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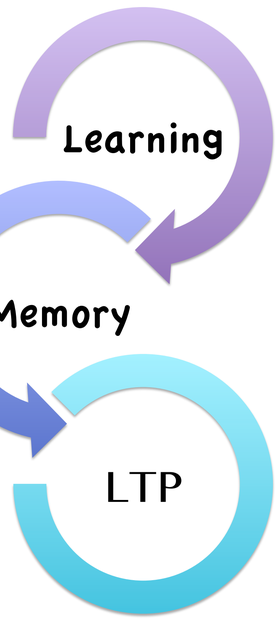
LTP: A MODEL OF LEARNING AND MEMORY

Universitat Autònoma de Barcelona

WHAT IS…?

Changes in NS resulting from experience, which create lasting changes in behavioural

Process whereby we encode, store and establish this learning



LONG-TERM POTENTIATION is a long-lasting enhancement in signal tranmission between two neurons that results from stimulating them synchronously

INTRODUCTION

LTP was discovered by Terje Lømo (1966) and originally defined by Bliss&Lømo (1973)

Only reported at excitatory synapses

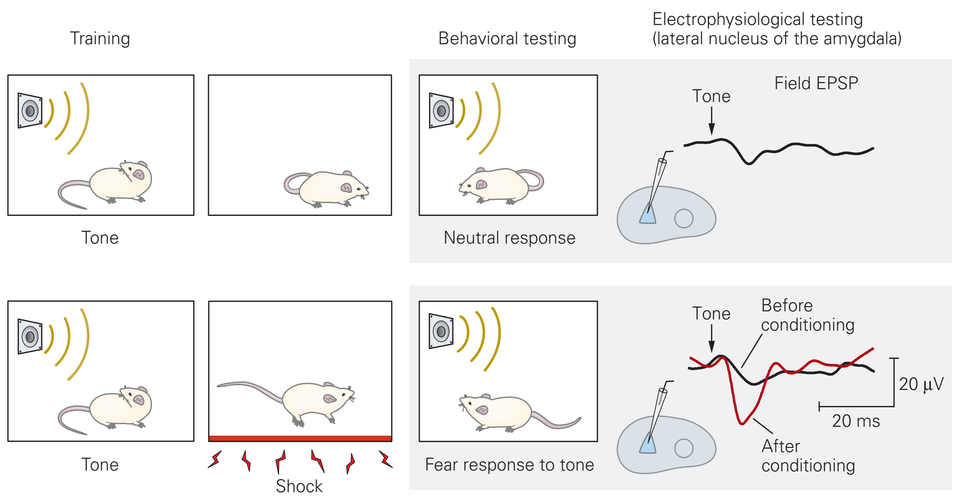
Different forms of LTP has been observed in different neural structures

LTP is the predominant experimental model for the synaptic plasticity mechanisms thought to underlie learning and memory

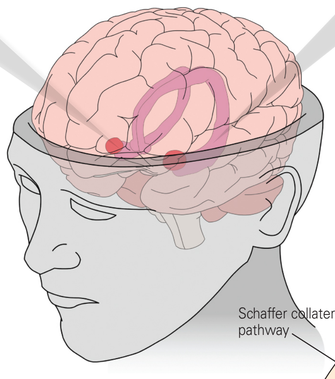
AMYGDALA

LTP is triggered by Ca2+ influx into the PS neurons, opening both NMDAR and L-voltage-dependent Ca2+ channels:

- Insertion of additional AMPAR in the PS membrane
- PKA and MAPK activate CREB → gene expression, necessary for the persistence of the memory for learned fear and the synaptic changes



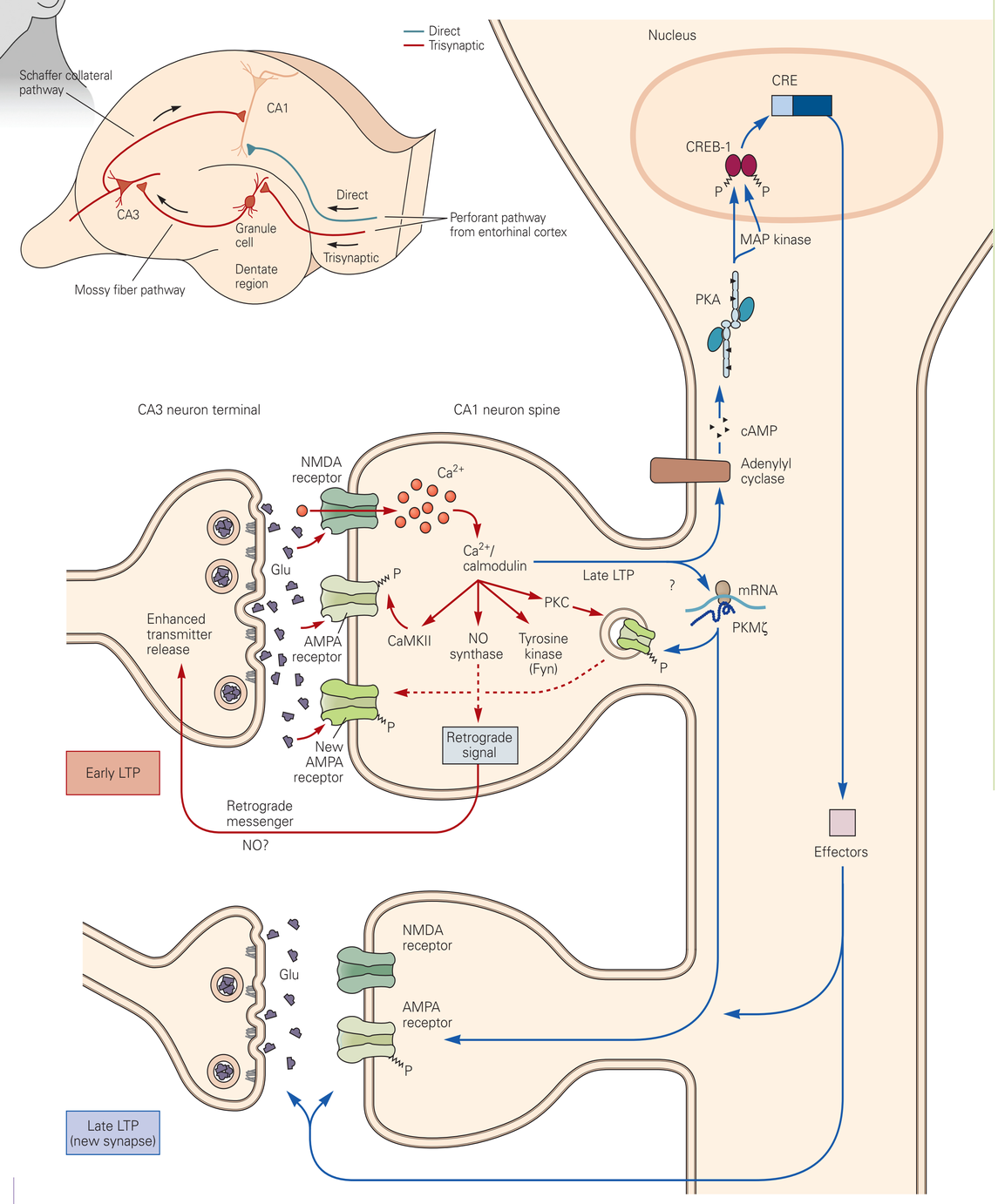
Pavlovian classical conditioning modifies the strength of synaptic transmission. When the tone is presented immediately before a foot shock (US, unconditioned stimulus), the animal learns to associate the tone (CS, conditioned stimulus) with the shock. From now on, the tone alone will be enough for the animal to elicit a fear response. After fear conditioning the electrophysiological response in the LA is greater than the response prior to conditioning. *(Picture from 3)*



HIPPOCAMPUS

Direct pathway: LTP depends partially both on activation of NMDAR and on activation of L-type voltage-gated Ca^{2+} channels.

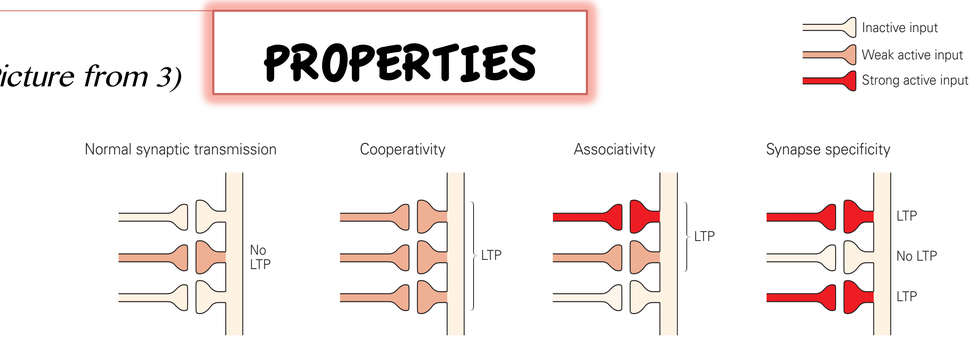
Mossy fiber pathway: LTP doesn't require activation of NMDAR. It requires activation of PKA. *Non-hebbian.*
Schaffer collateral pathway: LTP requires activation of NMDAR *Hebbian.*



(Picture from 3)

PROPERTIES

(Picture from 3)



& Persistance: LTP can last from several minuts to many months, years…

PHASES

E-LTP: ≈30-45 min to ≈2-3h. Non gene expression
L-LTP: Many hours (at least 24h). Gene expression → Synapse growth.

CONCLUSION

Discovering the physical basis of learning and memory in humans and other mammals is among the greatest remaining challenges facing the neurosciences. The phenomenon of LTP is the leading candidate for these explanations.

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