APPENDED MATERIAL: OTHER IMPLICATIONS

CS-UR relations provide a basis for interpretation of a number of conditioning phenomena as described in Donahoe and Vegas (2004). CS-UR relations also accommodate other phenomena now cast in the theoretical language of inferred-process psychology. Two such phenomena are briefly considered here—*temporal coding* (e.g., Miller & Barnet, 1993), and the *conditioning of behavior systems* (e.g., Timberlake, 1994).

Temporal Coding

Conditioning has been shown to be sensitive to the specific temporal relation between stimuli; e.g., between the CS and the US or between different CSs (Miller & Barnet, 1993). Miller proposed a temporal-coding hypothesis, whereby these observations were taken to mean that the specific time at which an event occurs enters directly into the conditioning process. In one experiment (Cole, Barnet & Miller, 1995), two groups of rats were exposed to a two-phase training regimen that used a conditioned-suppression, classical-conditioning preparation (***see p. 64, footnote 40***). For the trace-conditioning group during the first phase of the experiment, a stimulus (CS1) was presented for 5 s followed by a brief shock (US) given 5 s after CS1 had terminated. For the delay-conditioning group during the first phase, CS1 was presented for 5 s followed immediately by the US. During Phase 2, both groups were trained with a backward second-order conditioning procedure (***see p. 95 for a description of higher-order conditioning***). In this procedure, CS1 was presented for 5 s followed immediately by a second stimulus (CS2) for an additional 5 s and then the US. In a subsequent test, suppression during CS2 was greater following the trace procedure than the delay procedure. This occurred despite the fact that responding was more suppressed during the delay CS1 than the trace CS1. Paradoxically, the "poorer" CS appeared to serve as the better conditioned reinforcer. According to the temporal-coding hypothesis, greater backward second-order conditioning of CS2 occurred after the trace procedure because CS1 evoked a "memory" of the US that emerged 5 s after the termination of CS1. The forward pairing of CS2 with the onset of the memory of the US was said to permit CS2 to become an effective suppressor. The relatively poorer suppression with the delay procedure was attributed to pairing the US memory with the onset of CS2, a less favorable temporal arrangement for conditioning.

CS-UR relations provide the basis for an alternative interpretation of what was described as backward second-order conditioning in the trace procedure (see also Barnet, Grahame, & Miller, 1993). In keeping with the role of CS-UR relations, in the trace group during phase 2 the conditioned increase in CR activity would occur more than 5 s after CS2 had been presented: With long latency URs, such as the autonomic responses elicited by shock in conditioned suppression, the UR occurs substantially after US onset (e.g., Borgealt, Donahoe, & Weinstein, 1972). Thus, for the trace group in phase 2, the CR evoked by CS1 would occur *after* the onset of CS2. This is a favorable CS2-UR temporal arrangement for the acquisition of conditioned responding to CS2. However, in the delay group the CR evoked by CS1 would occur immediately *prior to* or very shortly after the onset of CS2. This backward or extremely brief CS2-CR temporal relation, together with generalization decrement occurring with such an arrangement, would disfavor the acquisition of suppression to CS2 (Kamin, 1965).

Additionally, the re-interpretation of backward second-order conditioning in terms of forward CS-UR relations appeals to potentially detectable, contiguous events that are known to produce conditioning instead of inferred, temporally remote events—memories of the US.

Conditioning of Behavior Systems

A given US sometimes evokes a sequence of responses (i.e., a behavior system), not a single discrete response. The different responses that compose a behavior system are known to become conditioned dependent on their temporal relation to a CS. In the case of food as a US, food evokes a *foraging* behavior system consisting of consummatory, focal search, and general search responses as its successive components (Silva, Timberlake, & Cevik, 1998). Specifically, the foraging behavior system consists of eating food, searching the location where food was found in the past, and general searching about a wider area. Research indicates that whichever component of the behavior system is contiguous with the CS, that component response becomes conditioned to the CS—even though the CS-US relation is backward (i.e., the CS follows the US). Because of the historical emphasis upon CS-US relations in associationist accounts of classical conditioning, these findings have been seen as "the expression of backward CS-US associations" (Silva et al, 1998, p. 1). However, if the relation of the CS to the *behavior* elicited by the US is the fundamental temporal relation, then the finding may be readily interpreted as an unexceptional instance of conditioning due to a favorable CS-UR relation. No appeals to backward associations and other complex inferences such as "backward scanning" are required (cf. Domjan, 1994; Spetch, Wilkie, & Pinel, 1981; Timberlake & Lucas, 1989; Domjan, 2000).

ADDITIONAL REFERENCES FOR APPENDED MATERIAL

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