

Dr. Skogsberg

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Memory Consolidation and Memory Retrieval in Fear Conditioning

An important topic covered in chapter six of *Psychological Science* is **classical conditioning**. Classical conditioning occurs when a neutral stimulus is able to evoke a certain response because it has been paired with a stimulus that naturally elicits a similar response (Gazzaniga, 2018). In other words, the neutral stimulus becomes a **conditioned stimulus** because it is associated with the **unconditioned stimulus** and able to cause the **conditioned response**. Organisms can be conditioned to respond to a variety of neutral stimuli, such as the sound of a metronome or bell. An example of classical conditioning mentioned in *Psychological Science* is an individual becoming anxious after hearing certain music because it had repeatedly been played during scary scenes in a movie (Gazzaniga, 2018). On a similar note, fear conditioning involves the pairing of a neutral stimulus with an aversive unconditioned stimulus; this pairing will allow the neutral stimulus to elicit fear expression on its own (Bruchey et al., 2010). Additionally, memory plays an important role in the process of fear conditioning, as well as other forms of classical conditioning. Therefore, this artifact will examine memory's role in fear conditioning through comparing two articles that are centred around different aspects of **memory**: "Memory Consolidation of Pavlovian Fear Conditioning: A Cellular and Molecular Perspective" and "Fear Conditioning By-Proxy: Social Transmission of Fear during Memory Retrieval."

Consolidation in Fear Conditioning

The article “Memory Consolidation of Pavlovian Fear Conditioning: A Cellular and Molecular Perspective,” as indicated by its title, emphasizes the function of memory **consolidation** in fear conditioning. Before delving into the specifics of memory consolidation in fear conditioning, however, it is important to first develop a basic understanding of consolidation itself. Therefore, memory consolidation is the process through which short-term memory is converted into **long-term memory** (Schafe et al., 2001). In regards to fear conditioning, memory consolidation is responsible for converting fearful experiences into long-term memories and the article describes this process as quite easy, likely due to the fact that this information has the potential to be important for survival (Schafe et al., 2001).

The primary focus of this article is synaptic plasticity in the brain. Specifically, this article investigates new findings in Pavlovian fear conditioning regarding the biochemical processes that occur during the acquisition and consolidation of fear memories. These findings are noteworthy because they suggest that **long-term potentiation** and memory consolidation share similar features, which can provide valuable knowledge in regards to plasticity in the brain.

The article identifies the amygdala, particularly the lateral amygdala, as a potential site of the plasticity involved in fear memory storage. One reason for this belief is that damage to this location prevents fear acquisition and fear expression (Schafe et al., 2001). Another reason given by the article is that the pairing of the unconditioned and conditioned stimulus leads to long-lasting changes in synaptic transmission and neuronal activity in the lateral amygdala (Schafe et al., 2001).

One similarity between memory consolidation and long-term potentiation mentioned in the article is that both processes have temporal phases. While memory can be divided into short-term memory and long-term memory, long-term potentiation also occurs in an early phase that lasts only minutes and a late phase that can last from minutes to hours (Schafe et al., 2001). Overall, this evidence suggests that memory consolidation can be better understood through studies of long-term potentiation.

Retrieval in Fear Conditioning

The article “Fear Conditioning By-Proxy: Social Transmission of Fear during Memory Retrieval” focuses on memory retrieval in fear conditioning. Memory **retrieval** consists of recalling information that was previously encoded and stored as needed (Gazzaniga, 2018). In the case of fear conditioning, memory retrieval involves recalling a fear and typically leads to fear expression (Bruchey et al., 2010).

This article primarily focuses on the possibility of fears being socially transmitted. In order to study this possibility, researchers placed three rats together in a cage. One rat was fear conditioned, one rat was meant to be fear conditioned by-proxy, and one rat was not going to be conditioned. Two experiments were conducted: one in which one rat was fear conditioned with three tone-shock pairings and then placed back in the cage with the naive cage-mate, and one in which one rat was fear conditioned and one rat was fear conditioned by-proxy before being conditioned to a mild shock. In both experiments, all of the rats were exposed to a tone the next day (Bruchey et al., 2010).

The results of the experiments indicated that fear of a stimulus can be socially transmitted to a cage-mate during memory retrieval (Bruchey et al., 2010). Moreover,

these results can help researchers better understand how specific phobias are developed.

Making Connections

Both “Memory Consolidation of Pavlovian Fear Conditioning: A Cellular and Molecular Perspective” and “Fear Conditioning By-Proxy: Social Transmission of Fear during Memory Retrieval” connect the concepts of fear conditioning and memory, albeit in contrasting ways. The former emphasizes the relationship between memory consolidation and long-term potentiation, while the latter examines the ability of fears to be socially transmitted during memory retrieval. Furthermore, “Memory Consolidation of Pavlovian Fear Conditioning: A Cellular and Molecular Perspective” places a greater importance on the internal processes that occur during the memory consolidation, while “Fear Conditioning By-Proxy: Social Transmission of Fear during Memory Retrieval” emphasizes the social component of fear conditioning. Altogether, both articles offer meaningful insights into the connection between memory and fear conditioning and explore the implications of said insights.

Application to My Life

Fear is an emotion experienced by all, so I think anyone can benefit from learning about the process of fear conditioning and its relationship to memory. I was especially fascinated by the ability of fears to be socially transmitted. Although I’ve never considered it before, I find it makes sense because I can recall times that I’ve become scared after a friend of mine was scared of something even if I was unaware of the stimulus. Therefore, I can apply the findings listed in “Fear Conditioning By-Proxy: Social Transmission of Fear during Memory Retrieval” to my life by recalling the ability

of fears to be socially transmitted and using this information to prevent myself from becoming afraid simply because someone I'm around is scared. As for "Memory Consolidation of Pavlovian Fear Conditioning: A Cellular and Molecular Perspective," the information provided by this article helped me gain a better understanding of how fear memories are formed. I was also unaware that fear memories are formed so quickly, but it does make sense that an organism would need to learn to fear something dangerous as soon as possible. Overall, I plan on using the information from these two articles to think critically about my fears. In other words, I think the knowledge that I may fear something simply because someone I'm around is afraid of it could help me eliminate some fears. Whenever I'm afraid of something, I will begin considering why I'm afraid of it and try to keep in mind the biochemical processes that occur during a fear memory in order to try to be less afraid.

Conclusion

"Memory Consolidation of Pavlovian Fear Conditioning: A Cellular and Molecular Perspective" and "Fear Conditioning By-Proxy: Social Transmission of Fear during Memory Retrieval" consist of concepts featured in both chapter six and chapter seven of *Psychological Science*. The approaches taken by the articles to explain the connections between **learning** and memory helped me better understand both why and how organisms can be conditioned to fear something. Before reading these articles, I never considered the role that cells and molecules play in fear, nor did I consider how fear can be passed on socially. Overall, these articles helped me become better informed on the process of fear conditioning and the importance of memory in fear conditioning, first through consolidation and later through retrieval.

References

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Glossary

Classical Conditioning (6.3): a type of associative learning in which a neutral stimulus comes to elicit a response when it is associated with a stimulus that already produces that response.

- Classical conditioning is the first concept addressed in this artifact and it is used to explain fear conditioning since fear conditioning is a form of classical conditioning meant to condition an organism to express fear.

Conditioned Response (6.3): a response to a conditioned stimulus; a response that has been learned.

- In fear conditioning, the conditioned response is always an expression of fear, such as freezing. This term was applied in this artifact when describing the rat study because the rats were being conditioned to express fear.

Conditioned Stimulus (6.3): a stimulus that elicits a response after learning has taken place.

- In fear conditioning, the neutral stimulus can be a tone, such as in the rat experiment discussed in one of the articles. This term was used to explain fear conditioning and relate it to classical conditioning.

Consolidation (7.1): the neural process by which encoded information becomes stored in memory.

- This artifact discussed how fear memories are consolidated quicker than other memories because of the likelihood of these memories being important for survival. This term was the focal point of one of the articles discussed in this artifact.

Learning (6.1): a relatively enduring change in behavior, resulting from experience.

- Fear conditioning is a form of learning, and this term was included in the artifact in order to explain how memory and fear conditioning are connected.

Long-Term Memory (7.6): the relatively permanent storage of information.

- Long-term memory was used in the artifact to help summarize one of the articles since memory consolidation was heavily discussed in that article and consolidation in fear conditioning stores fear memories in the long-term memory.

Long-Term Potentiation (7.2): strengthening of a synaptic connection, making the postsynaptic neurons more easily activated by presynaptic neurons.

- Long-term potentiation was an important concept in one of the articles and used in this artifact to summarize that article. Specifically, long-term potentiation was compared to memory consolidation.

Memory (7.1): the nervous system's capacity to retain and retrieve skills and knowledge.

- Memory is an important factor in fear conditioning and this term was applied in the artifact because two components of memory, consolidation and retrieval, were described in relation to fear conditioning.

Retrieval (7.1): the act of recalling or remembering stored information when it is needed.

- During memory retrieval is when fear can be socially transmitted. This term was emphasized in one of the articles and was used in this artifact to explain that article.

Unconditioned Stimulus (6.3): a stimulus that elicits a response, such as a reflex, without any prior learning.

- In fear conditioning, the unconditioned stimulus is typically a shock, which is what occurred in the rat study. This term was used to better explain the process of fear conditioning.