Abstract

An Exploration of Target Event Encoding in a Predictive Learning Task with Humans: Integrated or Separable Processing?

by

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A major theme in the study of Pavlovian learning explores how attributes of a predicted event are represented and encoded. In Pavlovian conditioning, the conditioned stimulus (CS) is frequently assumed to associate with one or more of the various attributes of a motivationally significant unconditioned stimulus (US, e.g. it’s hedonic, motivational, and/or sensory features). The present research asks whether humans learn to predict and encode different aspects of motivationally neutral target events, namely, their specific sensory and temporal features in a separable or integrated manner. This question of how target events are encoded has implications for associative and timing models of Pavlovian learning, and associative learning more generally. The associative approach assumes that a CS could enter into separate associations with distinctive aspects of the US, while other timing-focused models suggest that these two aspects would be encoded in an integrated manner. To investigate this question, four predictive learning tasks with human participants were designed with the goal of seeking evidence to support one or
the other of these encoding possibilities. In an initial experiment, subjects were trained with a single ISI and tested with multiple ISIs in a two alternative forced choice and a go/no go version of the task. In Experiment 2 subjects were presented with four cues and two targets, where two cue-target pairs were trained at a short ISI and two at a long ISI. Then valid and invalid cue-target pairs were tested at both ISIs. Experiment 3 presented four unique cue-target pairs trained in a four-alternative forced choice task. Two pairs were trained at a short ISI and two at a long ISI. During test, valid and invalid cue-target pairs were tested at both short and long ISIs. Experiment 4 employed a conditional discrimination training procedure, where one of two cues predicted target 1 after a short ISI and target 2 after a long ISI, and the other cue signaled target 2 after a short ISI and target 1 after a long ISI. In test, subjects received probe trials in which the cue-target relations were tested at their untrained ISIs. Results from all experiments reveal a consistent pattern – subjects’ reaction times were faster to validly than invalidly cued targets when these relations were tested at the training ISI, and the magnitude of this validity effect was not reduced when testing occurred with alternative ISIs. The outcome of this investigation, of how sensory and temporal attributes of the US are encoded, has resulted in support of the separable encoding account. These findings are at odds with the limited work on this problem. However, there is support in the associative literature for independent associations forming between a CS and the sensory and motivational attributes of the US, and recent evidence that the neural mechanisms mediating these two forms of learning are dissociable. The main implication of the present studies is that a similar dissociation may exist regarding learning about specific sensory and temporal features of the US.