of mice have been treated successfully using methods developed from Wolpe's idea of reciprocal inhibition: the pairing of deep relaxation with exposure to the feared object.

Joseph Wolpe

Joseph Wolpe was born in Johannesburg, South Africa. He studied medicine at the University of Witwatersrand, then served in the South African Army, where he treated people for "war neurosis." Returning to the university to develop his desensitization technique, he was ridiculed by the psychoanalytic establishment for attempting to treat neuroses without first identifying their cause. Wolpe relocated to the US in 1960, taking US citizenship. Initially, he taught at the University of Virginia, then became a professor of psychiatry at Temple University, Philadelphia, where he set up a respected behavioral therapy institute. Renowned as a brilliant teacher, Wolpe continued to teach until he died of lung cancer, aged 82.

Key works

1958 *Psychotherapy by Reciprocal Inhibition*
1969 *Practice of Behavioral Therapy*
1988 *Life Without Fear*