Switches in brain states in memory consolidation: a computational model approach

Kathleen Jacquerie, Guillaume Drion
Department of Electrical Engineering and Computer Science, University of Liege, Belgium

https://meet.google.com/gkb-kuac-mjy
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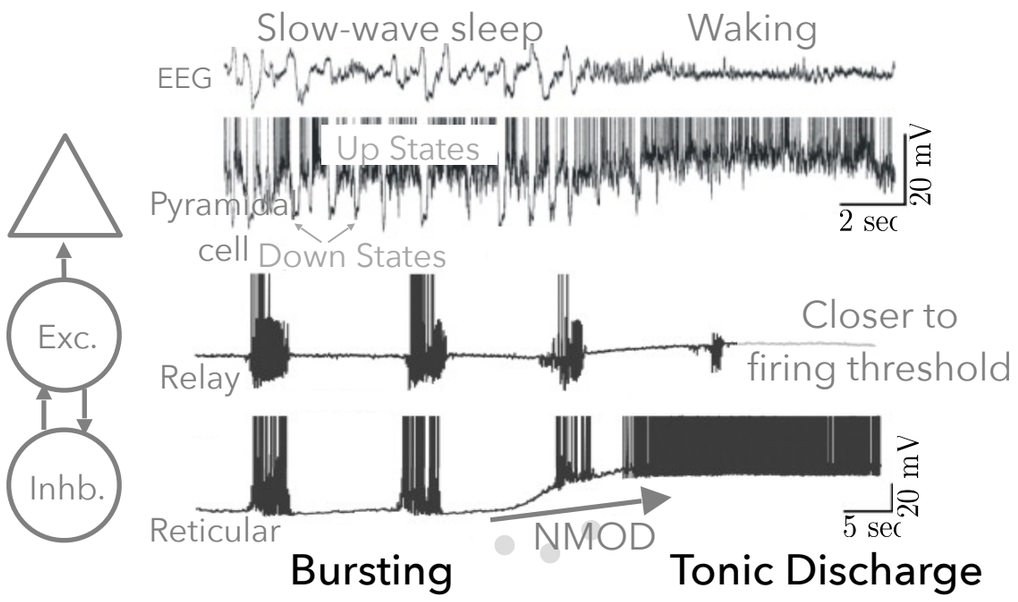
10:30-12:00 (GMT 0)

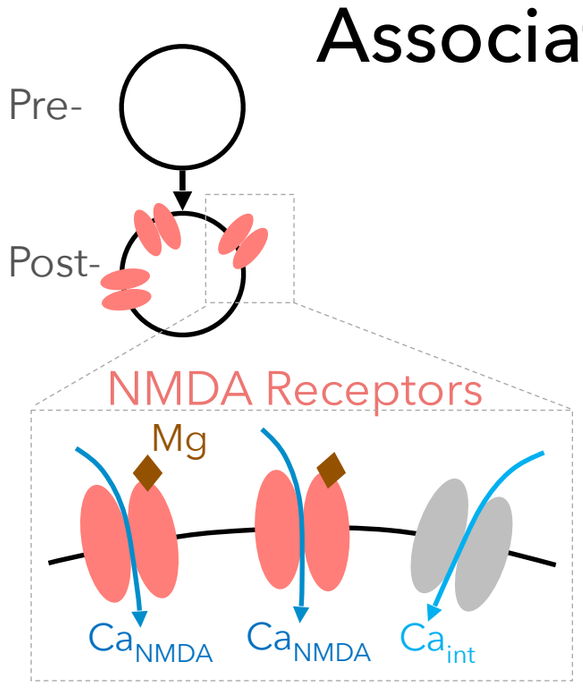
kathleen.jacquerie@uliege.be

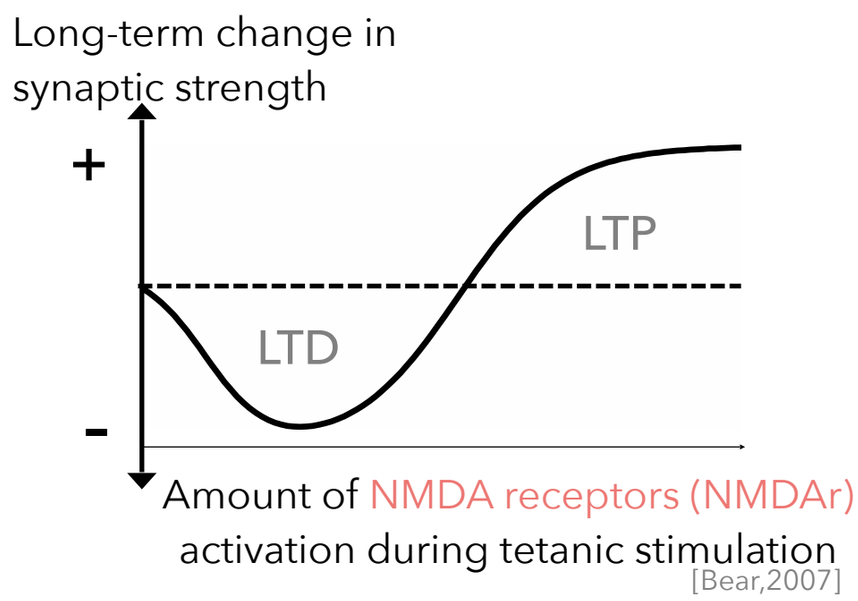
Switches in brain states



[Zagha-McCormick,2014]

Associative memory | Learning



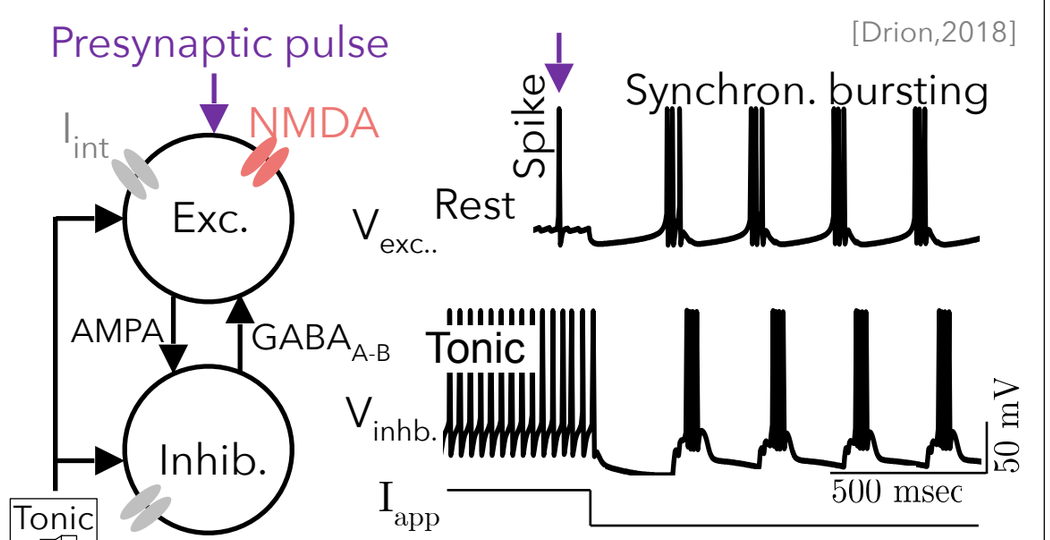


[Bear,2007]

How do switches in brain states affect **strong and **weak** synaptic connections ?**

Strong connection = # NMDAr ↑ = $[Ca]_{NMDA}$ ↑
Weak connection = # NMDAr ↓ = $[Ca]_{NMDA}$ ↓

Conductance based-model



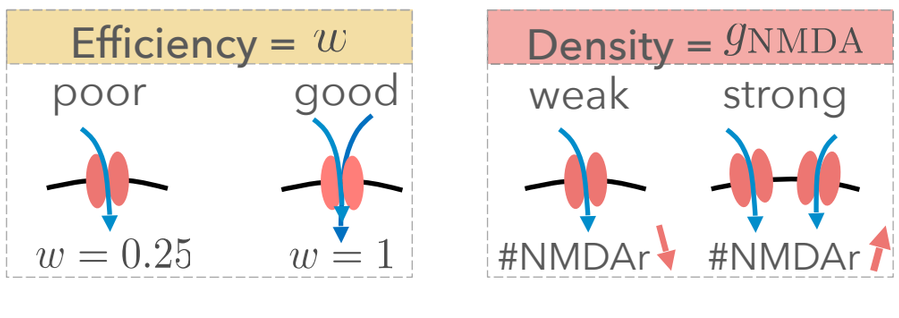
Switch is independent on synaptic connectivity

Mechanisms

- Dynamics of calcium entering NMDAr

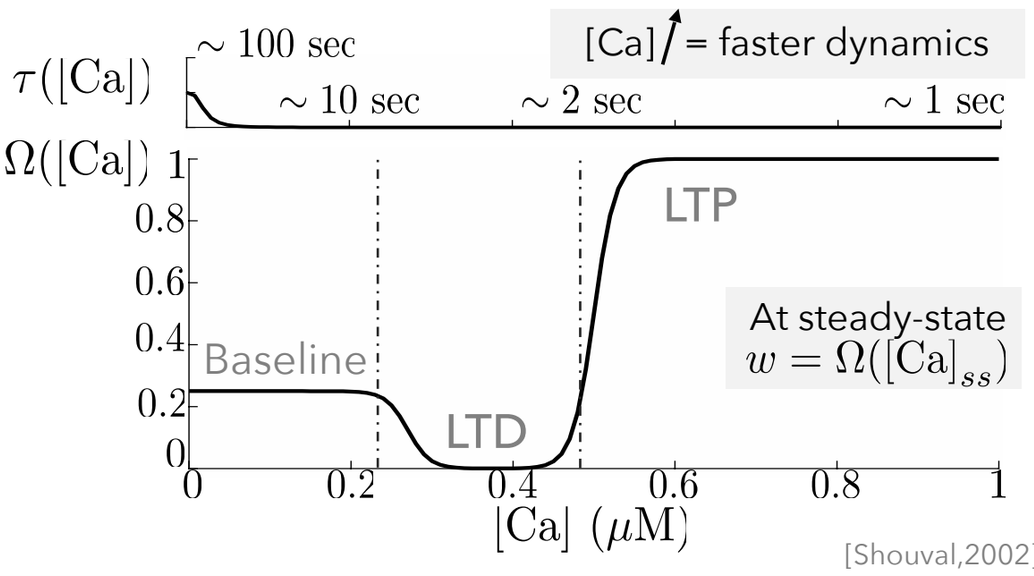
$$\frac{\partial [\mathrm{Ca}]_{\mathrm{NMDA}}}{\partial t} = \mathrm{Ca_F} g^*_{\mathrm{NMDA}} \mathrm{B}(V_m) - [\mathrm{Ca}]_{\mathrm{NMDA}} / \tau_{\mathrm{NMDA}}$$

- NMDA receptors (NMDAr) $g^*_{\mathrm{NMDA}} = w g_{\mathrm{NMDA}}$



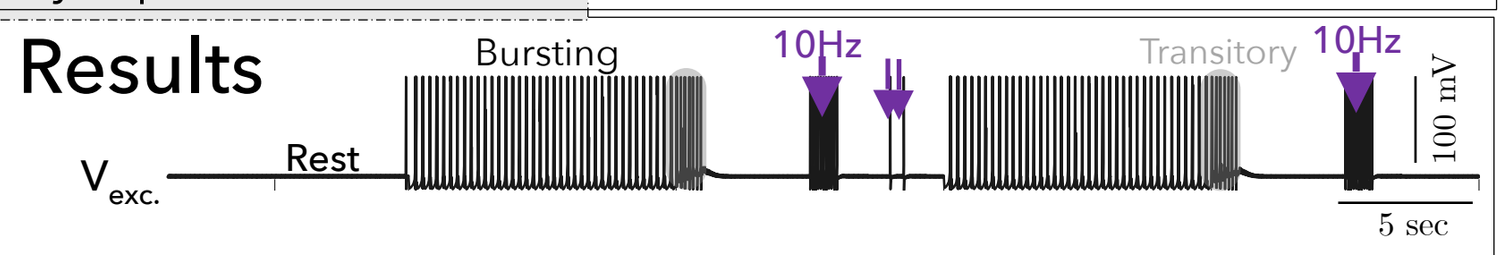
- Change in NMDAr density occurs at a large timescale (required protein synthesis,…).
- Here we focus on change in NMDAr efficiency driven by a **Ca-dependent synaptic plasticity rule**.

$$\frac{\partial w}{\partial t} = \frac{1}{\tau([\mathrm{Ca}])} \{\Omega([\mathrm{Ca}]) - w\}$$

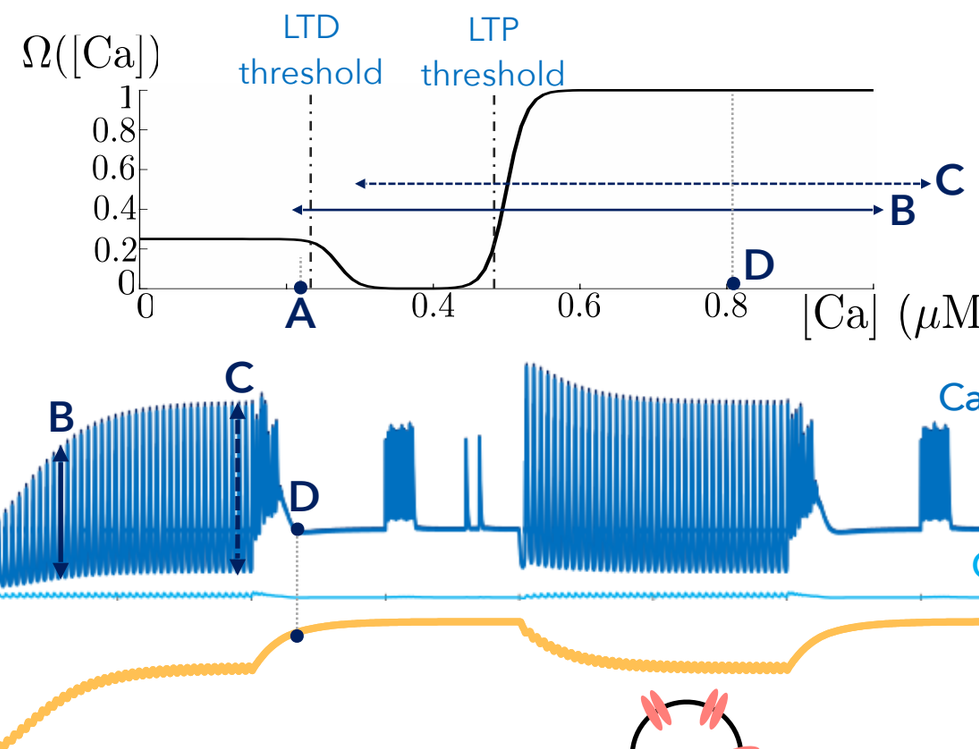


[Shouval,2002]

Results

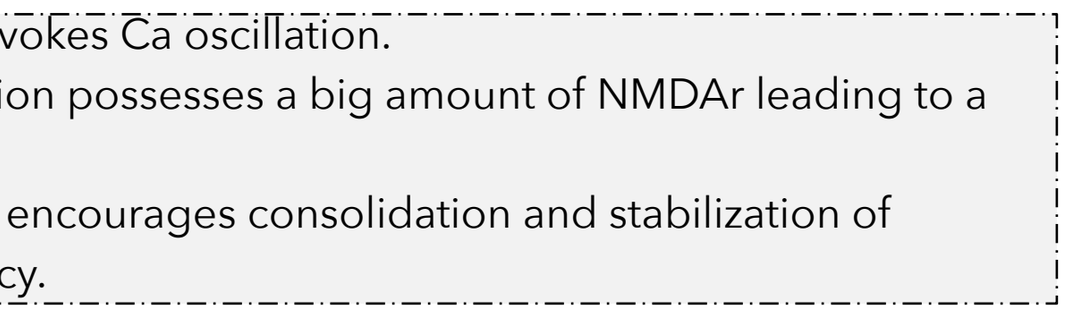


Strong connection



- Switch to burst provokes Ca oscillation.
- A relevant connection possesses a big amount of NMDAr leading to a large Ca fluctuation.
- This large Ca level encourages consolidation and stabilization of the synaptic efficiency.

Weak connection



- The weak connection, characterized by a small amount of NMDAr, presents Ca oscillation during switch.
- The low Ca level triggers depression and reduces the synaptic efficiency.