Contingency Not Contiguity

In his influential article "Pavlovian Conditioning: It's Not What You Think," Rescorla (1988) makes three observations about Pavlovian conditioning and delineates its importance in modern psychology.

Robert A. Rescorla. (Courtesy of Robert A. Rescorla.)

First, like Egger and Miller (1962, 1963), he says it is essential that there be a correlation between US and CS that is more than mere coincidence or contiguity. Take, for example, a situation in which an animal experiences random USs and CSs over an extended period. There may be as many instances when the US and CS occur together (contiguity) as when they occur separately. Contrast this situation with one in which the US and CS are programmed so that they only occur together. These two conditions are represented in Figure 7–6, and it is important to notice that in both situations, CS and US occur together the *same* number of times.

Which CS-US relationship produces the best conditioning? It may seem intuitive, but it comes as a surprise to some psychologists that the latter situation produces the stronger classical conditioning, whereas the former produces weak conditioning, if any. Clearly, contiguity is not enough. Rescorla uses the term *contingency* to describe the relationship in which a CS provides a clear and informative marker for the US.

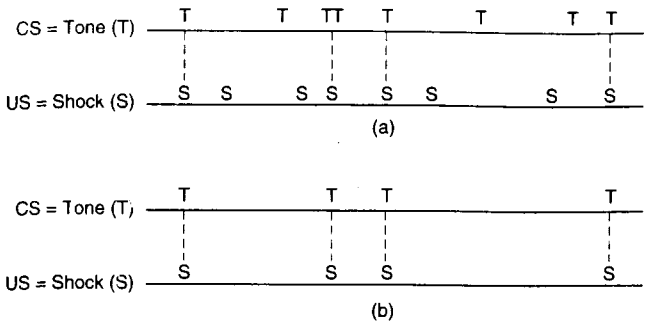

FIGURE 7–6 Although CS and US occur the same number of times in (a) and (b), the CS-US pairing in (a) produces little or no classical conditioning, but the CS-US pairing in (b) produces strong conditioning.

Second, like Zener (1937), Rescorla (1988) says that the common claim that a CR is a "miniature" or "abbreviated" UR is either an oversimplification or is entirely incorrect. A typical response to a US of electric shock in an open maze, for example, is increased activity or some version of a startle response. However, as seen in the conditioned suppression phenomenon described previously, if the CS used to signal shock is delivered during ongoing performance of a completely different response (lever pressing), the result is decreased activity. The CR can be several different responses, depending on the context in which the CS occurs.

These two points were clearly demonstrated when Rescorla (1966) trained dogs to jump over a hurdle in a shuttle box to avoid an electric shock that was delivered at regular intervals of thirty seconds. The situation was arranged so that the shock could be avoided if the dog jumped the hurdle before the end of the time interval. Each time the dog jumped over the hurdle, the clock was reset to zero and started running again. There was no external signal indicating when a shock would be delivered; the only signal was the animal's internal sense of the passage of time. All of the dogs in the experiment learned to jump often enough to avoid most of the shocks. The rate of jumping was then used as a frame of reference to judge the effects of other variables introduced into the experiment.

After the preliminary training described above, the dogs were removed from the hurdle-jumping apparatus and were subjected to tones followed by electric shock. The dogs were divided into three groups. Group 1 received standard conditioning in which a CS (a five-second tone) was always followed by a US (an electric shock). This procedure is generally referred to as **forward conditioning** and was called a positive contingency in Rescorla's study. Group 2 first experienced the US *and then* the CS. The situation for this group was arranged so that the CS was never paired with shock, nor was the CS ever followed within thirty seconds by the shock. The arrangement by which a CS *follows* a US, generally referred to as backward conditioning, was referred to as a negative contingency in Rescorla's study. This

was an especially interesting experimental condition because it has been widely believed that when the CS follows the US, no conditioning occurs. Group 3 experienced the CS preceding the US and following it an equal number of times. By randomizing the occurrence of the CS relative to the US, a situation is created whereby there is no correlation between the two. That is, the US is as likely to occur following the presentation of the CS as it is when the CS does not occur. Therefore, for subjects in group 3, the CS had no predictive value.

In the final phase of the experiment, the dogs were placed back in the shuttle box and were again given avoidance training until the rate of their avoidance responses stabilized. At this point, the CS (tone) from the classical conditioning phase of the study was presented for five seconds a number of times. It was observed that when the CS was introduced to animals in group 1 (forward conditioning or positive contingency), they *increased* their rate of responding relative to what it was in the initial stage of the experiment. In fact, subjects in this group almost doubled their response rate when the tone came on. When the CS was introduced to animals in group 2 (backward conditioning or negative contingency), they *decreased* their rate of responding by about one-third. When the CS was introduced to animals in group 3 (no correlation), their rate of responding remained essentially the same as in the initial phase of the experiment.

One crucial point to remember while interpreting the results of this experiment is that all animals received the same number of shocks during the classical conditioning phase of the experiment. What was varied was the relationship between the CS and the US. As we have seen, Rescorla (1966, 1967) says that it is contingencies that determine whether conditioning takes place and, if so, what kind of conditioning. In group 1, there was a positive contingency between the CS and the US, and, therefore, the CS accurately predicted the occurrence of the US. This, according to Rescorla, is why the animals in this group jumped the hurdle more rapidly when the CS was presented. In group 2, there was a negative contingency between the CS and the US. That is, the CS was never paired with or followed by the US within thirty seconds. Thus, for subjects in this group, the CS became a signal for safety. Contrary to the common belief that no classical conditioning occurs under these conditions (backward conditioning), Rescorla found that the animals in this group indeed learned a contingency. They learned that the CS predicted the absence of the shock, and, therefore, when the CS was introduced to these animals, they inhibited their rate of jumping. Rescorla says that it is important to realize that the procedure followed in group 2 is the most common "control" condition in classical conditioning studies. It has been commonly believed that because no facilitative conditioning occurs under these circumstances, no conditioning of any kind occurs, but this is clearly not the case. Because inhibitory conditioning does take place, this procedure cannot be used as a control group in classical conditioning studies. It is only the procedures followed in group 3 that provide a **truly random control group** for classical conditioning studies. In this group the appearance of the CS and of the US were independent of each other, and, therefore, animals in this group could not use the CS to predict either the subsequent presence or absence of the US. It is only under these conditions that

there is no contingency between the CS and US, and this is why, according to Rescorla, no classical conditioning occurs.

Again, Rescorla's explanation of his results is similar to the one offered earlier by Egger and Miller (1962, 1963). Both claim that for conditioning to take place, a CS must be informative; that is, it must provide the organism with useful information about the US. Rescorla expanded on Egger and Miller's work, however, by showing that negative contingencies are as informative as positive ones. According to Rescorla, it is only the truly random control procedure that creates an uninformative relationship between the CS and US, and, thus, produces no conditioning.

Finally, Rescorla (1988) claims that Pavlovian conditioning is more than mere reflex learning and that it has a vital place in contemporary psychology. He insists that the emphasis he and his colleagues place on contingencies, rather than contiguity alone, reveals new and important information about the nature of associative learning. Therefore, he says, classical conditioning provides both a useful data base and a theoretical orientation for two topics of current interest and activity in modern psychology. These topics, the neuroscientific study of learning and computer simulation of neural networks, are discussed in Chapter 14.