

Psychology Basics

Pavlovian Conditioning

DATE: 1890's forward

TYPE OF PSYCHOLOGY: Learning

FIELDS OF STUDY: Pavlovian conditioning

Pavlovian conditioning is a basic process of learning that relates especially to reflexes and emotional behavior. Interest in this form of learning has been long-standing and continues to the present day. Pavlovian principles apply to a very wide range of organisms, situations, and events.

KEY CONCEPTS

- conditioned emotional reaction (CER)
- conditioned response (CR)
- conditioned stimulus (CS)
- discrimination
- extinction
- flooding
- second-signal system
- spontaneous recovery
- stimulus generalization
- systematic desensitization
- unconditioned response (UR)
- unconditioned stimulus (US)

Pavlovian conditioning, also known as respondent conditioning and classical conditioning (to distinguish it from instrumental or operant conditioning), is an elementary learning process and has been of major interest to psychologists ever since the Russian physiologist Ivan P. Pavlov (1849-1936) discovered that a dog could learn to salivate to a neutral stimulus after the stimulus was paired repeatedly with food.

Pavlov's early career focused on the study of heart circulation and digestion in animals (usually dogs), for which he received the Nobel Prize in Physiology or Medicine in 1904. However, by that time Pavlov had already turned his attention to experiments on conditioned reflexes, from which flowed a new psychological nomenclature.

CONDITIONING

The core of Pavlovian conditioning is the pairing (association) of stimuli to elicit responses. Food (meat powder) placed in a dog's mouth naturally produces salivation. Pavlov called the food an unconditioned stimulus (US) and salivation, elicited by the food, the unconditioned response (UR). When a neutral stimulus—for example, a tone that does not naturally elicit salivation—is repeatedly followed by food, the tone alone eventually evokes salivation. Pavlov labeled the tone a conditioned stimulus (CS) and the response (salivation) elicited by it the conditioned response (CR).

Pavlov's formulation can be summarized as follows:

Before conditioning:

Food (US) elicits Salivation (UR)

Conditioning procedure:

Neutral Stimulus (Tone) plus Food (US) elicits Salivation (UR)

After conditioning:

Tone (CS)-elicits-Salivation (CR)

Pavlov believed that conditioned responses were identical to unconditioned responses. That is usually not the case. For example, conditioned responses may be less pronounced (weaker) or a bit more lethargic than unconditioned responses.

Several phenomena turn up in studies of Pavlovian conditioning. Extinction, generalization, and discrimination are among the most important. Extinction refers to the procedure as well as to the elimination of a CR. If the CS is repeatedly presented without the US, extinction occurs: The dog stops salivating to the tone. During the course of extinction, the CR may return from time to time until it is finally extinguished. Pavlov called the occasional return of the CR "spontaneous recovery."

Stimulus generalization refers to responding not only to a particular CS but also to similar but different stimuli. Further, the magnitude (amount of salivation) of a generalized response tends to decline as stimuli become less and less like the CS. For example, a dog trained to salivate to a 5,000-cycle-per-second (cps) tone is likely to salivate also to 5,300 cps and 4,700 cps tones without specific training to do so (stimulus generalization). Responses tend to weaken in an orderly way as tones become more and more unlike the CS—that is, as the tones move away from the CS in both directions, say, to 4,400 cps from 4,100 cps, and 5,600 cps to 5,900 cps, the flow of salivation becomes less and less.

Stimulus generalization in effect extends the number of stimuli that elicit a conditioned response. Discrimination procedures restrict that number by conditioning a subject not to generalize across stimuli. The procedure involves two processes: acquisition and extinction. The CS is paired repeatedly with the US (acquisition) while the US is withheld as generalized stimuli are presented repeatedly (extinction). If the dog now salivates to the CS and not to the generalized stimuli, the dog has learned to discriminate or to act discriminatively. Pavlov reported that some dogs displayed a general breakdown in behavior patterns (experimental neurosis) when called upon to make discriminations that were too difficult for them to make.

Pavlov's work on what he called the second-signal system implies that conditioning principles are relevant to human as well as to animal learning. Once, say, a tone is established as a CS in first-order conditioning, the tone can be paired with a neutral stimulus to establish a second-order CS. Thus, in the absence of food, a light might precede the tone (CS) several times until the light itself begins to function as a CS. Second-order conditioning appears to follow many of the same rules as first-order conditioning.

Pavlov's work has clearly provided one way to study the learning process in great

detail. It has also provided the kind of data and theory that have affected research in other areas of learning, such as instrumental conditioning and, subsequently, cognitive science and neuroscience.

RANGE OF PAVLOVIAN CONDITIONING

Pavlovian phenomena have been demonstrated with different kinds of organisms and a wide variety of stimuli and responses far beyond those studied by Pavlov. Stimuli that precede such unconditioned stimuli as sudden loud noises (leading to rapid heart rate), a puff of air delivered to the eye (evoking blinking), or a large temperature increase (eliciting sweating) may become conditioned stimuli capable of eliciting conditioned responses on their own. The idea of second-order (higher-order) conditioning is profoundly important because it suggests how rewards such as words of praise and money are established apart from primary (biologically necessary) rewards, such as food and water. It also may in part explain the power of films, plays, novels, and advertisements to evoke strong emotion in the absence of direct experience with primary (unconditioned) stimuli. Studies concerned with conditioned emotional reactions (CER), especially fear and anxiety in people—a subject much more complex than simple reflexes—have been of special interest to researchers and therapists for many years.

ADDITIONAL RESEARCH FINDINGS

Studies of conditioning essentially look at how various unconditioned and conditioned stimuli influence responses under different arrangements of time and space. Following are a few general findings.

Pavlovian conditioning tends to be readily established when stimuli or responses or both are strong rather than weak. For example, in response to a near-drowning experience, some people promptly learn to fear such conditioned stimuli as the sight of water, boats, palm trees, bathing suits, and so on. In such cases, relevant stimuli and responses (panic) are presumably quite strong.

Conditioned stimuli are most likely to elicit conditioned responses when unconditioned and conditioned stimuli are paired consistently. If a mother always hums when she rocks her infant daughter to sleep, humming is likely to become a potent and reliable CS, which soothes and comforts her daughter. This outcome is less likely if mother hums only occasionally.

When several stimuli precede a US, the one most often paired with the US will likely emerge as the strongest CS. If, for example, both parents threaten to punish their young son, but only father always carries out the threats, father's threats are more likely than mother's to evoke apprehension in the child.

For some responses, such as eye blinking, conditioned stimuli tend to be strongest when they precede the US by about one-half second. The optimal interval for other responses varies from seconds to fractions of seconds: A neighbor's dog barks immediately before little Sophie falls from her swing, bumping her nose very hard. She cries. If the dog's bark subsequently makes Sophie feel uneasy, the bark is functioning as a CS. This outcome becomes less and less likely as the bark and fall increasingly separate in time.

Conditioned responses are usually not established if a US and CS occur together (simultaneous conditioning)-the potency of the UC overshadows the potential CS-or when a neutral stimulus follows the US (backward conditioning).

SOME PRACTICAL APPLICATIONS

In a widely cited study reported in 1920, American researchers John B. Watson and Rosalie Rayner conditioned a phobic reaction in an eleven-month-old infant named Albert. The researchers discovered that Albert feared loud noises but seemed unafraid of a number of other things, including small animals.

Watson and Rayner subsequently placed a white rat in Albert's crib. When Albert reached for it, the researchers struck a piece of resonant metal with a hammer, making a "loud sound." After a few such presentations, presenting the rat alone elicited crying and various avoidance reactions. Albert also showed signs of fear to similar things, such as a rabbit, a furry object, and fluffy clumps of cotton (stimulus generalization). Thus, Watson and Rayner provided early experimental evidence that Pavlovian principles are involved in the acquisition of human emotional reactions.

While this study induced a phobic reaction in the subject, systematic desensitization is a procedure designed to eliminate phobias and anxieties. The procedure was largely developed and named by South African-born therapist Joseph Wolpe. Noting that it is very difficult to have pleasant and anxious feelings simultaneously, Wolpe fashioned a systematic technique to teach clients to engage in behavior (relaxation) that competes with anxiety.

Therapy typically begins with an interview designed to identify specific sources of the client's fears. The therapist helps the client assemble a list of items that elicit fear. Items associated with the least amount of fear are positioned at the bottom of the list; most feared items are placed near the top. For example, if a client has a strong fear of dogs, the therapist and client would develop a list of scenes that make the client fearful. Situations may vary from hearing the word "dog" to seeing pictures of dogs, being in the vicinity of a dog, hearing a dog bark, being close to dogs, and patting a dog.

The client is next taught to relax by tensing and releasing various groups of muscles-shoulders, face, arms, neck, and so on. This phase of treatment ends when the client has learned to fully relax on his or her own in a matter of minutes.

The client and therapist now move on to the next phase of therapy. While remaining fully relaxed, the client is asked to imagine being in the first situation at the bottom of the list. The image is held for several seconds. The client then relaxes for about twenty seconds before imagining the same situation again for several seconds. When the client is able to imagine an item and remain fully relaxed, the therapist presents a slightly more fearful situation to imagine. This procedure continues until an image causes distress, at which time the session ends. The next session begins with relaxation, followed by the client slowly moving up the list. As before, the client stops at the point of distress. Therapy is successful when the client can imagine all the items on the list while remaining fully relaxed. The technique is less helpful when clients have difficulty identifying fearful situations or calling up vivid images.

In the hands of a skillful therapist, systematic desensitization is an effective

technique for reducing a wide variety of fears. Its Pavlovian features involve pairing imagined fearful scenes with relaxation. When relaxation successfully competes with fear, it becomes a new CR to the imagined scenes. As relaxation becomes sufficiently strong as a CR, anxiety is replaced by calmness in the face of earlier aversive stimuli.

Extinction offers a more direct route to the reduction of fear than systematic desensitization. The technique called flooding makes use of extinction. Flooding exposes the client to fear-arousing stimuli for a prolonged period of time. Suppose a child is afraid of snakes. Although fear is likely to increase initially, flooding would require the child to confront the snake directly and continuously-to be "flooded" by various stimuli associated with the snake-until the conditioned stimuli lose their power to elicit fear. Some therapists think that the application of this technique is probably best left to professionals.

SOME EVERYDAY EXAMPLES

Pavlovian principles may be plausibly applied to daily life, as the following examples illustrate.

Couples sometimes refer to a certain tune as "our song." A plausible interpretation is that Pavlovian conditioning has been at work. The favored tune may have been popular and repeated often at the time of the couple's courtship and marriage. The tune has since become a CS that evokes a variety of pleasant feelings associated with initial love.

A babysitter notes that giving a young child a blue blanket in the absence of his mother markedly reduces his irritability. Most likely the blanket has been sufficiently associated with the soothing actions of his mother (US) and now functions as a calming stimulus (CS).

An adolescent steadfastly avoids the location where he was seriously injured in an automobile accident. He says that just thinking about the highway makes him nervous. The location doubtless contains a number of conditioned aversive stimuli that now trigger unpleasant feelings (CR) and avoidance.

After a bitter divorce, a woman finds that the sight of household items (CS) associated with her former husband is terribly upsetting (CR). She has reduced her resentment by getting rid of the offending items.

A wife often places flower arrangements in her husband's den. The flowers (CS) now bring him a measure of comfort (CR) when she is away on trips.

RESPONDENT CONDITIONING AND REINFORCEMENT

Pavlovian behaviors are principally elicited by antecedent events (just as low temperatures elicit shivering), while many behaviors are strengthened (in reinforcement) or weakened (in punishment) by what follows behavior. In Pavlovian conditioning, two stimuli are presented, one following another, regardless of what a subject does. What follows behavior is usually not important in this form of conditioning. In studying the role of reinforcement on behavior (instrumental or operant conditioning), the consequences that follow a person's actions often determine what the person is likely to do under similar circumstances in the future. What follows behavior is important in this type of conditioning.

The topic of reinforcement is introduced here because Pavlovian conditioning and reinforcement are intricately related in that any Pavlovian conditioning is likely to

contain elements of instrumental conditioning, and vice versa. For example, if someone has a near-drowning experience and now avoids bodies of water, it is plausible to say that conditioned stimuli associated with the experience evoke unsettling feelings. The person reduces the unpleasant feelings by avoiding bodies of water. In this example, negative feelings are conditioned according to Pavlovian principles. The avoidance reaction is maintained by (negative) reinforcement and involves instrumental learning. Virtually all the previous examples can be analyzed similarly.

SOURCES FOR FURTHER STUDY

Baldwin, John D., and Janice I. Baldwin. *Behavior Principles in Everyday Life*. 4th ed. Upper Saddle River, N.J.: Prentice-Hall, 2001. Written by two sociologists, this book provides an overview of psychological principles of behavior, including many details about Pavlovian conditioning. The authors provide hundreds of plausible and interesting examples of how behavior principles show up in everyday life. An excellent book for those interested in an interpretation of how Pavlovian and instrumental conditioning work together in daily life.

Hergenhahn, B. R., and Matthew Olson. *Introduction to Theories of Learning*. 6th ed. Upper Saddle River, N.J.: Prentice-Hall, 2001. This book describes the work of fifteen major figures in the area of learning. There are chapters about associative theorists such as Pavlov and functionalist theorists such as the American psychologist B. F. Skinner. A useful elementary survey of learning research and theory spanning one hundred years of development.

Rescorla, Robert A. "Pavlovian Conditioning: It's Not What You Think It Is." *American Psychologist* 43, no. 3 (May, 1988): 151-160. A critical analysis of Pavlovian conditioning by a leading researcher in the field. A major point is that traditional descriptions of Pavlovian conditioning are at best misleading and have failed to incorporate many important developments in the field. The author questions orthodox descriptions of conditioning because they imply that organisms form associations blindly. His view is that organisms actually seek out information using logic and perception to form sophisticated representations of the environment. Rescorla provides a sophisticated examination of the intricacies of conditioning, concentrating on the various outcomes of conditioning and on the circumstances that create them, while citing some of his own work in support of his position.

Watson, John B., and Rosalie Rayner. "Conditioned Emotional Reactions." *Journal of Experimental Psychology* 3 (1920): 1-14. Although this research has been questioned on methodological and ethical grounds—for example, concerns have been raised about the deliberate creation of a phobic reaction in a young child—it is nonetheless a historically important experiment that provided information about how human emotions are learned.

Wolpe, Joseph. *The Practice of Behavior Therapy*. 4th ed. New York: Pergamon, 1990. A significant book by the behavior therapist largely responsible for the development of systematic desensitization. Wolpe discusses behavior therapy as it applies to simple and complex cases of fear and anxiety. Therapeutic approaches discussed include flooding, systematic desensitization, assertiveness training, and the interaction of Pavlovian and operant conditioning. Wolpe is highly critical of the

view that therapy consists of little more than information processing and cognitive correction.

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See Also

Behaviorism; Conditioning; Habituation and Sensitization; Learned Helplessness; Learning; Phobias; Reflexes.