ESSAY

What Is Learned During Classical Conditioning?

Classical conditioning is a form of associated learning. The question is, what exactly is being associated. There are two main theories, the traditional Pavlovian S-S theory and the S-R theory. The S-S theory states that an association is formed between two stimuli, the conditioned stimulus (CS) and the unconditioned stimulus (US). The S-R theory (Hull, 1943, as cited in Lieberman, 2000) states that an association is formed between the conditioned stimulus (CS) and the unconditioned response (UR), which becomes the conditioned response (CR).

Evidence for the S-S theory, or stimulus substitution theory, is shown in US devaluation studies. Holland and Straub (1979) devalued the taste of food to rats by conditioning noise with the production of food, then, once conditioned, the food was paired with an unpleasant high-speed rotation. The CR of higher activity significantly dropped. Devaluing the US weakened the CR, indicating that the CR is mediated by the US.

The nature of the CR-US association is arguable. The preparatory response theory states that the organism is reinforced for making a certain response because that response prepares the organism for the US. Tolman (1932, as cited in Lieberman, 2000) believed that the CS caused an expectation of the US. So, if a dog was conditioned to expect food after a tone, salivation would occur on hearing the tone, to facilitate the digestion process.

The stimulus substitution theory argues that the CS and US centres are linked in the brain, so when the CS becomes activated, the US centre will also, producing the same behaviour. CS is the substitute of food. Pavlov described a dog in his experiments that had been conditioned to associate light with food (Pavlov, 1927, as cited in Lieberman, 2000). The dog, when released from its harness, would lick the light bulb. Similarly, in Jenkins and Moore’s (1973) study of conditioning in pigeons, the birds would act as if drinking when presented with the US of a lighted key associated with water, and as if trying to pick up and eat grain when presented with the US of a key associated with grain. In a similar study (Wasserman, Franklin and Hearst, 1974), birds were conditioned to peck when food was presented. Even when there was not enough time to collect food if they pecked, they still continued to do so, as if the CS was food itself.

Support for Tolman’s theory is evident also. Zener (1937) showed that dogs conditioned to associate food with the conditioned stimulus not only salivated when the stimulus was presented, but approached the food tray, as if expecting food. Colwill and Motzkin (1994) showed that devaluing US1 reduces CR to CS1 but not to CS2. The CS can therefore signal specific food rather than activating the general food centre.

Sensory preconditioning provides evidence of S-S learnt associations, occurring when a stimulus gains the ability to produce a CR, due to its prior association with another stimulus. Matzel, Held and Miller (1988) demonstrated this by pairing a tone and clicker, then a tone and shock. When the clicker was presented fear was shown, as an association between the clicker and tone had been formed.

In an experiment by Light and Gantt (1936), pressure was exerted on the motor nerves of dogs necessary for flexion to occur in the leg, and a tone was paired with shock to the leg. When pressure on the motor nerves was removed and the CS was presented, a leg flexion response was elicited, though the CS could not have become associated with the UR. Similarly, Solomon and Turner (1962) administered a drug to a dog disabling the use of any muscles, yet when the animal was again mobile, it elicited appropriate CR. In a similar type of experiment, Finch (1938) injected dogs with a drug preventing salivation. When the effect of the drug had worn off the CS
was presented and salivation (CR) was observed, suggesting the dogs has learnt a relationship between a CS and US, not between CS and UR. These three experiments provide strong evidence for an S-S interpretation of what is learned during classical conditioning. However, an alternative interpretation based on S-R learning has been put forward. It is accepted that overt occurrence of the response to the stimulus is not necessary for classical conditioning to take place, though it is argued that an internal response to the US still takes place, which becomes associated with the CS, preserving the S-R interpretation. This, however, is difficult to test.

The evidence for the S-S theory is overwhelming, but the exceptions cannot be ignored. If both views are correct, that CS can be the US, and that CS signals the US, we can assume that classical conditioning consists of two systems (Lieberman, 2000). The associative system is the basic and automatic response system based on associations. The cognitive system is the evolved system, based on expectation. This two level hypothesis has been demonstrated in the conditioning of fear (Averill et al., 1994). When the amygdala in rats was surgically removed, they did not learn to fear a tone, which signalled shock. Furthermore, he believed, judging by the direct and indirect pathways to the amygdala, that the amygdala itself processes a fast fear response, while the cortex processes conditioned fear responses based on evaluation.

Timberlake (1984, as cited in Lieberman, 2000) suggested a behaviour-system approach, whereby the stimulus has the potential to create a response, but the response is based on a motivational state and will be appropriate to the present stimuli, with the goal of obtaining or avoiding the US. Fanselow (1989) demonstrated this by presenting rats with the US of shock, causing a response of increased respiration and jumping. When a CS of a tone before the shock was presented, a decrease in respiration occurred, and the rats froze. Here it is not only demonstrated that the CS is not just a substitute for the US, but that the response was stimuli appropriate. The tone could indicate a type of avoidance activity, to freeze when a predator is in the vicinity, and the shock a flight response, to escape the predator. This is an example of a species-specific defence reaction. Furthermore, Timberlake and Grant (1975) have shown that CS rats can elicit social behaviour in other rats only after an association has been formed between CS rat and food, demonstrating that auto shaped behaviour reflects conditioning of species-typical behaviours related to the reward, and behaviour is dependent on the CS.

To conclude, animals in classical conditioning learn associations formed between the CS and US, in either an associative, automatic manner, or via a cognitive system based on expectancy. However, associations between their context and other stimuli are also learned.
References


