



Are synaptic plasticity rules compatible with memory consolidation during sleep?

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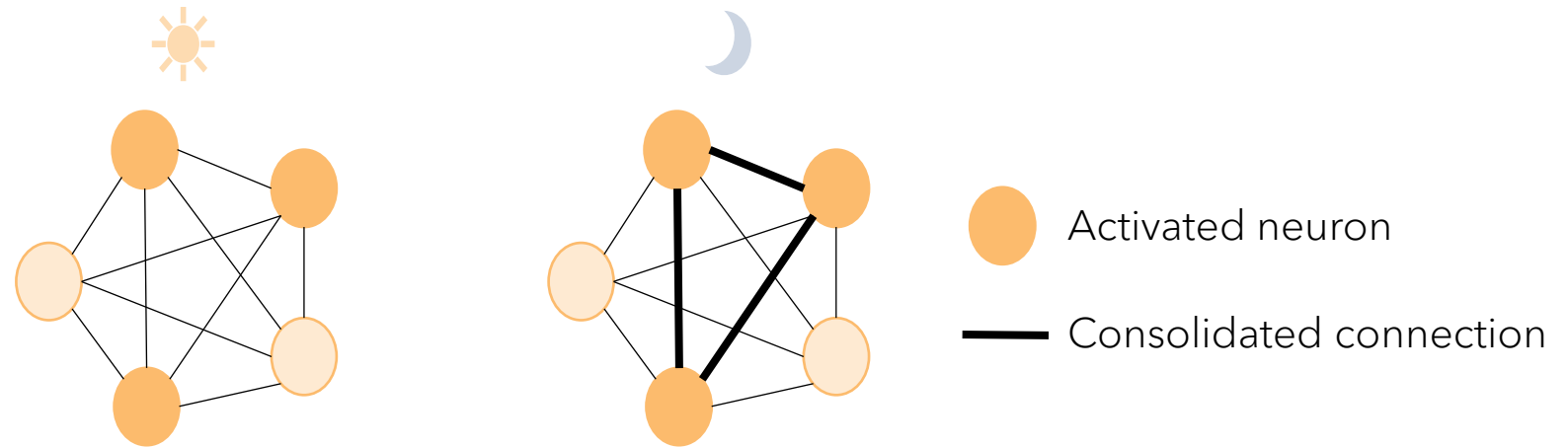


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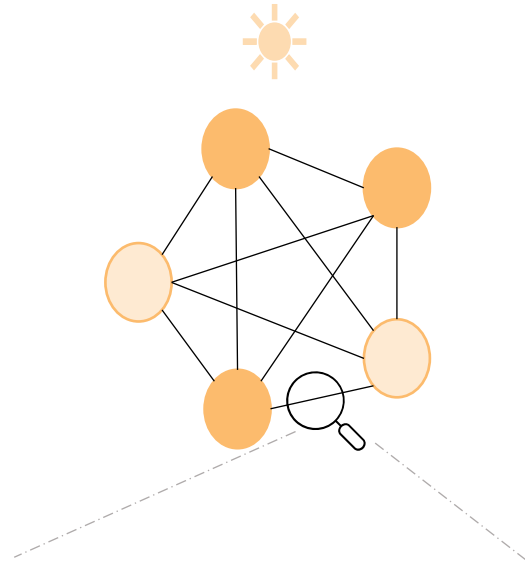


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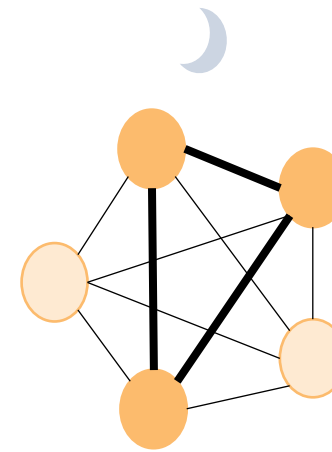
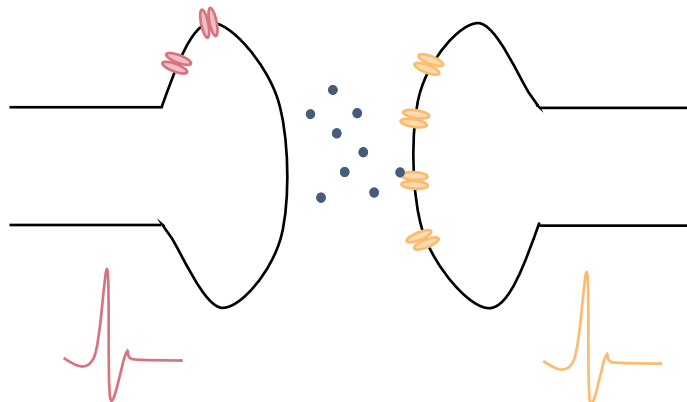
Memory consolidation happens during sleep



Memory consolidation happens during sleep

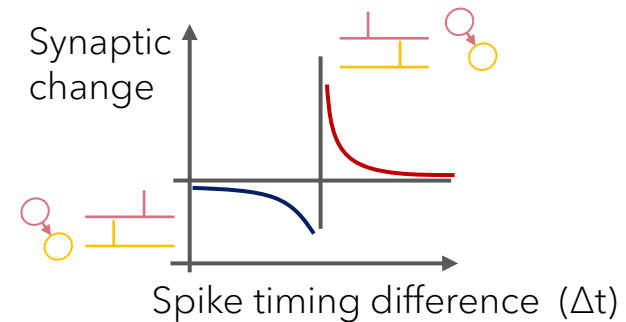


Neuronal activity



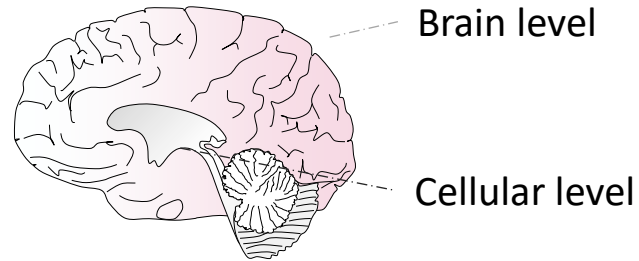
- Activated neuron
- Consolidated connection

Synaptic plasticity

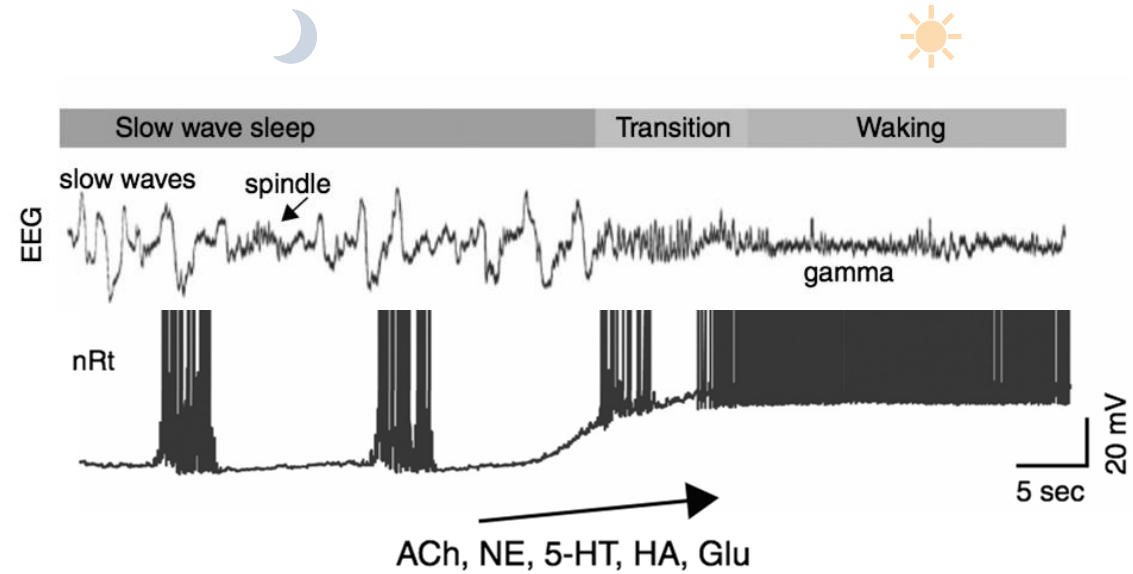


Adapted from [Bi and Poo, 1998]

Wake-sleep cycle is characterized by a change of neuronal firing pattern

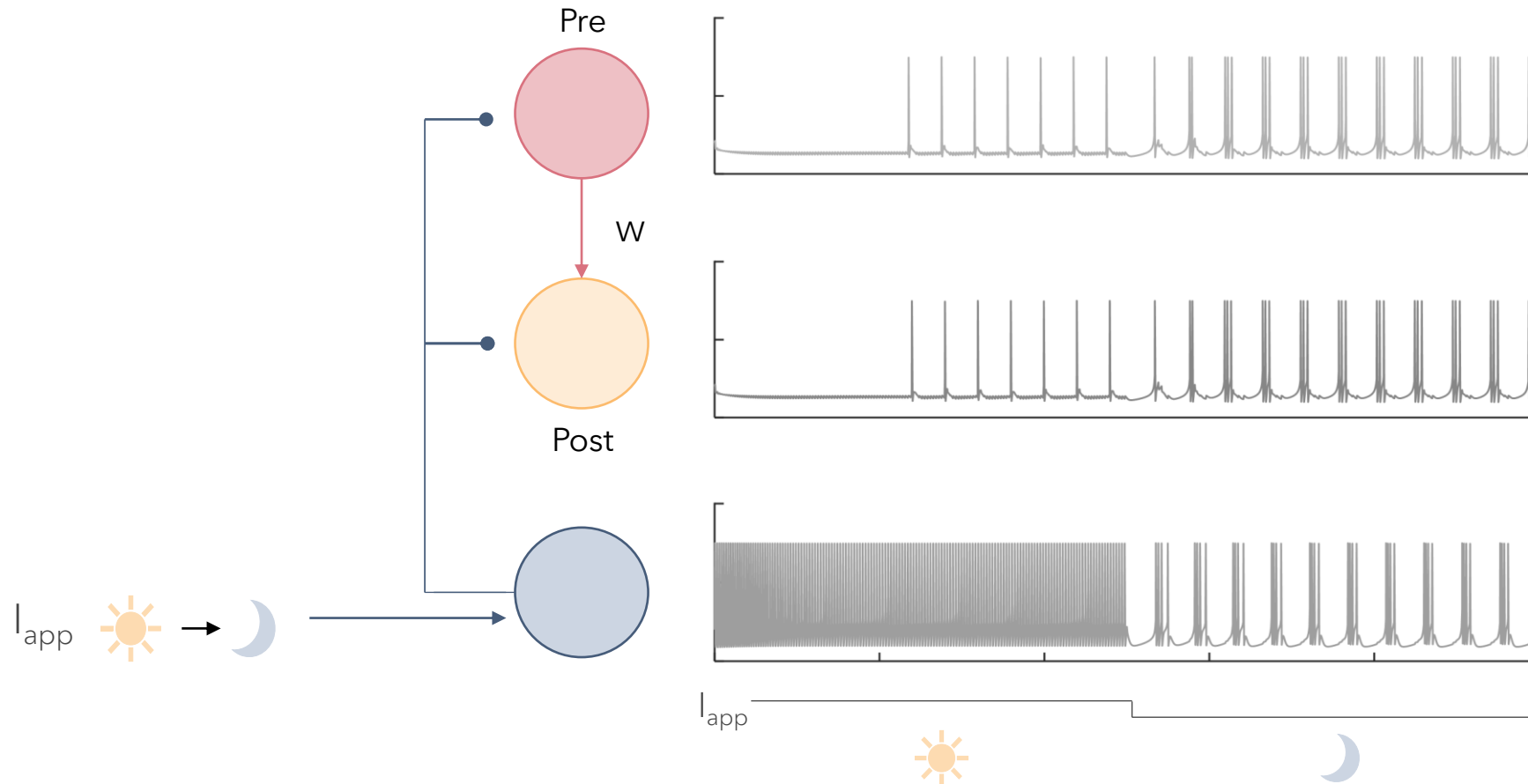


[Adapted from http://www.incertae-sedis.fr/gl/docu1173_03_circuits-recompense-encephale-humain.html]

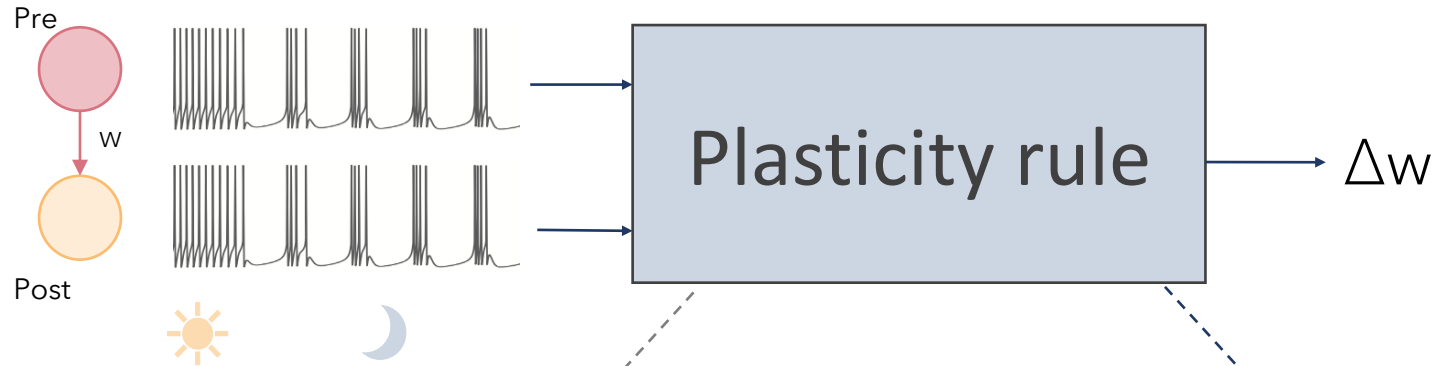


Adapted from [Zagha and McCormick, 2014]

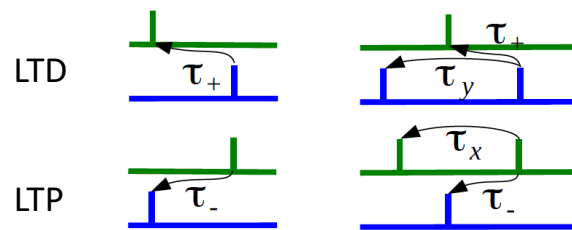
Implementation of a **physiological conductance-based model**



Modeling synaptic plasticity

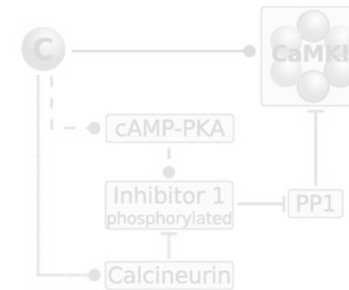


Phenomenological models

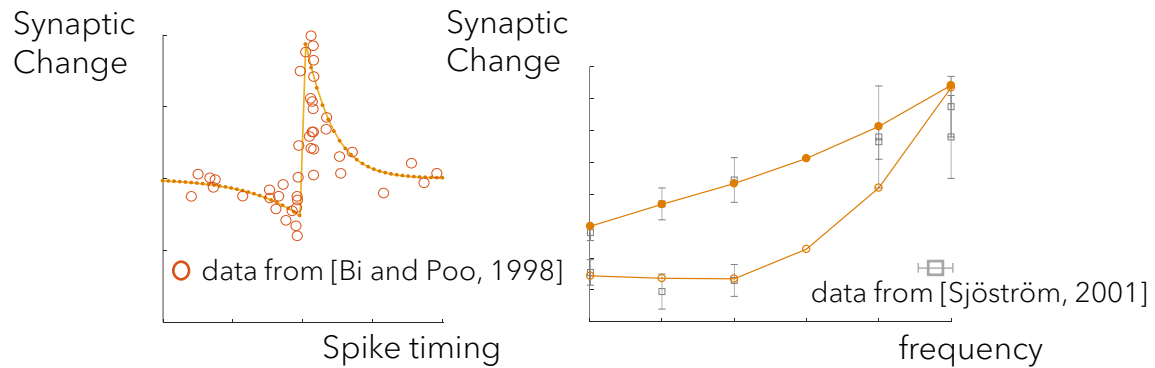
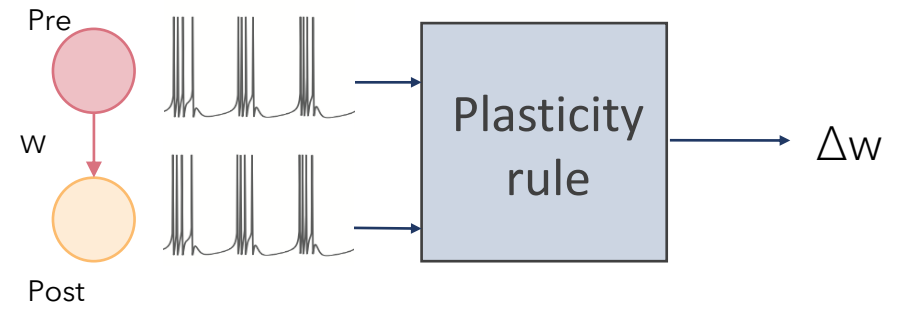
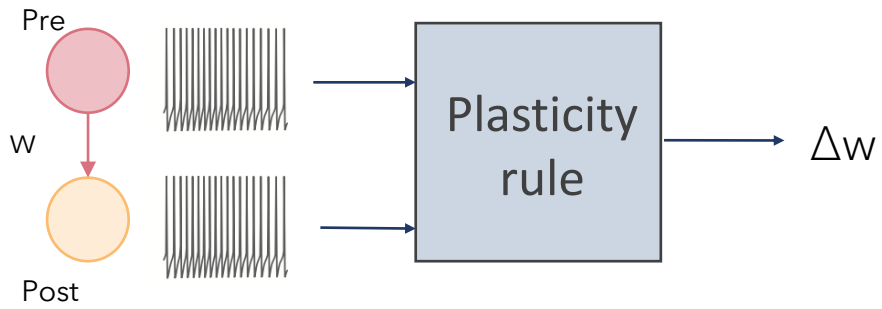
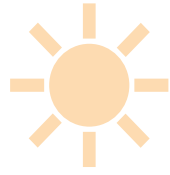


- Using spike time to compute Δw
 - Pair-based model [Abbot 2000],
 - triplet Model [Pfister 2006, Graupner 2016], ...

Biophysical models

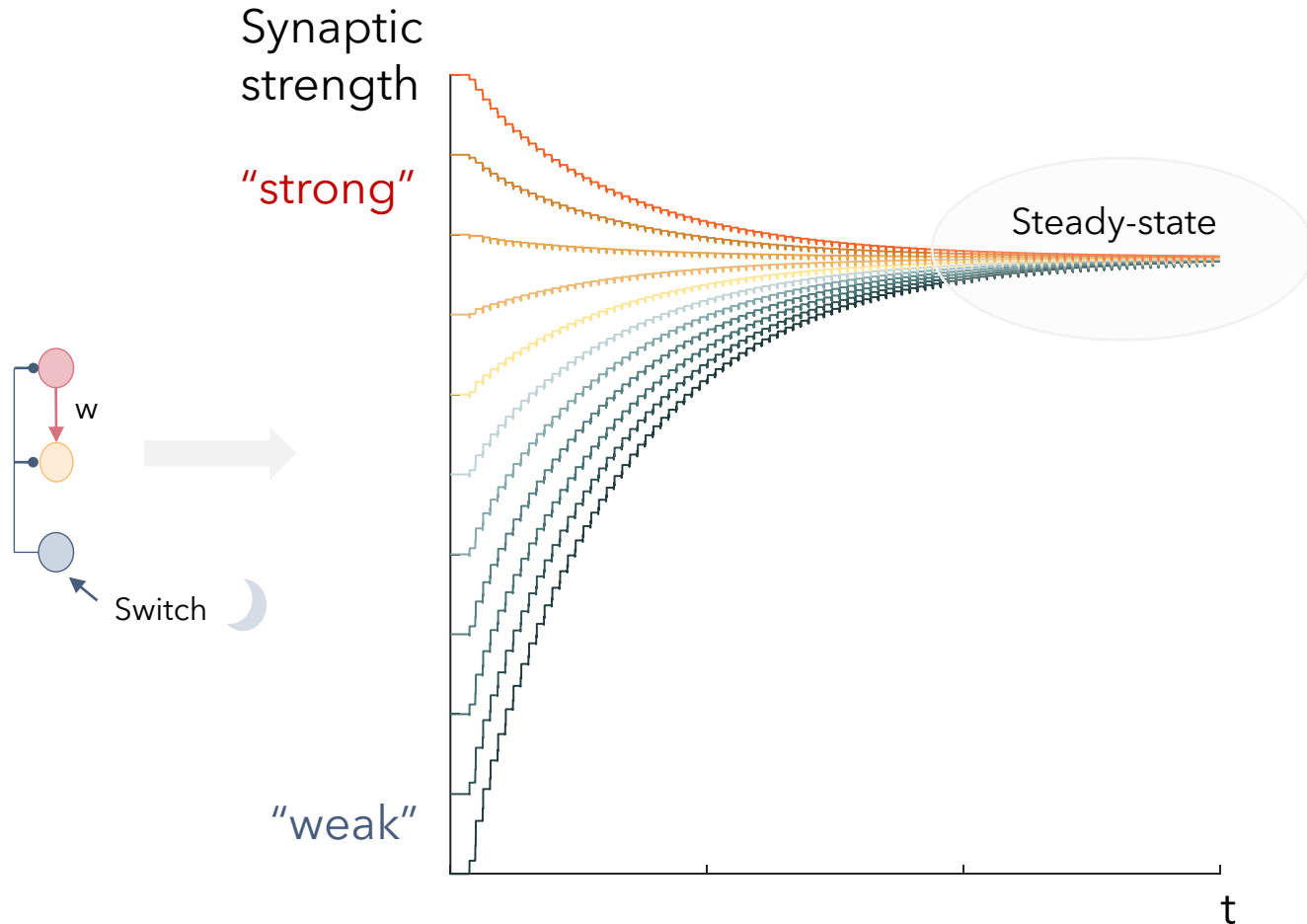


- Model the biological machinery
- Degree of biological details can vary



Validation of plasticity rules in wakefulness ✓

Sleep period resets all the initial weights to the same value and the result is bound-dependent



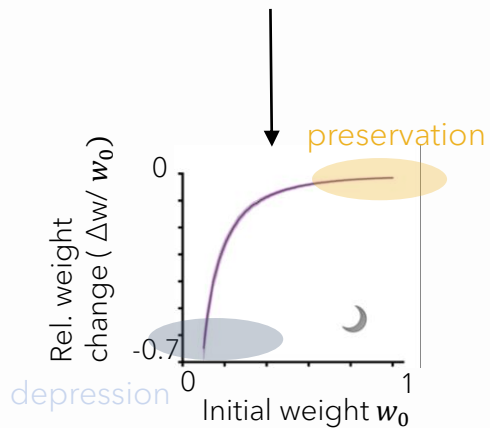
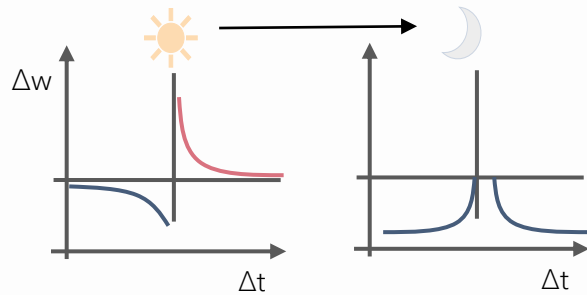
Conclusion

- Sleeping period resets all the weights
- Result independent of:
 - Bursting parameters
 - Model type (phenomenological or biophysical [P113.06 from K. Jacquerie])
 - Bounds applied

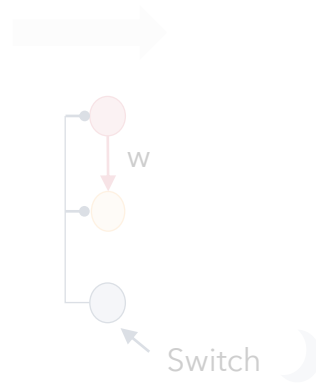
Hypothesis : a switch in the neuronal activity should be associated with a **switch in the learning rule**



[Gonzales-Rueda, 2018] learning rule:



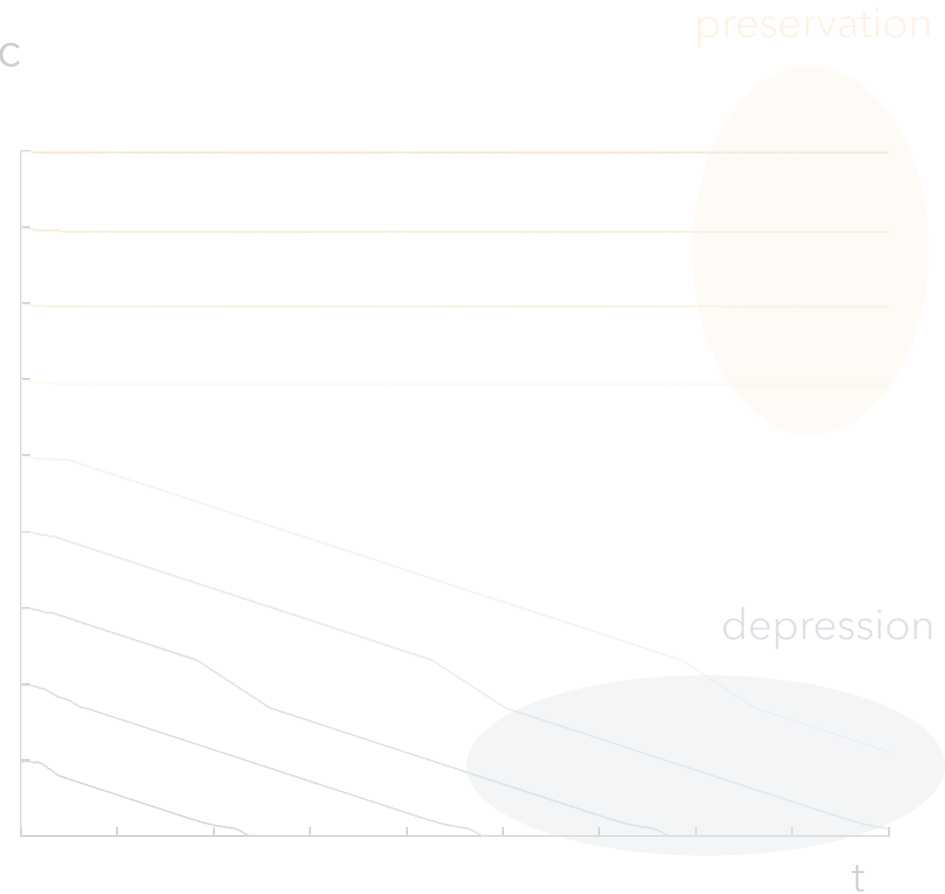
Implementation



Synaptic change

"strong"

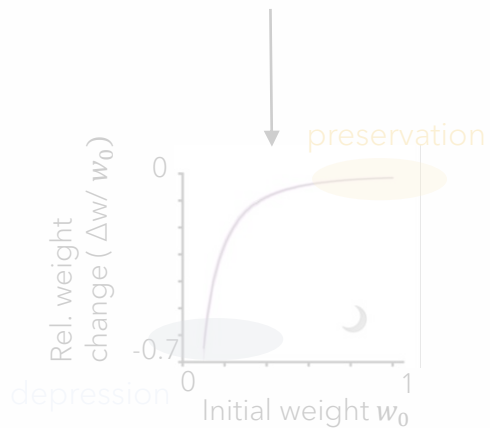
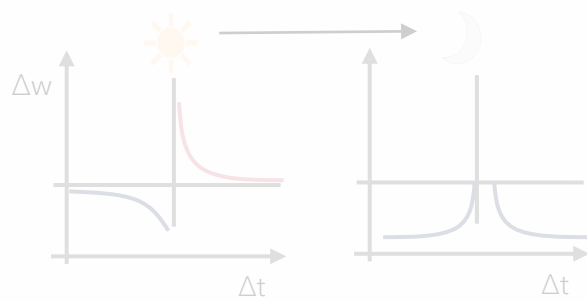
"weak"



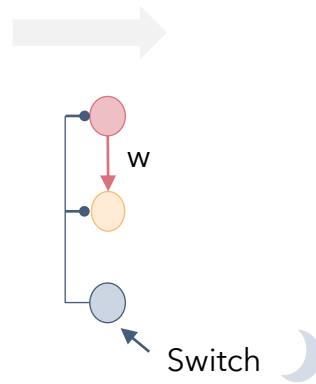
Hypothesis : a switch in the neuronal activity should be associated with a **switch in the learning rule**



[Gonzales-Rueda, 2018] learning rule:



Implementation



Synaptic strength

"strong"

"weak"

