An Investigation of Acquisition, Extinction and Spontaneous Recovery in Classical Conditioning

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This experiment was conducted to investigate classical conditioning using a rat named Sniffy. The experiment used a tone that could be heard in the chamber that Sniffy was in and a shock was used to produce an association between the shock and the tone. The experiment was simulated in the Sniffy program on the computer where the tone intensity and shock intensity were controlled to create associations between the stimuli. Sniffy was found to have a strong response initially to the shock-tone pairings but then the response faded slowly after the shock was taken away. Also, after being taken out of the experimental chamber for a while and being put back in, Sniffy retained the initial strong conditioned response. The stronger response to the initial shock-tone pairing was due to the fact that a fear response was generated. A fear response is harder to extinguish than to generate and therefore the extinction occurs much more slowly than the acquisition of the fear response. This is important because it describes how acquisition of a fear response differs from the extinction of a fear response. This can be further studied to increase understanding of fear conditioning by studying how Sniffy responds to a shock with a different stimulus pairing such as a light.

Introduction

The aim of this study was to understand various aspects of classical conditioning through conditioning using a different stimuli and having a rat named Sniffy learn to associate them together. To get Sniffy to learn to associate these stimuli together, a neutral stimulus and unconditioned stimulus were used. These stimuli were paired together to create an unconditioned response then a conditioned response after being paired several times. The purpose was to analyze how the response changes under certain conditions such as removing a stimulus or taking Sniffy out of the chamber where the experiment was being performed. Introducing these changes to the experiment help explain certain aspects of classical conditioning such as acquisition of a conditioned response, recovery of a conditioned response, and extinction of a conditioned response.

Classical conditioning is a method of learning through which a human or animal learns to associate a neutral stimulus with an unconditioned stimulus. The unconditioned stimulus generates a natural response such as salivation in the case of Pavlov's dogs and the neutral stimulus doesn't initially generate a response. When the neutral stimulus is paired with the unconditioned stimulus it causes the neutral stimulus to produce the same response as the unconditioned stimulus. After that, the neutral stimulus becomes the conditioned stimulus. In experiment 1, Sniffy undergoes classical conditioning and his response is shown through the movement ratio which measures how much Sniffy freezes before being shocked.

There are multiple previous experiments that analyzed classical conditioning. One study analyzed associative learning based on olfactory classical conditioning using honeybees and "found that 24 h memory retention can be indistinguishable after single-trial and multiple-trial

conditioning in individuals" (Pamir, Szyszka, Scheiner, & Nawrot 2014, para. 1). This means that the conditioned response stays the same throughout the training and memory retention trials (Pamir, Szyszka, Scheiner, & Nawrot, 2014, para 1). Another study investigated the role of classical conditioning in placebo effects and found that classical conditioning likely plays a role in placebo effects rather than response expectancy theory, which states that classical conditioning is just one way our expectations our shaped (Babel, 2019, para. 1). This is an important because it establishes that classical conditioning is the primary mechanism through which placebo effects occur. This highlights the importance and ubiquity of classical conditioning. It occurs in everyday life and can have a big impact on our lives. Another study examines how circadian rhythms have different affects in classical and operant conditioning (Garren, Sexauer, & Page, 2013, para. 1). In the experiment the authors stated that, "it appears that the role of learning and memory may generally be different for classical and operant conditioning" (Garren, Sexauer, & Page, 2013, sect. 7). Therefore, classical conditioning is distinct from operant conditioning in how it affects an organism. Additionally, another study provides a great example of classical conditioning in action. The authors state that "nausea and vomiting can be learned via classical (Pavlonian) conditioning" (Stockhorst, Enck, Klosterhalfen, 2007, para. 1). In their experiment, they find a link between classical conditioning and anticipatory nausea (AN) but also find that classical conditioning can prevent it (Stockhorst, Enck, Klosterhalfen, 2007, sect. 17). This is important because it establishes that classical conditioning can generate a physiological response. This means that when Sniffy gets shocked after hearing a tone, he has a physiological response as well as the psychological that we observe.

The research question being answered in experiment 1 is the importance in the movement ratio in measuring Sniffy's response to the shock and tone pairing. The response will be measured by how long Sniffy stays still when being shocked, which is known as the movement ratio. The movement ratio will be important in measuring how much Sniffy stays still while being shocked which is critical in measuring his response. Therefore, if the movement ratio is high then the response will also be high. The research question in experiment 2 is the effect of removing the shock on Sniffy's response. This will be important in helping to understand acquisition of a response and how that differs from the extinction of that response. Therefore, if the shock is removed then Sniffy's movement ratio will decrease indicating a smaller response. The research question in experiment 3 is the impact of removing Sniffy from the chamber on his response. This will be important in understanding how a conditioned response remains with Sniffy over time and how the response will reappear once Sniffy is brought back into the chamber. Therefore, if Sniffy is taken out of the chamber and put back in then he will retain a response that is similar to the initial response.

Methods

Participants

The participant in the experiment was Sniffy, who was the rat who participated throughout the entire experiment. Sniffy was not trained in the operant chamber to press the bar to obtain food before the experiment. Therefore, the movement ratio was used to measure his fear response.

Procedures

In experiment 1, the movement ratio, or how much Sniffy freezes after being shocked, was plotted on a graph, which represents Sniffy's response to the shocks in each trial. Sniffy was presented with a shock at a medium intensity, presented a tone of medium intensity, and an

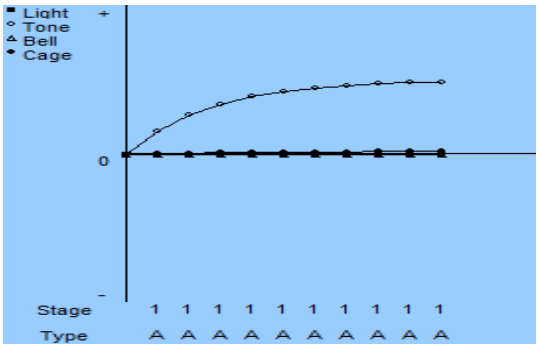
interval of 5 minutes was set in between each shock and tone pairing. The tone was presented first then the shock was presented followed by 5 minutes of no shock or tone. Ten trials are performed in this experiment. In experiment 2, Sniffy was exposed to a medium intensity tone with no shock. There were 30 trials performed with an interval of 5 minutes between each trial. This measured Sniffy's response while the conditioned response was being extinguished. In experiment 3, Sniffy was removed from the chamber before being put back in. Sniffy was again exposed to a medium intensity tone with no shock. There were 15 trials with an interval of 5 minutes between each trial.

When the experiment is performed, a shock is paired with a tone at certain time intervals and the response is measured. This experiment controlled for confounding variables because all aspects of the experiment such as the interval of time in between each shock and the intensity of shock were controlled. The experiment had validity because it directly tested Sniffy's response to the pairing of a tone and a shock, which is a direct investigation of classical conditioning. The experiment was reliable because several trials were performed at each intensity level for the tone and shock.

Results

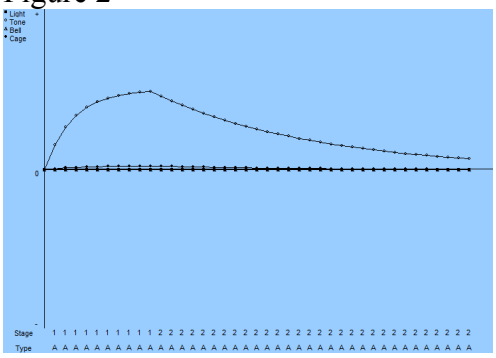
There were 10 trials in exercise 1, 30 trials in exercise 2, and 15 trials in exercise 3. In the first exercise, we became familiarized with the purpose of the movement ratio and the fact that it is measured to tell us about Sniffy's response to the shock. Figure 1 shows a quick increase at the beginning followed by a plateau, which indicates a stronger initial response followed by a steady response after that initial response had been generated. This response is indicative of an acquisition of a conditioned response.

Figure 1



In the 30 trials of the second exercise, the movement ratio was used to analyze Sniffy's response to a shock and tone pairing then having the shock removed. It showed that Sniffy initially had a strong response to the shock but when it was removed the response slowly faded. Figure 2 shows that there was initially a very fast response followed by a slow decline when the shock was removed. This indicates that the initial conditioned response was very strong and it took a while for this response to diminish during extinction due to the strength of the initial response. As can be seen in Figure 2, the graph sharply changed when the response was beginning to plateau, which is when the shock was removed.

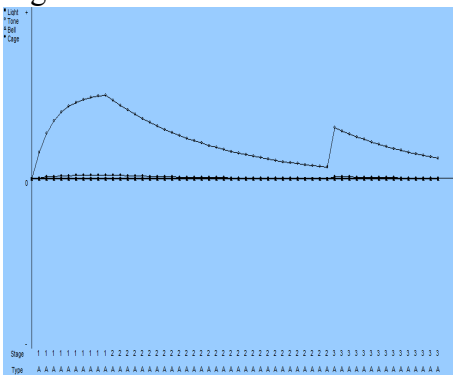
Figure 2



In the third exercise, Sniffy was removed from the chamber then put back in. This caused the graph to sharply increase once Sniffy was put back in the chamber because he retained the conditioned response from earlier. After being put back into the chamber the response diminished because there was no shock. This resulted in extinction of the response. Figure 3

shows a quick recovery of the previously conditioned response. This indicates that Sniffy remembered the initial conditioned response and it resulted in a large response once he was put back in the chamber. The first part of the graph in Figure 3 represents extinction of the response while the second part of the graph as shown by a smaller spike represents the recovery of the conditioned response

Figure 3



Discussion

The results from these experiments are similar to the experiment using honeybees for olfactory classical conditioning (Pamir, Szyszka, Scheiner, & Nawrot 2014) because in both cases the conditioned response was retained throughout the trials. In experiment 3 Sniffy retained the initial conditioned response even when taken out of the chamber. The results were similar to the experiment about the role of classical conditioning in placebo effects (Babel, 2019) because it corresponded to various psychological effects such as acquisition of a conditioned response, extinction of a conditioned response, and spontaneous recovery of a conditioned response. This experiment was similar to the experiment that compared the effects of the circadian rhythm on operant and classical conditioning (Garren, Sexauer, and Page, 2013) because it established how

classical conditioning distinctly impacts Sniffy. It showed how Sniffy acquired the response, retained the response and got rid of the response through extinction. The results relate to the experiment about the relationship between nausea and vomiting and classical conditioning (Stockhorst, Enck, & Klosterhalfen, 2007) because it shows how classical conditioning can generate physiological responses that are involuntary. In the experiment with Sniffy what we are observing in Sniffy's responses are not only psychological responses that cause him to change behavior but physiological responses that cause biological changes in Sniffy.

The significance of the outcome of this experiment is that it provides an understanding of how conditioned responses are obtained, how they are extinguished, and how they are retained. This can help increase understanding of how classical conditioning works and how various psychological disorders such as phobias develop. What remains unanswered is what the effects of different levels of intensity of stimuli are on how strong the response is. An experiment could be performed where Sniffy is exposed to multiple intensities of shock or tone to see how the response changes according to the intensity of the stimulus.

Sniffy's response in the first experiment showed the acquisition of a conditioned response. The response was measured in the experiment as the movement ratio which quantifies freezing behavior in Sniffy. It increased quickly and then leveled off, which shows that a level of response has been established. The response in the second experiment was strong initially then declined slowly after the shock was removed. Sniffy had a strong response to the shock in the first 30 trials of the second exercise because the conditioning of fear generates a strong response that takes a while to be removed. This is the case because fear naturally generates a strong response because it is an evolutionarily adaptive to be fearful of potentially dangerous stimuli. This caused the response to increase because the response to shock is stronger and quicker than

the response to the absence of a shock because it is naturally more adaptive to be fearful of a dangerous stimulus like a shock. This is an adaptation that is intended to promote survival. Another example of an adaptation intended to promote survival is the presence or absence of food. “the establishment of food-related memory is limited by the presence of food and promoted by its absence, implying that this behavior is driven by motivation” (Brünner et al 2020). This shows that the presence or absence of food has an effect on the *Drosophilia* larvae because the presence of food promotes survival and the absence of food generates a fear response. In the third experiment, Sniffy was removed from the chamber and then put back in. When he was put back in, he showed a strong response because he retained the initial strong conditioned response.

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