

**Title**

Neuronal excitability is tightly associated with the regulation of fear memory in the lateral amygdala

**Abstract**

Fear memory among diverse memories brings two different aspects. Some experience on fearful situations lets subjects learn defense mechanisms whereas excessive fearful conditions cause PTSD (Posttraumatic Stress Disorder). In this regard, it is extremely significant to understand the process of fear memories in the brain. It has been very well known that the amygdala is in charge of fear memory. However, it is still unclear how the brain encodes fear memories and maintains, although countless researches have suggested the data explaining the mechanism. In this study, the majority goal is to pinpoint what an essential substrate for memory retention in the LA. Since we have reported that auditory fear training induces the increased excitability of principal neurons in the LA, I speculate that the manipulation of neuronal excitability would regulate fear memories. To control neuronal excitabilities, I applied optogenetics to fear behaviors such as fear conditioning and recall. Using the advantages of optogenetics, I manipulated fear memory expression. This is because optogenetics offers that different colored lights have distinct functions on target neurons. First of all, I allocated fear memory to randomly chosen neurons by infusing the virus having optogenetic constructs. Secondly, I delivered excitatory light or inhibitory light on mice during specific behavioral phases. Finally, I observed that regulating neurons' activity is strongly linked to fear behaviors. This finding is highly critical to approach to mental health problems regarding fear, since the explanation about the process of fear memories is able to suggest the fundament to resolve the issue.