CLASSICAL AND OPERANT CONDITIONING: THEORETICAL CONSIDERATIONS

In ***Learning and Complex Behavior***, the difference between classical (Pavlovian) and operant (instrumental) conditioning was treated as a procedural difference: In classical conditioning the temporal relation between an environmental stimulus (the CS) and the eliciting stimulus (the US) is manipulated whereas in operant conditioning the relation between behavior (the operant, or R) and the eliciting stimulus is manipulated. The outcome of both procedures was accommodated within the same theoretical framework—a unified principle of reinforcement. In short, the two procedures were thought to be two ways of studying the same conditioning process.

The Associationist View of Conditioning

The view of the classical and operant procedures held by normative (i.e., inferred-process) psychology is quite different: The procedural difference is thought to have fundamental theoretical implications. In inferred-process psychology, the two procedures are said to produce different kinds of *associations*. The classical procedure primarily produces associations between the CS and US. The operant procedure, in contrast, is said to primarily produce associations between the environment that is present when the operant occurs and the operant. Associations are inferred hypothetical or cognitive processes that are hypothesized to intervene between environmental and behavioral events. (The associationist view is even more complex: Observable environmental and behavioral events are said to have corresponding "representations"—inferred entities—and the associations are actually formed between the representations and not the events themselves. (The notion of representation is briefly considered later in the book—p. 264, footnote 8.) The concept of association may be traced to 18thth-century British empirical philosophy (Rescorla, 1985). A somewhat simplified illustration of the hypothesized differences in the types of associations formed during classical and operant procedures is illustrated in **Figure 2.A**.

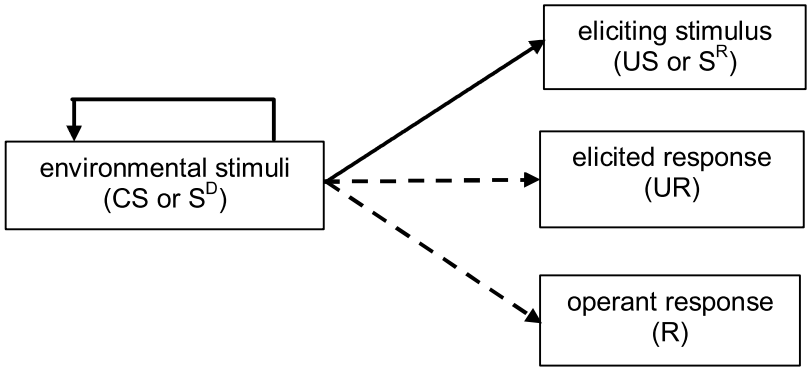

FIGURE 2.A ***Differences in the nature of associations inferred to form during classical and operant procedures.*** An environmental stimulus—the CS (conditioned stimulus) in the classical procedure or the S^D (discriminative stimulus) in the operant procedure—occurs prior to the eliciting stimulus (the US and S^R, respectively). The eliciting stimulus functions as a reinforcer in either procedure. Note that the same eliciting stimulus, e.g., food, is designated by different technical terms in the two procedures. In the classical procedure, the inferred associations are shown by arrows with solid lines. To wit, the CS becomes associated with the US and possibly other stimuli that accompany the CS. In the operant procedure, the inferred associations are shown by arrows with broken lines. To wit, the S^D becomes associated with both the R and the UR.

As **Figure 2.A** makes clear, the classical procedure is assumed to produce associations between stimuli—e.g., the CS with the US—whereas the operant procedure produces associations between stimuli and behavior—e.g., the S^D with the R and UR. The inference that the classical procedure produces stimulus-stimulus associations is based most directly on the finding that conditioning is affected when the temporal relation between the CS and US is varied; see **Figure 2.7**, p. 42.

The CS-UR relation. Note, however, as shown in **Figure 2.B**, that when the temporal relation between the CS and US is varied, the relation between the CS and the UR varies as well (cf. Gormezano & Kehoe, 1981). Unless the US and the UR can be separated experimentally in the classical procedure, the observed effects of changing the relation between two stimuli (the CS and US) can be attributed with equal validity to changing the relation between a stimulus and behavior (the CS and UR).

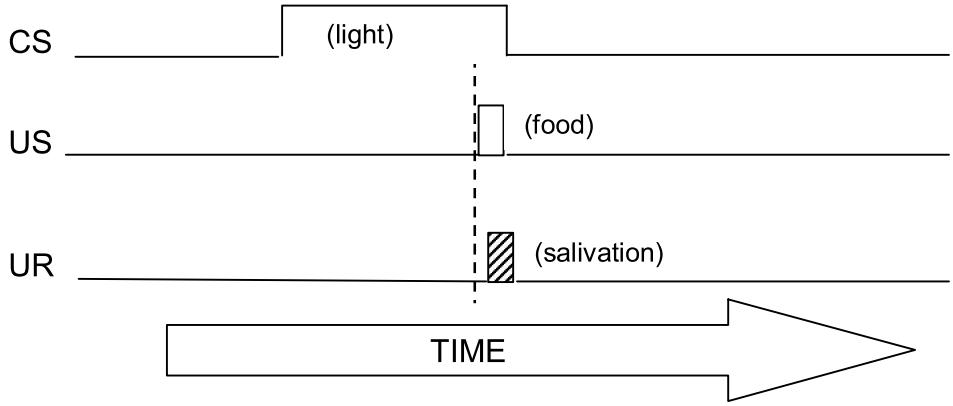

Figure 2.B *Temporal relations between the CS, US, and UR in a typical classical conditioning procedure. Note that the CS-US temporal relation is essentially the same as the CS-UR relation.*

More recently, an experimental preparation has been developed in which the UR occurs with sufficient delay after the presentation of the US to separate experimentally the effects of the CS-UR relation from the CS-US relation (Donahoe & Vegas, 2004). When a water US is injected into the mouth of a pigeon, a swallowing UR is elicited with a delay of over a quarter of a second (250 ms) and with a duration of several seconds. Although this is a short delay, the swallowing UR is much more delayed than a blink UR following an air-puff US (less than 50 ms) and it has a much greater duration than the blink (less than 1 s). The longer delay of the swallowing UR allowed the CS to be introduced *after* the onset of the US but *before* the onset of the UR. The greater duration of the swallowing UR allowed the CS to be introduced *after* the onsets of both the US and UR while still overlapping the UR. The central finding with this preparation was that the CS (a light) came to evoke the conditioned response (swallowing) independent of the relation of the CS to the US as long as the CS preceded and/or overlapped the UR. Thus, conditioning varied more systematically with the temporal relation between the CS and UR than with the relation between the CS and US. The inference that the classical procedure produces a different kind of association—a stimulus-stimulus association—was based primarily on a misunderstanding of the finding that variations in the CS-US relation affect conditioning.

The new finding that environment-behavior (CS-CR) relations are changed in the classical procedure undermines the inference that the classical procedure promotes stimulus-stimulus associations whereas the operant procedure promotes stimulus-response associations. The simplest interpretation of the outcome of both procedures is that conditioning changes the environmental guidance of behavior. Partially different responses are affected by the two procedures because the procedural arrangements ensure that somewhat different responses occur in proximity to the eliciting stimulus—the conditioned response (CR), which closely resembles the UR, in the classical procedure or the operant (R) in addition to the CR in the operant procedure. To date, the most parsimonious treatment of the outcome of both the classical and operant procedures is provided by a unified reinforcement principle. Because of differing temporal relations of the reinforcing stimulus to environmental and behavioral events, the two procedures produce somewhat different changes in the environmental control of behavior. An appeal to different types of inferred associative processes is not required.

*[To access the complete manuscript on CS-UR relations in classical conditioning, left-click button 2 (***CS-UR *Relations)**. *Click button 3 for additional implications of the critical role that CS-UR relations play in other conditioning phenomena (cf. Miller & Barnet, 1993; Timberlake, 1994).]*

Skinner's View of the Difference Between Classical and Operant Conditioning

Learning and Complex Behavior takes the view that changes in the environmental guidance of behavior are the product of the same selection process—selection by reinforcement. The same process has different outcomes in the classical and operant procedures, however. The outcomes are different because the procedures ensure that the on-going behavior when the reinforcing behavioral discrepancy occurs is not the same. In the classical procedure, the UR has just occurred when the reinforcing stimulus evokes the behavioral discrepancy. In the operant procedure, the operant (R) as well as the UR has just occurred. The result is that behavior resembling the UR is generally selected in the classical procedure whereas a relatively arbitrary behavior (the operant) is selected in addition to the UR in the operant procedure.

The view that one conditioning process occurs in both procedures is sometimes seen as inconsistent with Skinner's treatment of conditioning. It is not. In *The Behavior of Organisms* (1938), B. F. Skinner's seminal extended treatment of classical and operant conditioning, he identified two procedures—Type S (or *respondent*) conditioning and Type R (or *operant*) conditioning. Type S conditioning corresponds to the classical procedure and Skinner so-named the procedure to emphasize that the behavior of interest (the UR) was a response (i.e., a respondent) to a specified *stimulus* (the US, hence Type S). Type R conditioning corresponds to the operant procedure, where operant is term that Skinner introduced to emphasize that the reinforcer occurred when the response *operated* on the environment (the R, hence Type R); see also Skinner, 1938. The procedure was called Type R conditioning to emphasize that the temporal relation of the organism's *response* to the reinforcer was paramount and that the response was not elicited by any specifiable stimulus. In his words, "…there are two types of conditioned reflex, defined according to whether the reinforcing stimulus is correlated with a stimulus or with a response" (p. 62). "The fundamental difference rests upon the term with which the reinforcing stimulus … is correlated. In Type S it is the stimulus …, in Type R the response …" (p. 109). Note especially that the two types of conditioning are "defined" (his word) by a procedural distinction, not a process distinction.

Later in the same work, Skinner cited without dissent the views of contemporaries proposing a possible theoretical consistency between the processes occurring in the classical and operant procedures. "An analysis of differences between the two types has been made by Hilgard (1937), who points out that both types usually occur together and that 'reinforcement' is essentially the same process in both. The present distinctions [Skinner's procedural distinctions] are, however, not questioned." (p. 111). He then also cites the following without dissent: "Mowrer (1938) holds out the possibility that the two processes may eventually be reduced to a single formula." (p. 111) and notes that "in Type R … the process is very probably that referred to in Thorndike's Law of Effect (1911). (For a presentation of Thorndike's views as they relate to current work on reinforcement, see Donahoe, 1999; http://seab.envmed.rochester.edu/jeab/articles/1999/jeab-72-03-0451.pdf). *[Note: Any addresses must be typed into the browser because text within a FlashPaper document may not be copied and pasted.]*

In summary, Skinner's prescient distinction between the classical and operant conditioning was based on procedural grounds alone. A unified theoretical treatment of the processes involved in the two procedures was a possibility that he both anticipated and endorsed.

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