

Abstracts  
(Alphabetical Order)

Lorraine Allan  
McMaster University

Shepard Siegel: Past and Future Contributions to Associative Learning

All of Shep's contributions are characterized by an appreciation of the contribution of associative learning principles to a variety of disciplines. For example, he has applied his insights to integrate such seemingly disparate phenomena as the placebo effect and multiple chemical sensitivity disorder. Recently, he has integrated concepts from learning theory and signal detection theory. I will take you on a short tour of his past contributions and give you a glimpse of his future research plans.

Mark E. Bouton  
University of Vermont  
Time Between Trials as a Contextual Stimulus

Increasing the time between trials (intertrial interval, or ITI) is widely known to facilitate learning. However, the effects of ITI on extinction, a phenomenon of considerable theoretical and practical importance, appear to be complex. In several experiments, we found that extinction ITIs of 1, 4, or 16 min had lawful effects on performance during extinction, but no differential effect on its retention when tested 72 hrs later: Each ITI allowed significant, and apparently equivalent, spontaneous recovery. One reason may be that extinction performance is especially specific to the context in which it is learned; if the time between trials is encoded as part of the extinction "context," tests occurring after a different interval might allow a "renewal" of conditioned responding. Several experiments investigated this idea. In one experiment, extinction with 4-min ITIs yielded spontaneous recovery after a 16-min retention interval, but extinction with 16-min ITIs did not. In discrimination learning experiments in which the ITI signaled whether or not the next CS would be reinforced, ITI was shown to be a powerful contextual cue. However, the results uncovered at least two anomalies that may provide new insights into how time is encoded and influences learning and retention. The findings are interesting from both theoretical and practical perspectives—like many of Shepard Siegel's well-known results.

Michael Domjan  
University of Texas  
Pavlovian Conception

One of S. Siegel's lasting legacies is his extensions of Pavlovian conditioning to new domains, and his virtuosity in showing how such extensions can provide new insights into both those domains and the basic mechanisms of Pavlovian learning. I will review the extensions of Pavlovian conditioning to yet another area, namely sexual behavior. Studies have shown that many of the conventional phenomena of Pavlovian conditioning also occur in the sexual behavior system. These studies have demonstrated experiential modifications of appetitive as well as consummatory sexual responses, illustrating that sexual behavior is much more flexible than is commonly believed. Of particular interest has been the finding that sexual conditioning can increase sperm output and fertilization success and can bias paternity in favor of a conditioned male in sexual competition. These findings focus attention on the importance of conditioned modifications of the unconditioned response rather than the conventional conditioned response as the outcome that is of greatest functional significance in Pavlovian conditioning.

Barry Dworkin  
Pennsylvania State University College of Medicine  
Long-term Potentiation and Interoceptive Conditioning

Arbitrary stimulus substitution is convincing evidence of Pavlovian conditioning; often in laboratory studies, to make the most convincing case, intentionally unrelated conditioned and unconditioned stimulus pairs are used. For example, the taste of decaffeinated coffee paired with intragastric glucose to elicit conditioned hypoglycemia; and an auditory tone paired with electrical aortic nerve stimulation to elicit a conditioned depressor response. Such conditioned responses emulate anticipatory responses to environmental cues, which afford protection from harmful drug effects, and contribute to undesired tolerance to useful drug effects. In contrast to these *heterotopic* conditioned responses, for *homotopic* conditioned responses, the conditioned stimulus shares, with the unconditioned stimulus, the same sensory modality and/or physiological locus of activation. The manifestation of this kind of conditioning is less dramatic; and, because recognizing it requires quantitative response measurement, it is often overlooked; however, homotopic conditioning has important implications for physiological regulation, and may dilute the conditioning effects observed in laboratory studies. Because both CS and US are within the same sensory input, temporal contiguity is inevitable, and the usual distinction between conditioning and sensitization is possibly moot.

I will describe recent experiments showing augmentation, by strong aortic nerve stimuli, of responses to weak aortic nerve stimuli in second order neurons of the

cardiovascular part of the dorsomedial solitary nucleus. The temporal properties of these effects resemble hippocampal LTP, and are the first direct neurophysiological evidence of baroreflex conditioning. Peripheral summation, at the baroreceptors, of the reflex effects of the weak and strong inputs probably regulates the growth of the conditioned response to thus optimize the gain of the baroreflex and insure blood pressure stability. Because the US is modified by the CR, the classical-instrumental distinction is blurred.

Peter Killeen and Federico Sanabria  
Arizona State University  
Continual Reconditioning

When causal structures are important and dependable over generations, they are phylogenetically internalized as reflexes and instincts, with some ontogenetic fine-tuning by Pavlovian and Skinnerian conditioning. More evanescent correlations are left to conditioning, tout-court. Conditioning adjusts perception, drug responsivity, chemical sensitivity, and attribution of causality. Yet the paradigms for study of conditioning are typically one-time-through. This historical precedent not only delimits the ecological validity of the generalizations, but also provides a curtailed database. In the research reported here, pigeons are given thousands of trials in a paradigm that blends strong Pavlovian inducements to respond with weak omission contingencies. The long records of probabilistic responding to brief stimuli (5 or 15 s key lights) in the context of long inter-stimulus intervals provides many trials in which responding was paired with reinforcement, many in which it had no consequences, many in which non-responding (quiet) trials ended with food, and many in which quiet trials ended without food. Linear learning models with separate parameters for each of the four cells were applied to the data, and contrasted with a simple moving average. In all cases non-zero learning parameters significantly improved the fit to the data. The consistency of the parameters across animals, and their variation across variations in the conditions of reinforcement, are reported.

Ralph R. Miller and Steven C. Stout  
SUNY-Binghamton  
Sometimes Competing Retrieval (SOCR): A Formalization of the Extended  
Comparator Hypothesis

Competition between cues for behavioral control is one manifestation of the relative nature of conditioned responding. A long standing theoretical debate has focused on whether it reflects a learning or performance deficit. The comparator hypothesis, a model of expression of Pavlovian associations, posits that *learning* is not subject to cue competition, but that *performance* reflects relative

associative strengths. That is, subjects respond to a cue to the degree that during training it signaled a *change* from the likelihood or magnitude of reinforcement in its absence. Initially, this performance-focused view was supported by studies showing that posttraining reevaluation of a competing cue often influences responding to the target cue. However, recently developed learning-focused accounts of retrospective reevaluation have revitalized the debate concerning cue competition. Further complicating the picture are phenomena of cue facilitation, which have been addressed less frequently than cue competition by formal models of conditioning of either class. Here, we review the history of associative theorizing as a prelude to formalizing a natural extension of the comparator hypothesis, which results in sharpened differentiation between it and the new learning-focused models.

Robert A. Rescorla  
University of Pennsylvania  
Error-Correction and Extinction

Many contemporary models of associative learning rely heavily on one form or another of error correction mechanism. A significant number of these models assume that all of the stimuli present on a trial contribute to the calculation of an error which in turn is used to govern associative changes. The implications of this approach have been widely evaluated for acquisition of Pavlovian conditioning, and been found to have considerable explanatory power. However, the approach also has substantial, but largely uninvestigated, consequences for the extinction of conditioning. Such models suggest that the decremental effects of nonreinforcing a stimulus will be heavily influenced by the associative strength of concurrently present stimuli. Recent experiments in our laboratory confirm the implication that concurrent exciters promote and concurrent inhibitors attenuate the typical decremental impact of nonreinforcement. These results have implications not only for the circumstances that produce extinction but also for its content, as well as for clinical applications.

Allan R. Wagner  
Yale University  
Associative modulation of US processing

Some years ago, I presented a body of evidence indicating that events that are associatively “primed” in active memory by discrete cues are not as effectively processed, as they otherwise would be (Wagner, 1976, 1978). With an incautious leap, I also suggested that a similar phenomenon might happen during long-term habituation, as stimuli come to be “expected” in the context in which they have been exposed. I will reflect upon this reasoning in the light of

subsequent evidence from our laboratory and elsewhere. A major complication is that extended contexts (as well as discrete cues) can control potentiating (conditioned-emotional) tendencies in addition to the presumed decremental effects. Experiments that separate these effects will be exemplified, with some implications for our theories and future studies of habituation.

Edward A. Wasserman  
University of Iowa

Transposition in Pigeons: Reassessing Spence' (1937) Associative Learning Theory

Do animals perceive the relations between or among stimuli? C. Lloyd Morgan first considered, but later rejected this intriguing possibility for lack of compelling empirical evidence. Perhaps the most famous chapter in the story of relational discrimination learning in animals comes from the case of *transposition*, a phenomenon first studied by the Gestalt psychologist Wolfgang Köhler. He proposed that stimuli are not judged in *absolute* terms, but *relative* to one another. If finding empirical evidence of transpositional or relational responding were the whole story, then there would be no question that animals can perceive the relations between or among stimuli. But, there is much more to the story than that. Kenneth W. Spence (1937) devised an ingenious associative account of discrimination learning that could explain transpositional or relational responding *without* hypothesizing that animals actually perceive the relations between or among stimuli—a much-celebrated theoretical tour de force. Recent work in my laboratory has reexamined Spence's famous model. In each of several experiments involving multiple pairs of discriminative stimuli lying along the size dimension, clear failures of the model arose; the most glaring failures involved pigeons' responding relationally when Spence's theory expected the birds to respond in accord with the absolute associative histories of the discriminative stimuli. These failures strongly suggest that any theory of discrimination learning that is based solely on the associative histories of the individual discriminative stimuli cannot predict relational responding.