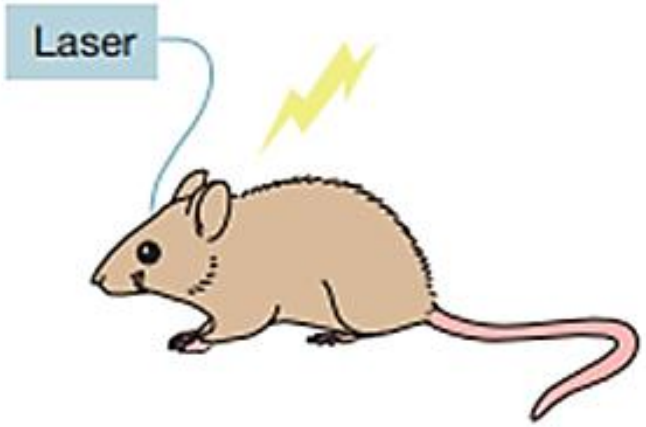
Master in Neuroscience

MOLECULAR NEUROPHYSIOLOGY

-lesson 3-



Prof. Giada Cellot

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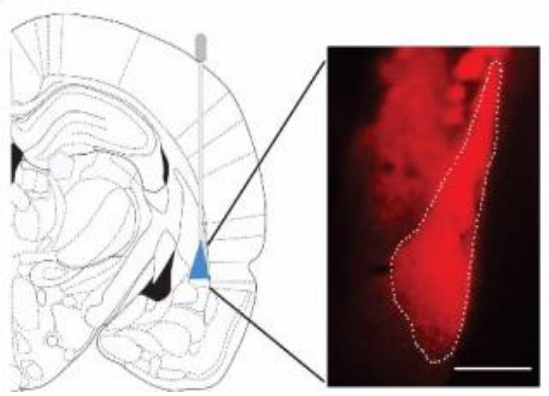
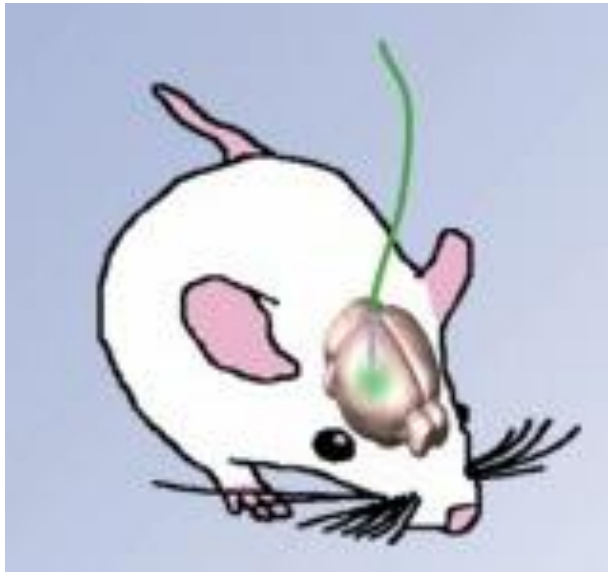
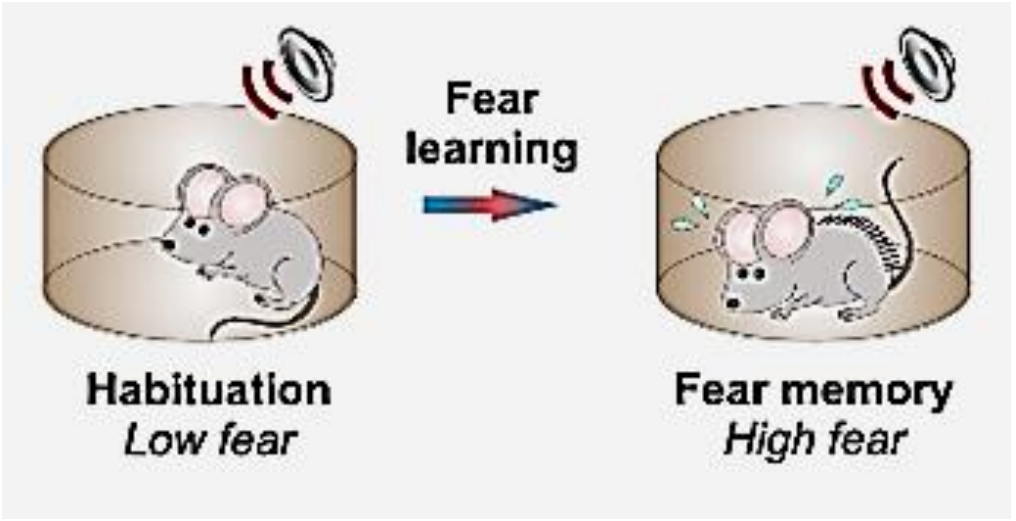
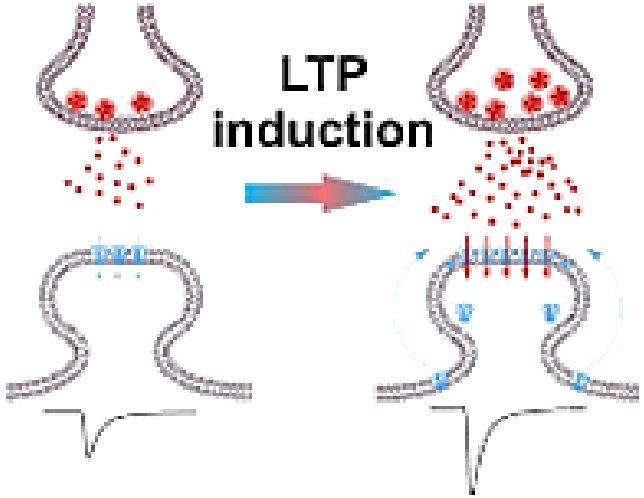




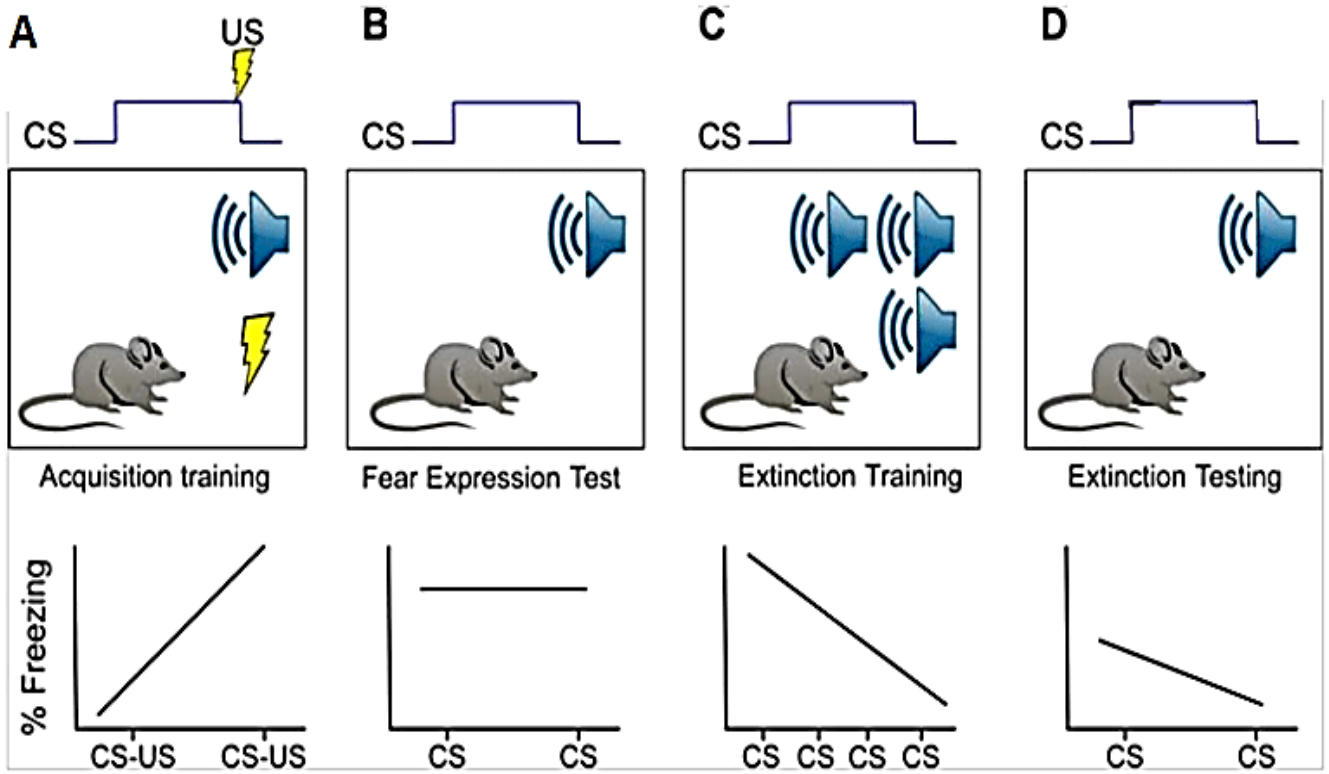


Optogenetic makes possible to (re-) activate the ENGRAM related to a fear memory



Can memory/learning be erased? An animal model for fear extinction

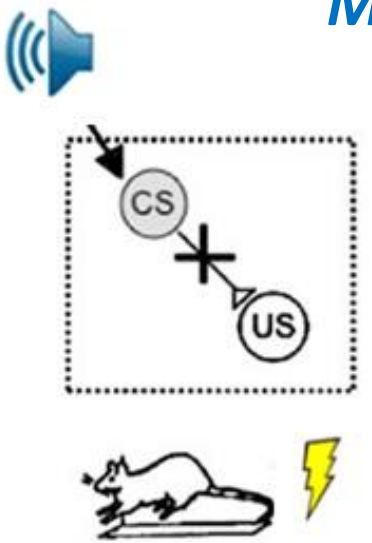
The repetitive exposure to the CS in the absence of UC trains the animal to extinguish fear conditioning



Fear extinction can be thought as a new learning process wherein animals learn that the CS is no longer predictive of the US

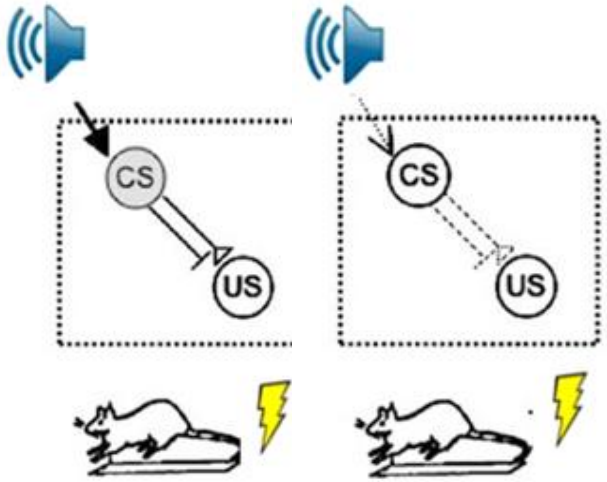
As in some cognitive behavioral therapies against phobias…

Mechanisms?

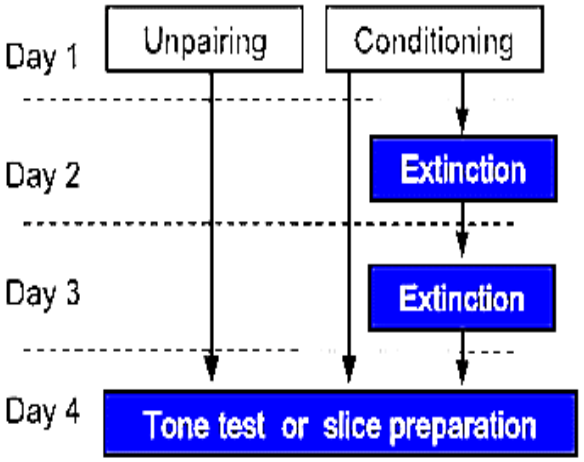


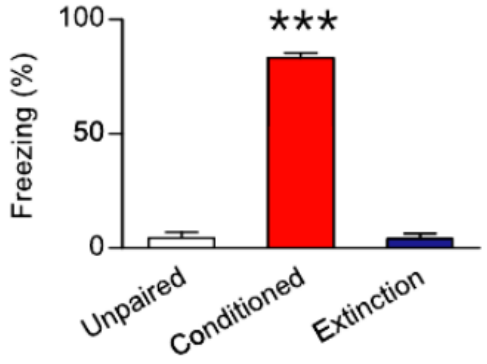
1. Depotentation of conditioning induced LTP

2. Additional plastic changes of synapses inside or outside the amygdala



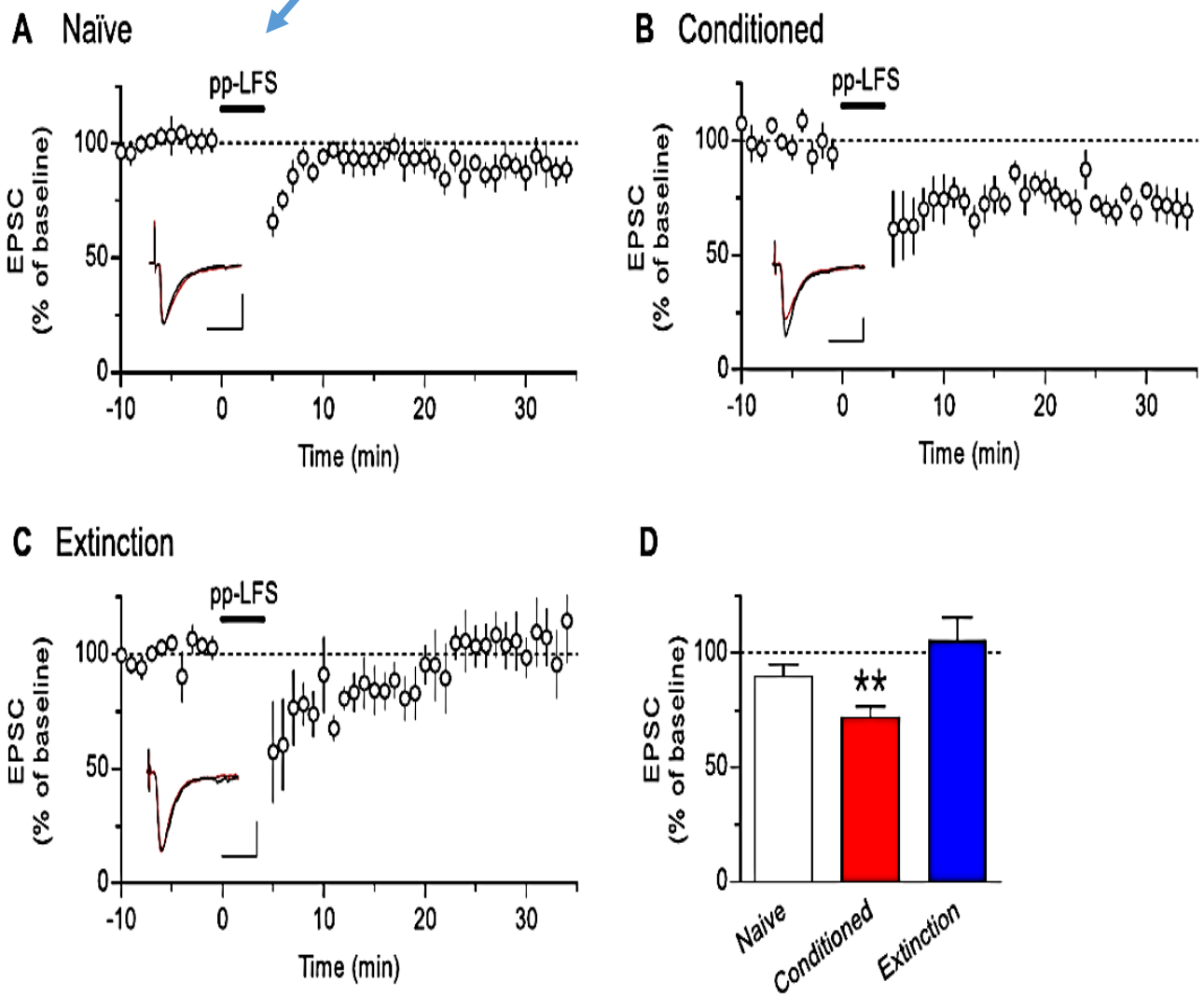
Mechanisms underlying fear extinction: DEPOTENTIATION of the conditioning induced plastic changes?



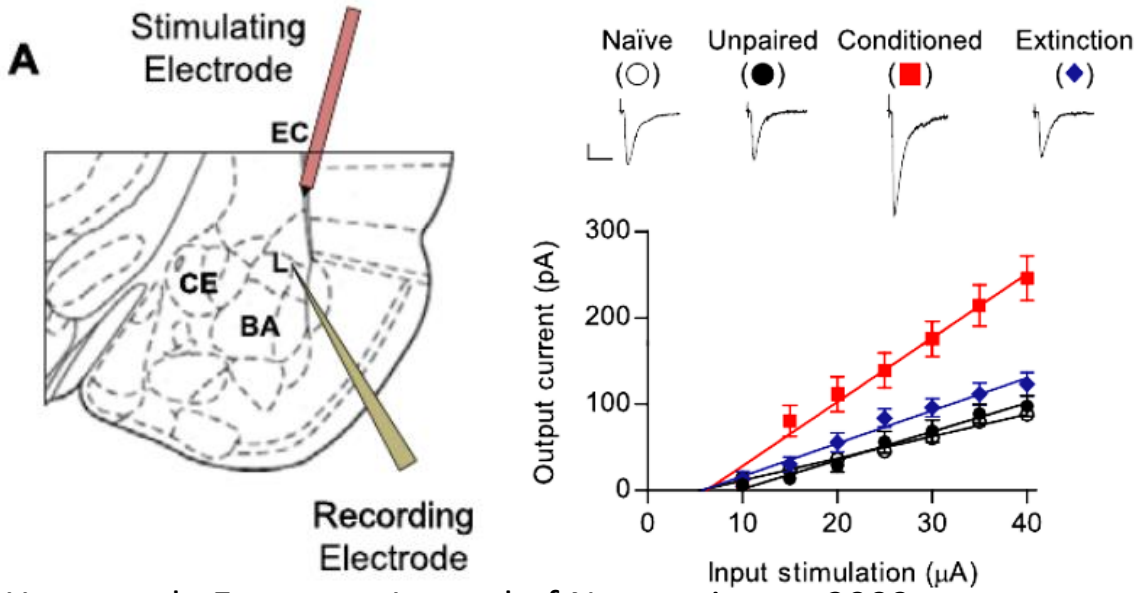


Paired-pulse low-frequency stimulation

2 stimuli (50-ms inter-stimulus interval) at 1 Hz for 5 min



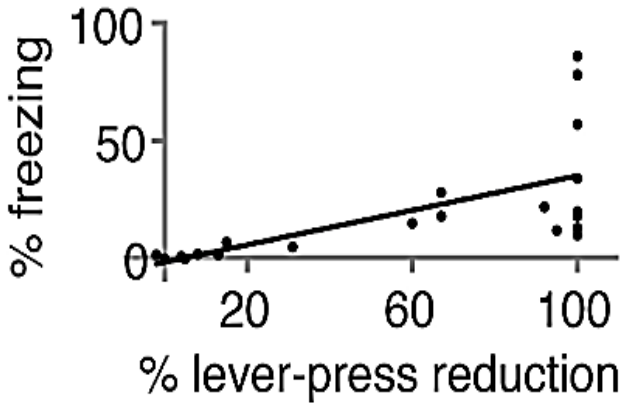
Stimulation of cortical inputs

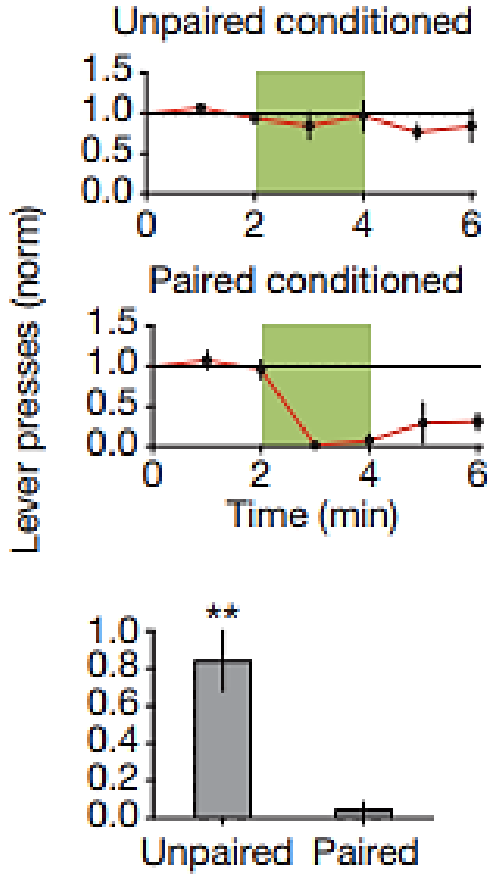


Hong et al., European Journal of Neuroscience, 2009, doi:10.1111/j.1460-9568.2009.07004.x

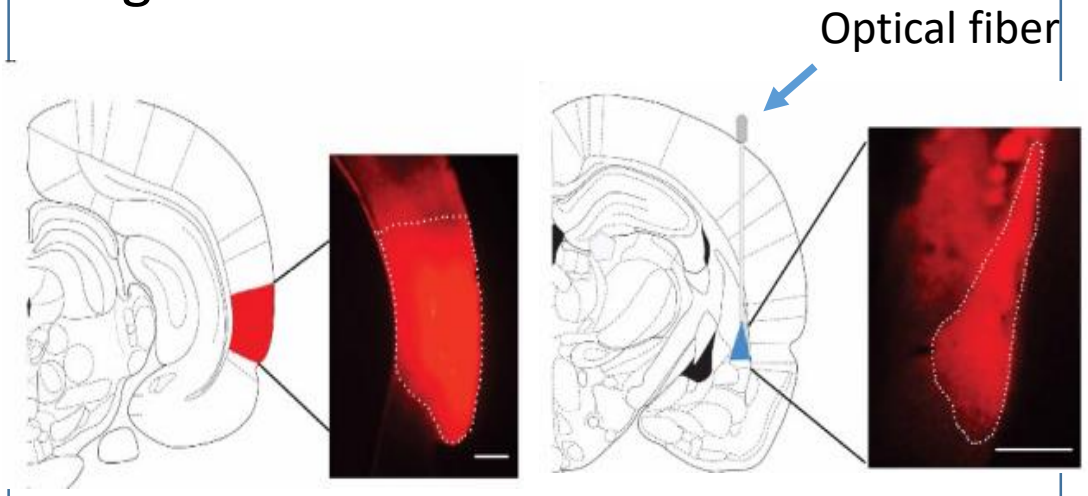
Optogenetic manipulation of circuit involved in fear extinction

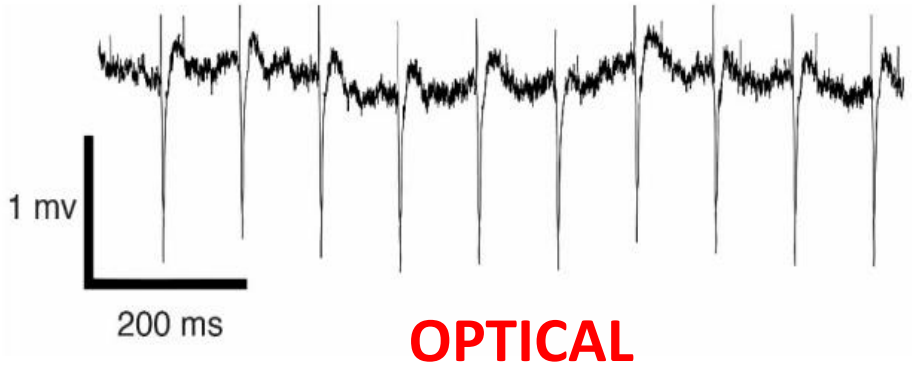
1. Pre-training:
Rats were trained to associate lever press for a reward





2. Injection in auditory cortex of an adeno associated vector carrying light-activated channel ChR2



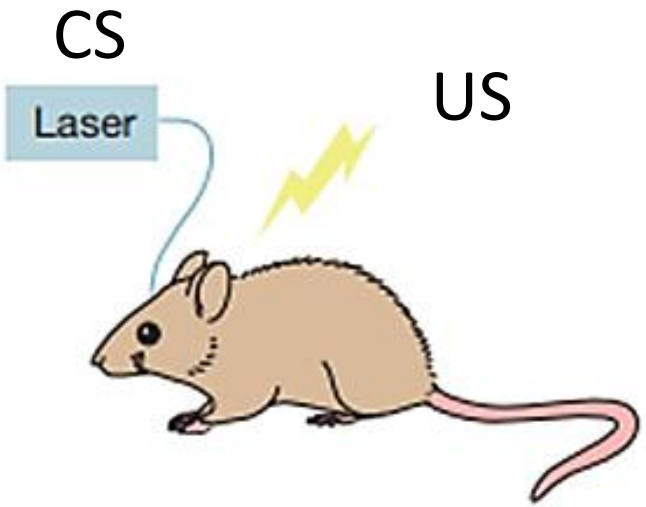


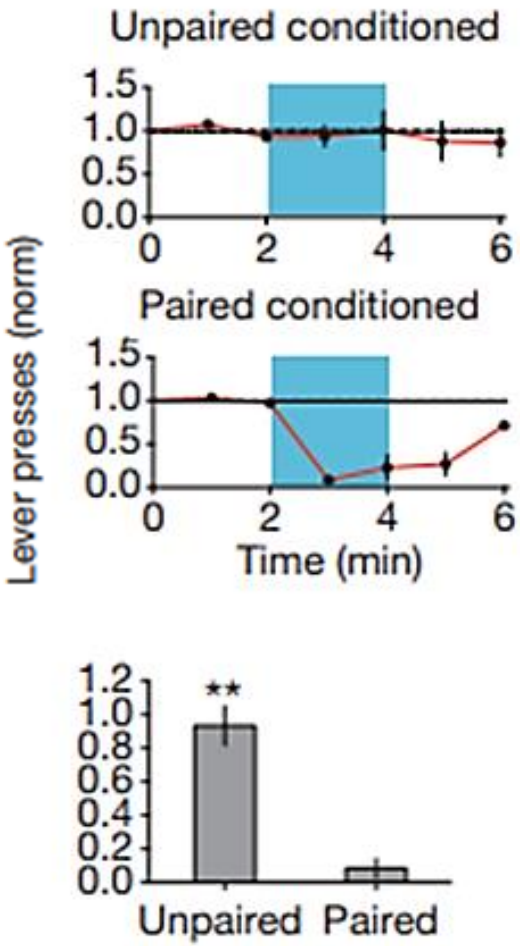
OPTICAL STIMULATION=CS

Nabavi et al, 2014, Nature, doi:10.1038/nature13294

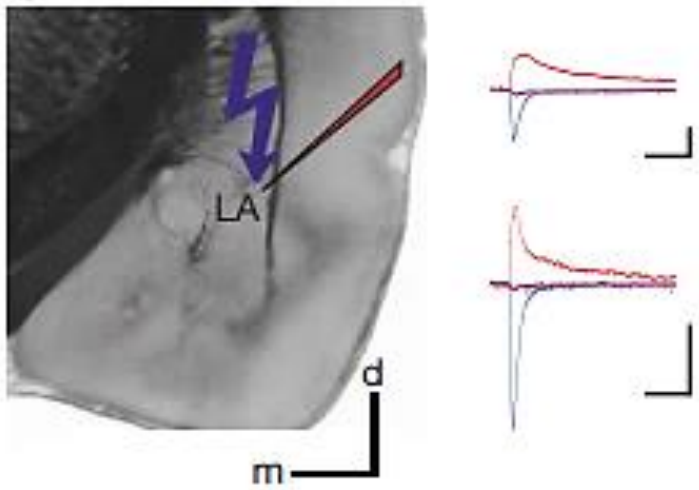
Optogenetic manipulation of circuit involved in fear extinction

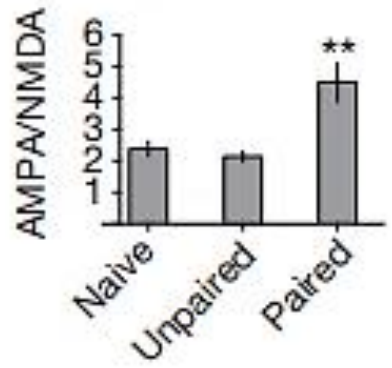
3. Pairing optogenetic stimulation of CS with footshock (US) results in fear learning





Evoked by light





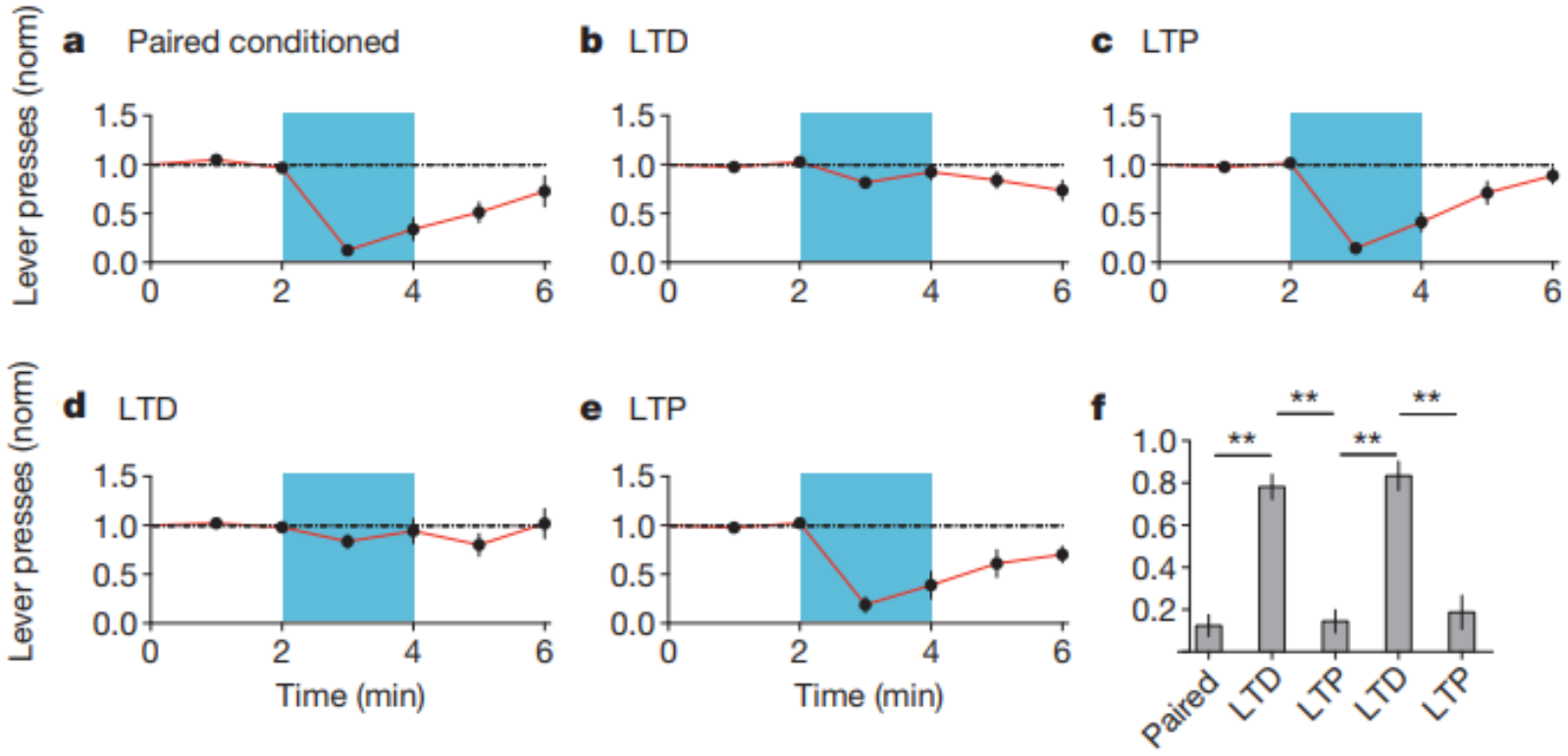
And in LTP in the lateral amygdala

Nabavi et al, 2014, Nature, doi:10.1038/nature13294

Can memories be inactivated through optogenetic manipulation?

Optical LTD: 900 pulses of light (2 ms @1 Hz)

Optical LTP: 5 trains of light (each train 100 pulses, @ 100 Hz; 3 min interval)



Synapses are capable of undergoing multiple rounds of bidirectional plasticity, correlating with fear acquisition/extinction