First NeuroMat Meeting
January 20th,2014

Ontology Droplet: Neurons and single unit recordings

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BRASIL UM PAÍS DE TODOS

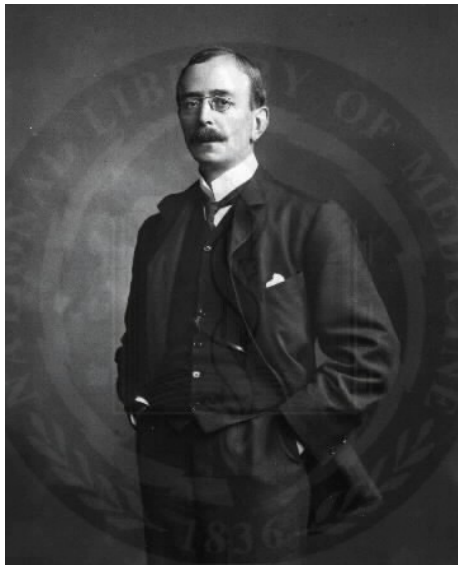
PEW Latin American FELLOWS PROGRAM in the BIOMEDICAL SCIENCES

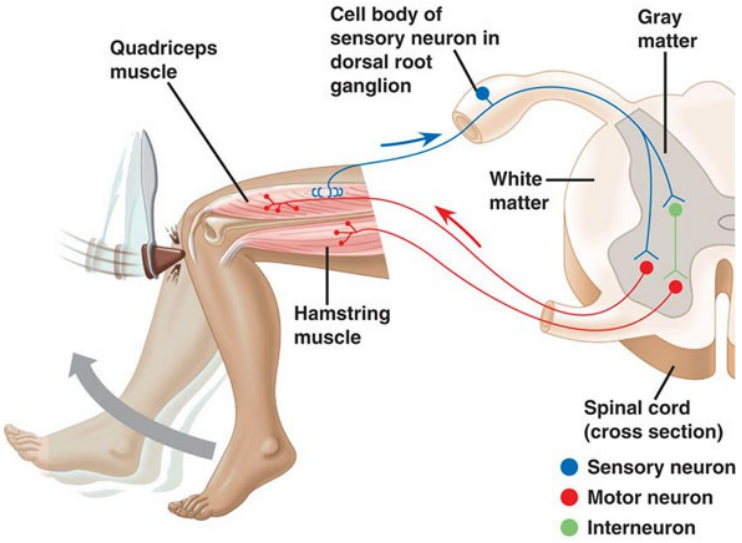
FAPERN Fundação de Apoio à Pesquisa do Estado do Rio Grande do Norte

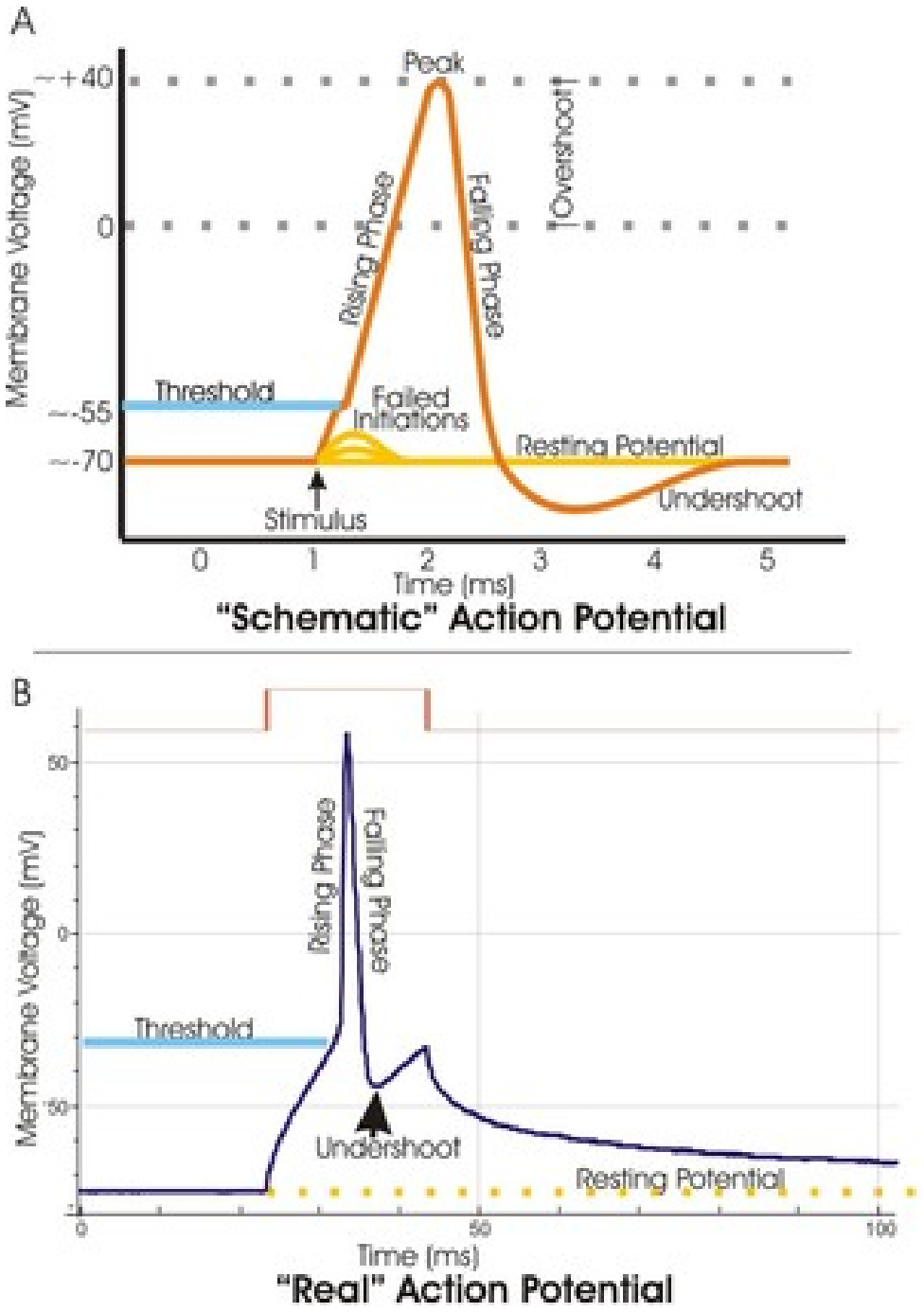
CNPq Conselho Nacional de Desenvolvimento Científico e Tecnológico

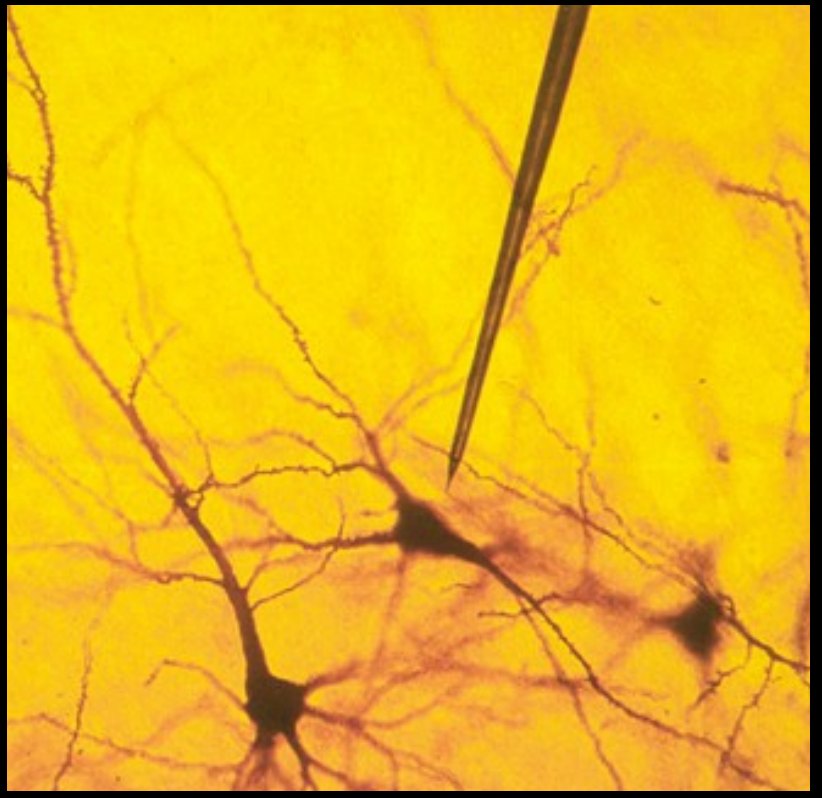
CAPES

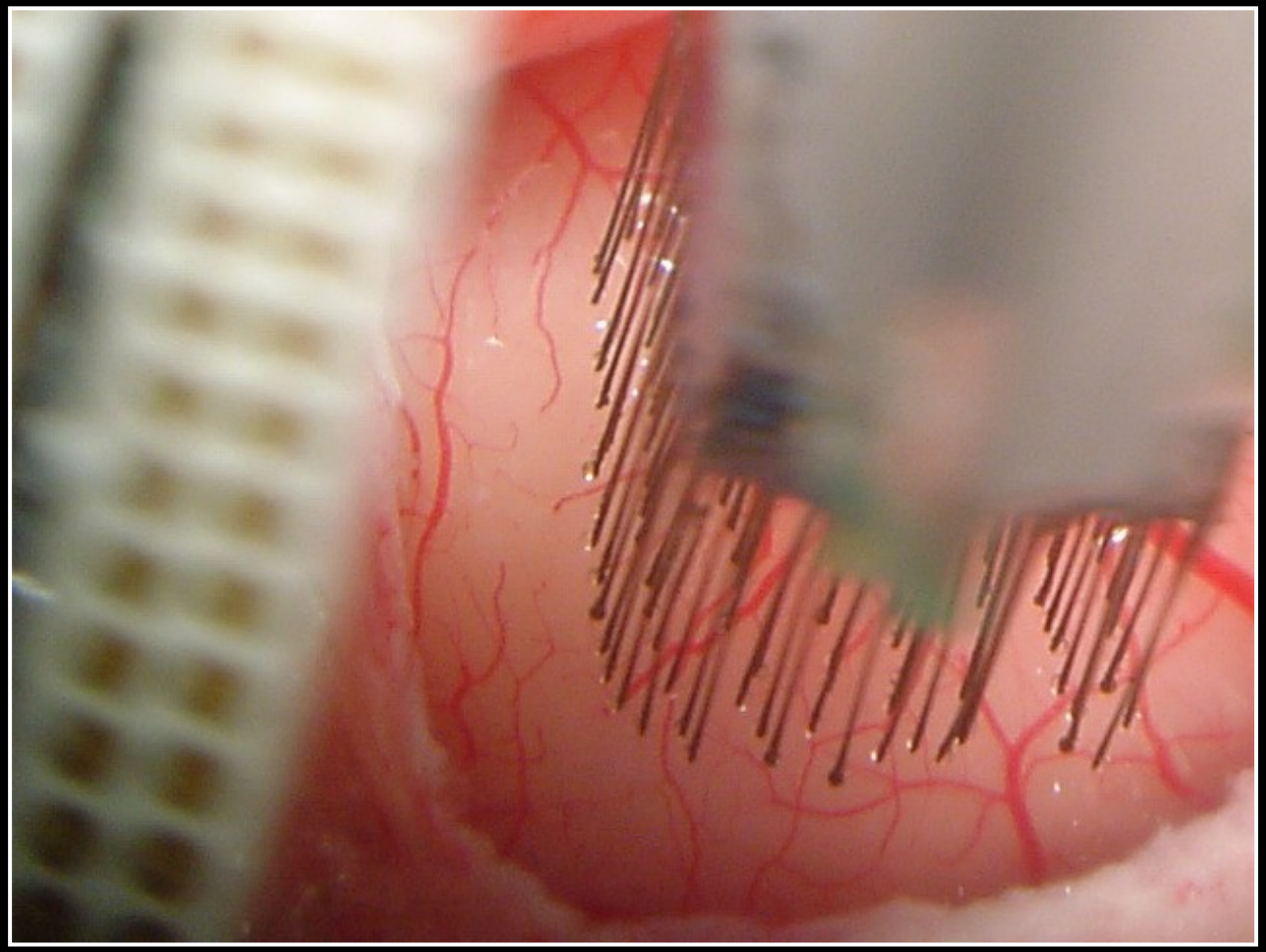
Sir Charles Sherrington (1857-1952)

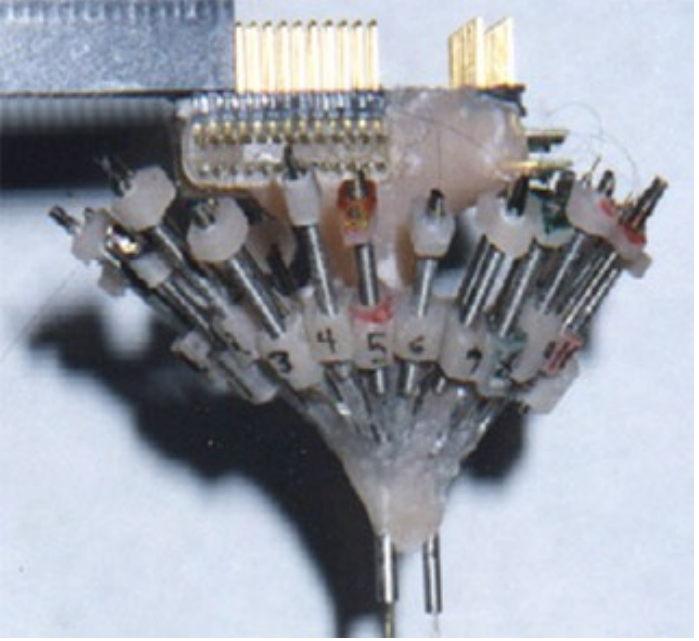


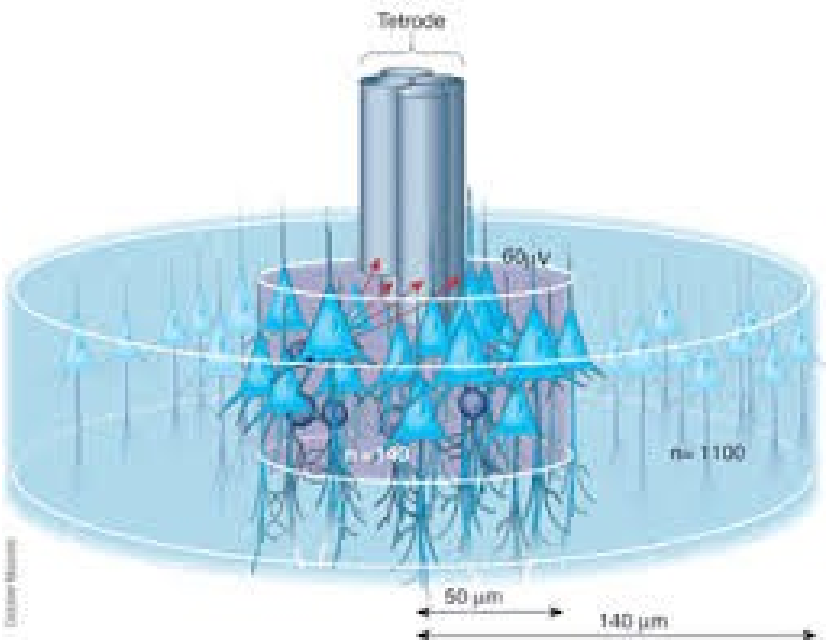



A
Membrane Voltage (mV)
~+40
0
~-55
~-70
Peak
Rising Phase
Falling Phase
Overshoot
Threshold
Failed Initiations
Resting Potential
Undershoot
Stimulus
0
1
2
3
4
5
Time (ms)
"Schematic" Action Potential
B
Membrane Voltage (mV)
50
0
-50
Rising Phase
Falling Phase
Threshold
Undershoot
Resting Potential
0
50
100
Time (ms)
"Real" Action Potential

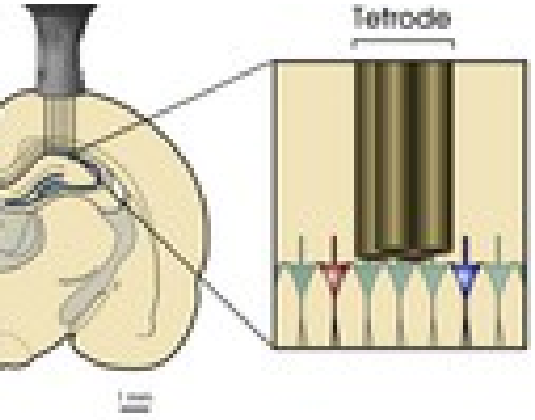


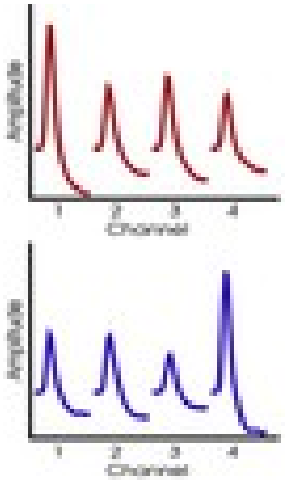






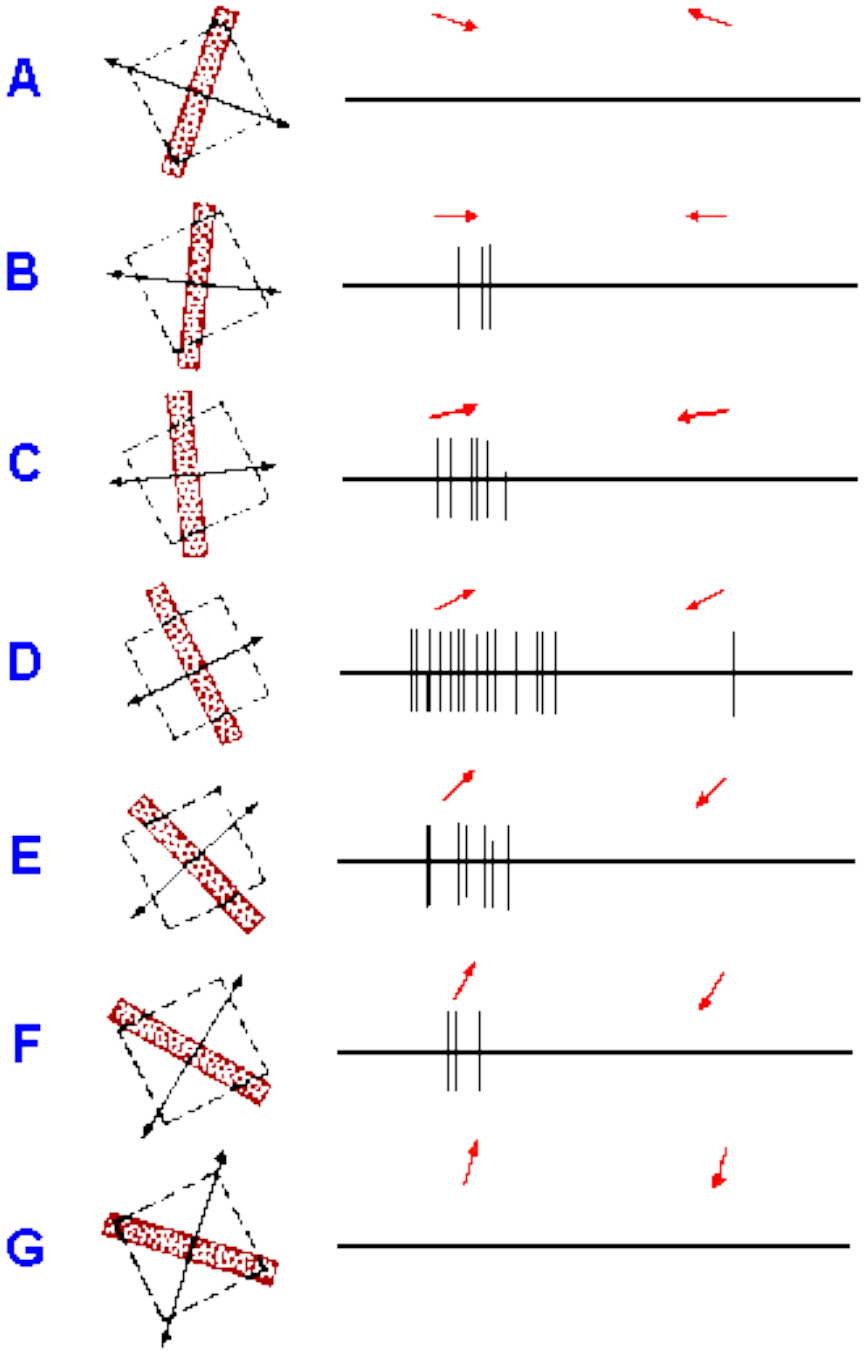
State of the art: movable tetrodes



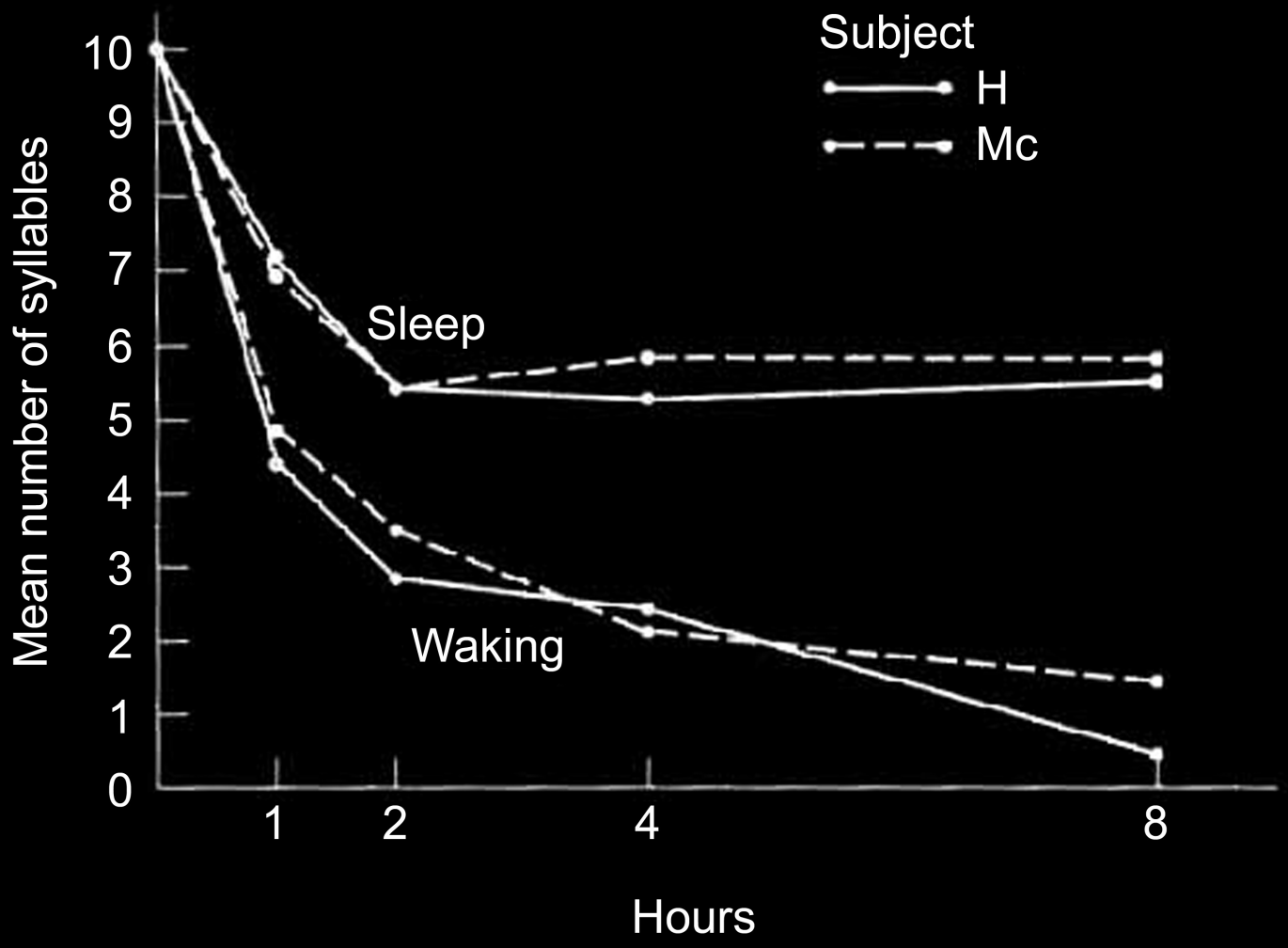


Torsten Wiesel (1924-)

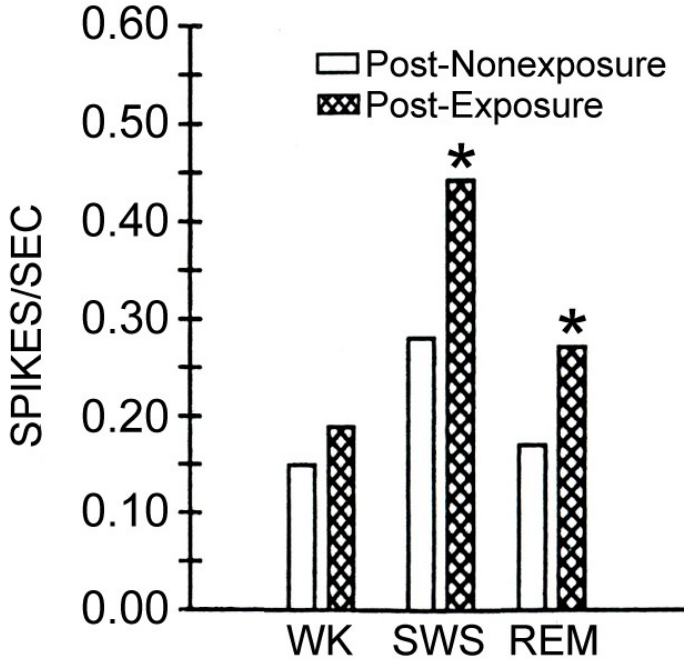
David Hubel (1926-2013)



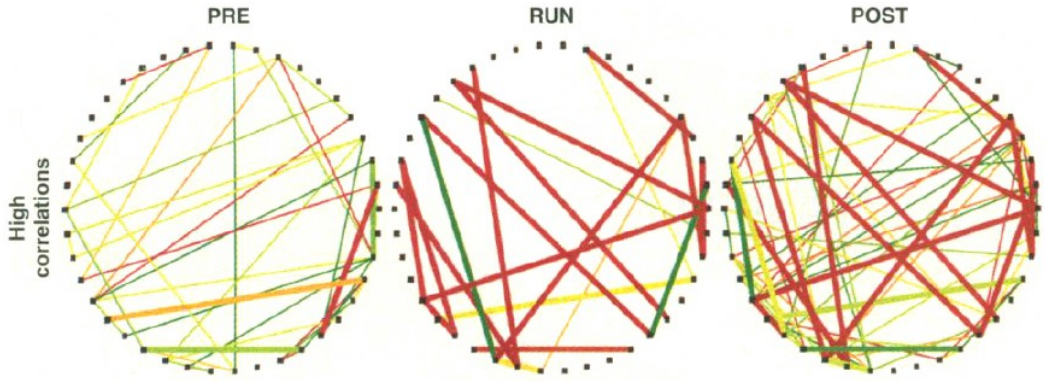
Sleep favors memory consolidation



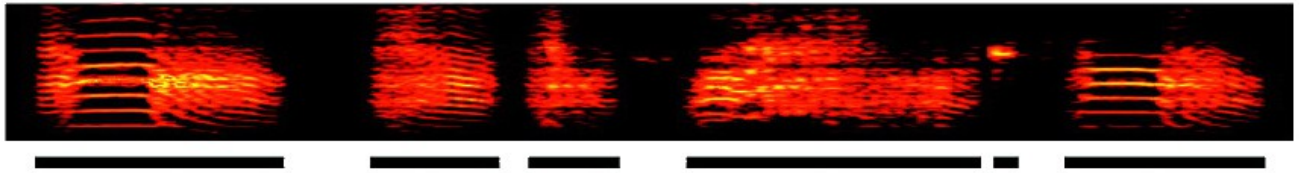
Jenkins & Dallenbach (1924) Am. J. of Psychol. 35:605-612



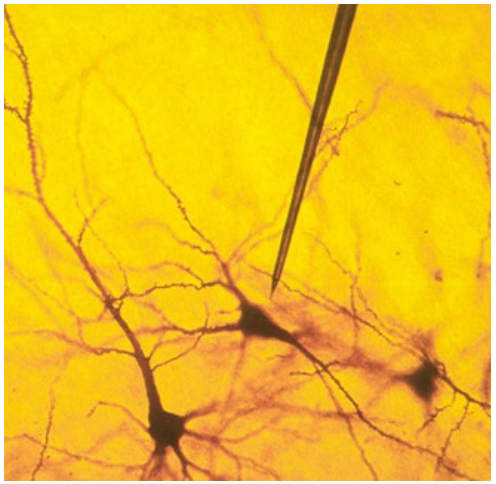
Pavlides and Winson (1989) *J. Neurosci*. 9: 2907-2918

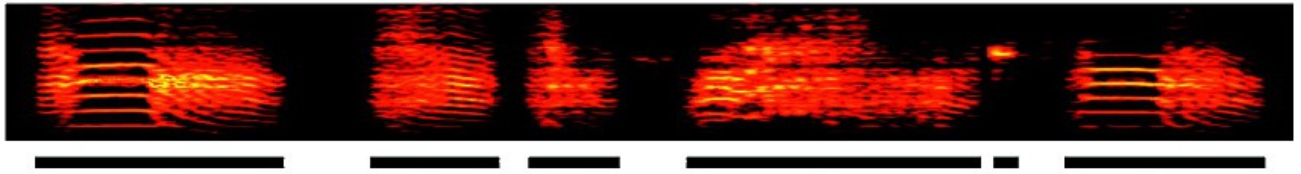


Wilson and McNaughton (1994) *Science* 254:676-679

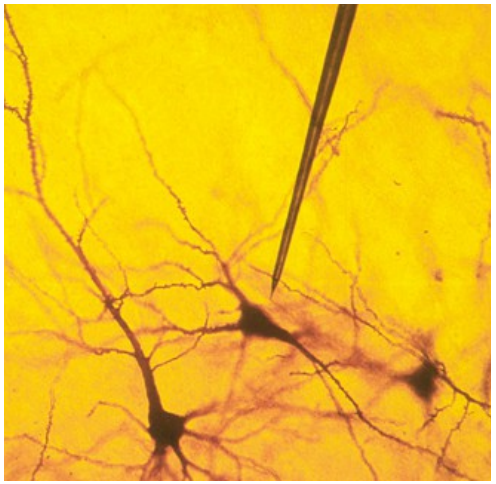


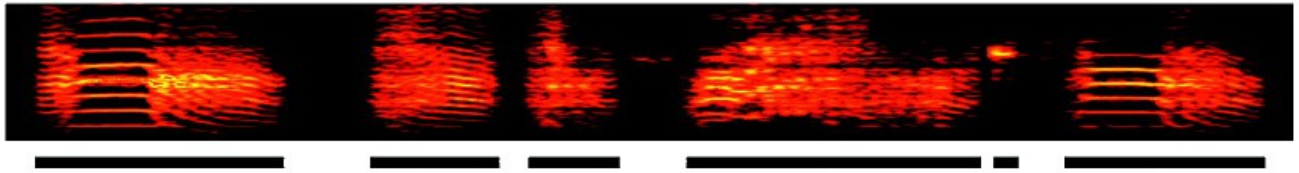
Dave & Margoliash (2000) Science 290:812-816





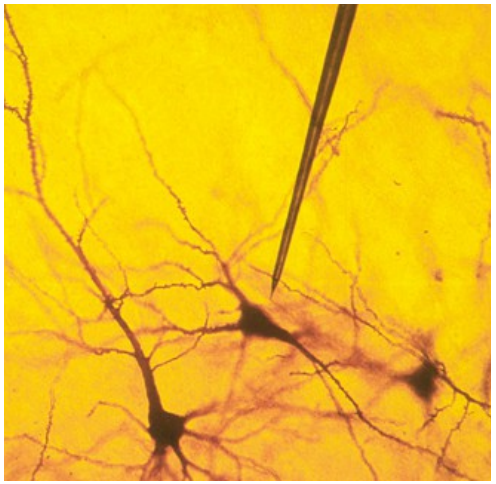
Dave & Margoliash (2000) Science 290:812-816

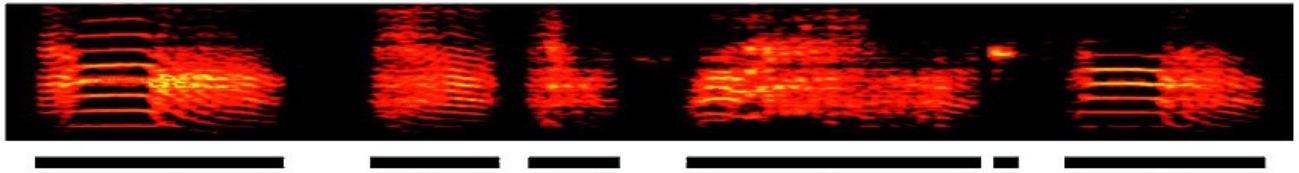


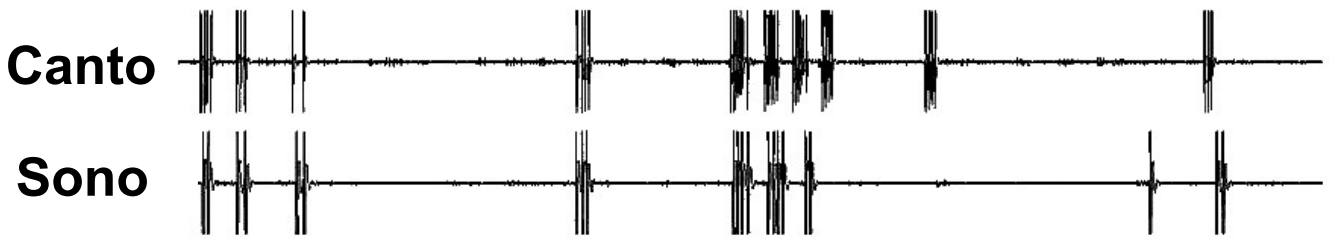


Canto

Dave & Margoliash (2000) Science 290:812-816



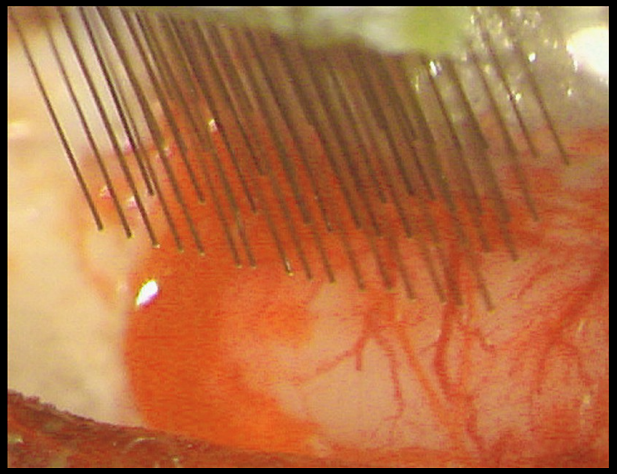


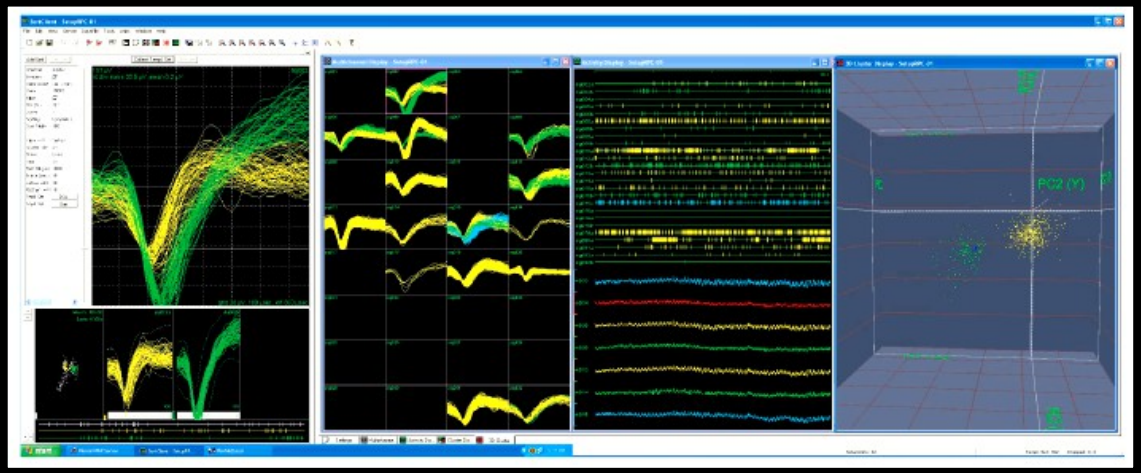


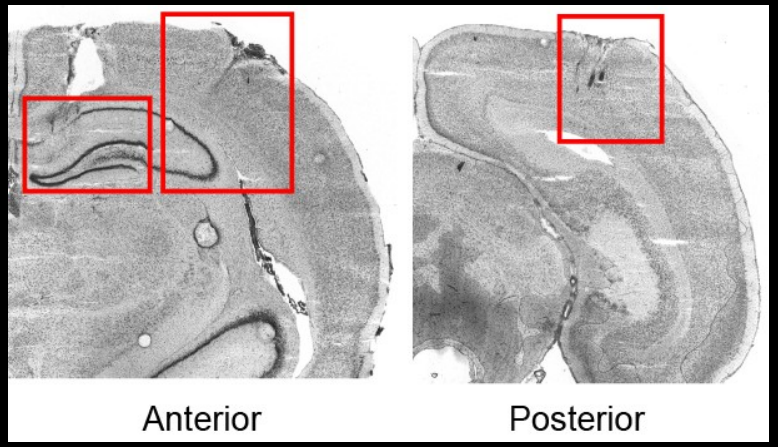
Dave AS, Margoliash D. Song replay during sleep and computational rules for sensorimotor vocal learning. Science 290: 812–816, 2000.

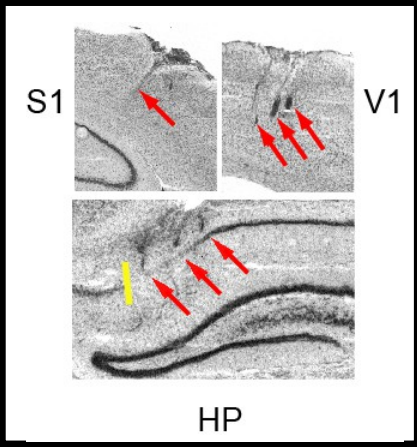
Dave & Margoliash (2000) Science 290:812-816

Chronic extracellular recordings with multielectrode arrays





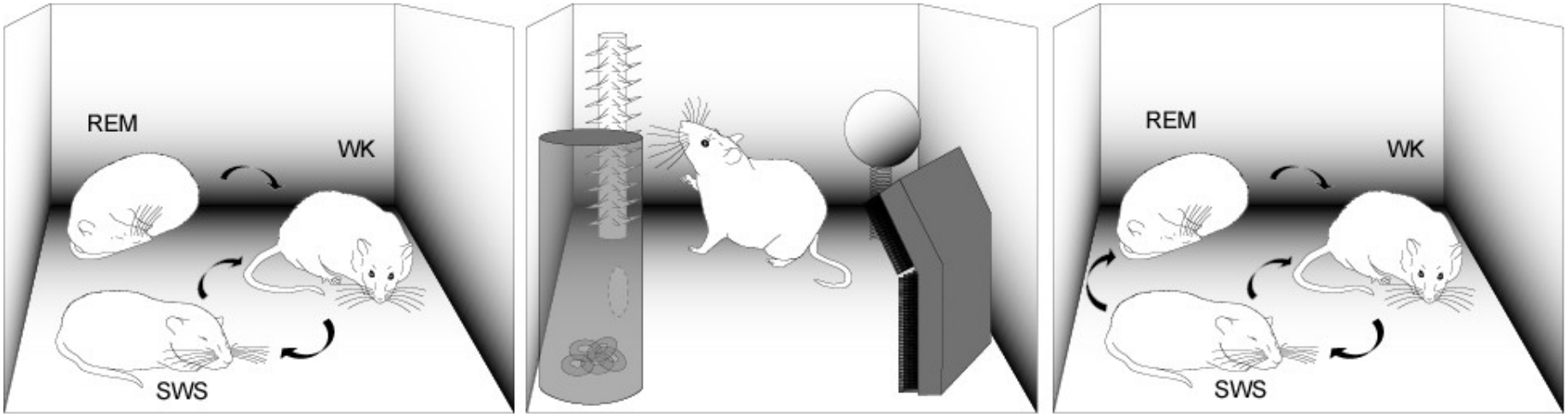


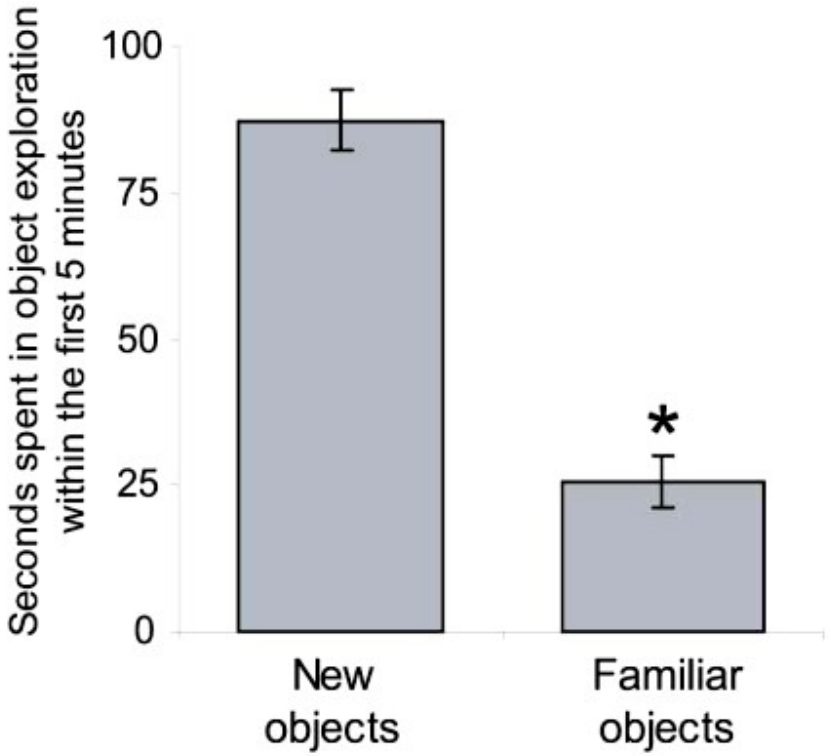


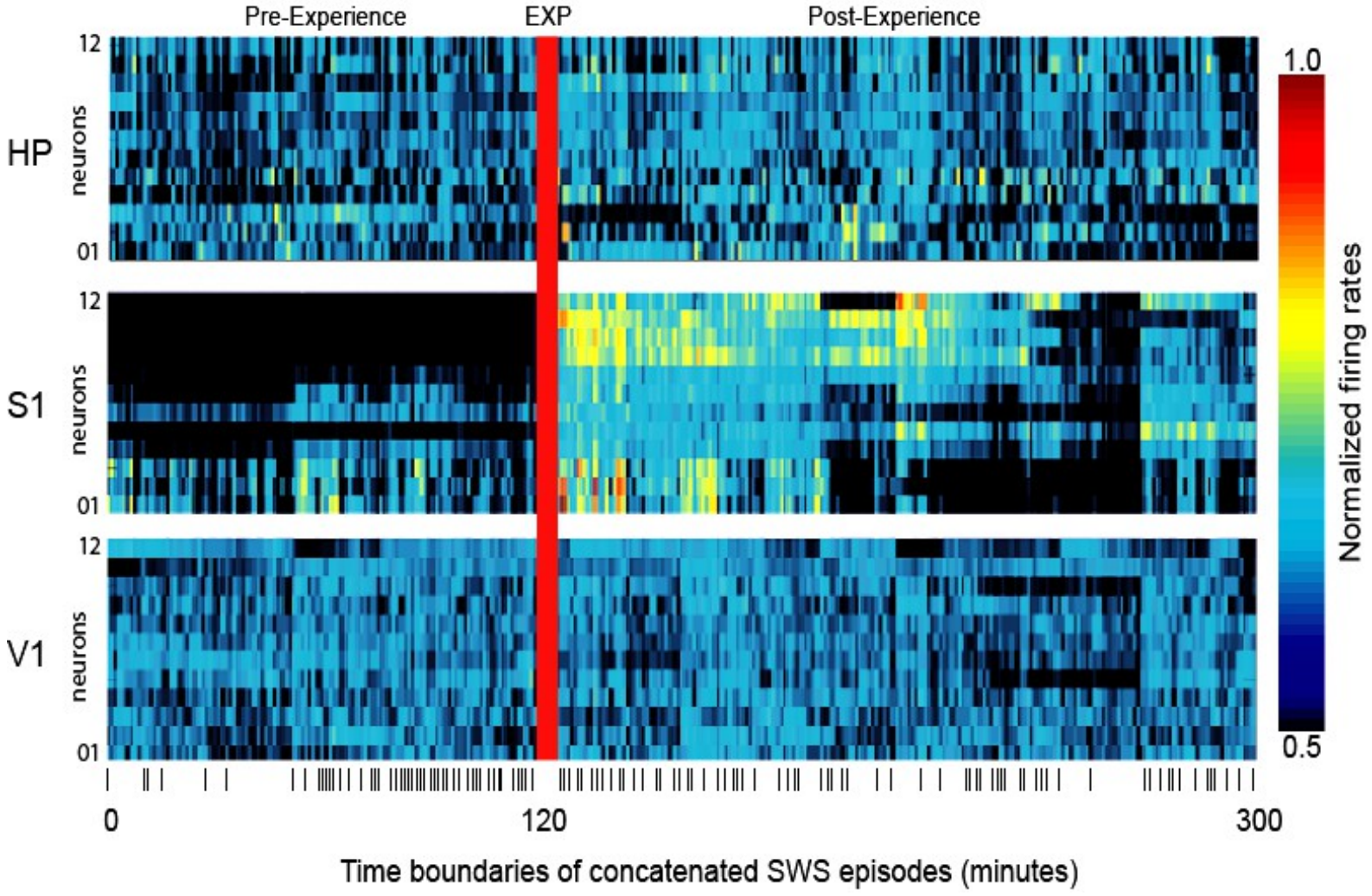
Pre-Exposição

Exposição

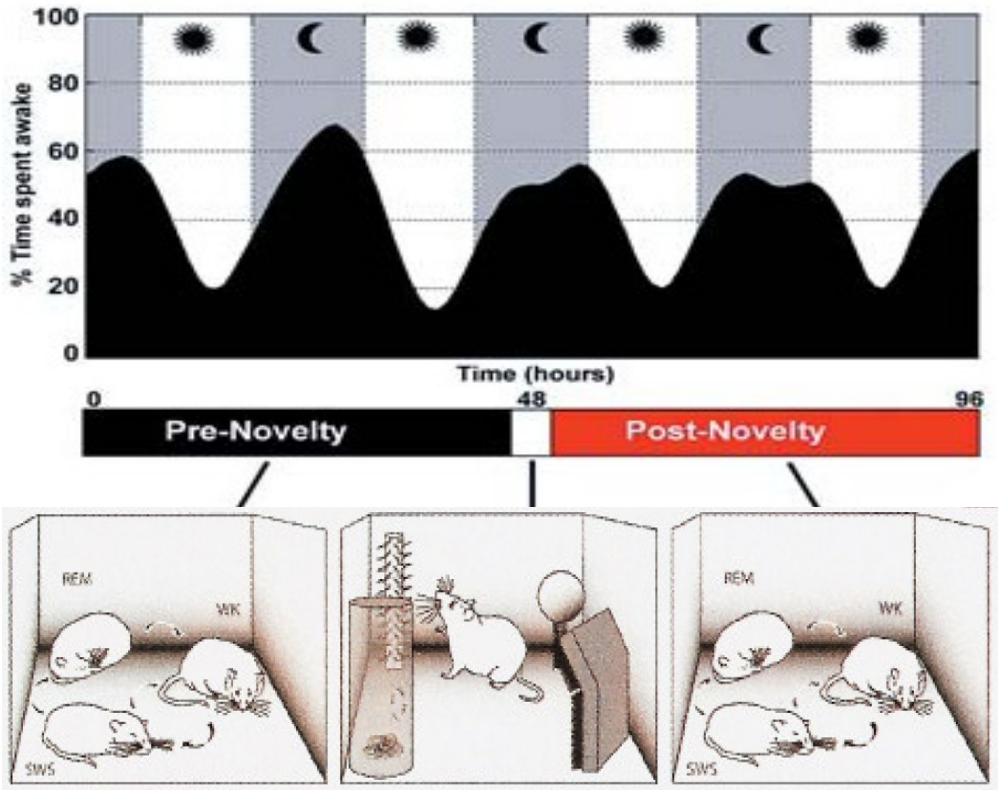
Pós-Exposição

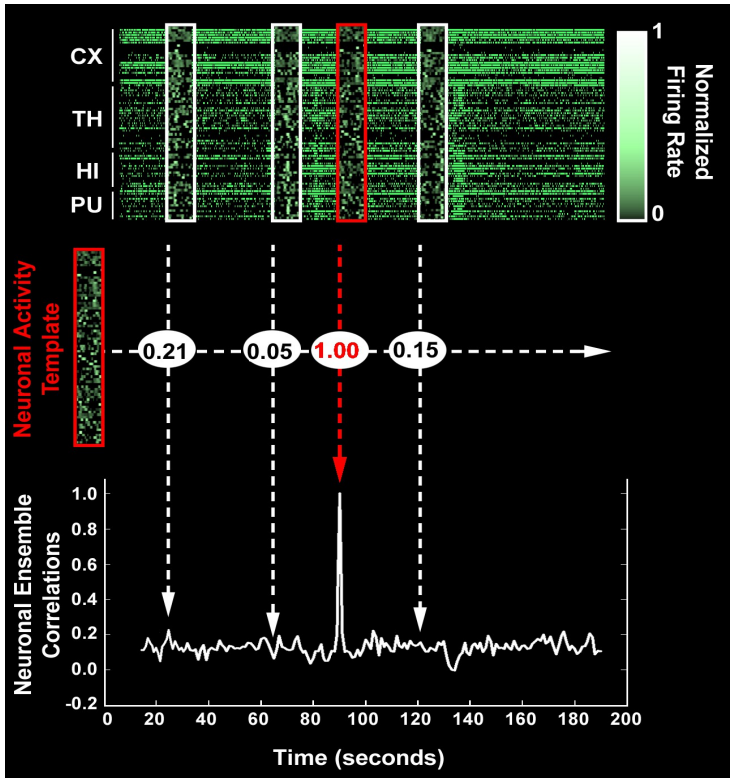


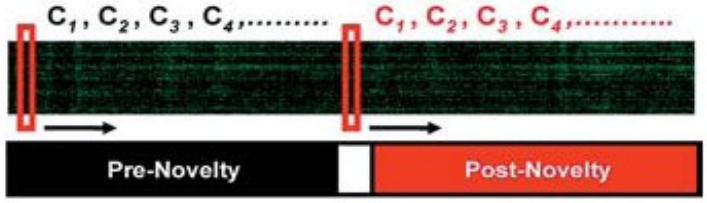




Ribeiro et al. (2007) Frontiers in Neuroscience 1(1) 43-55

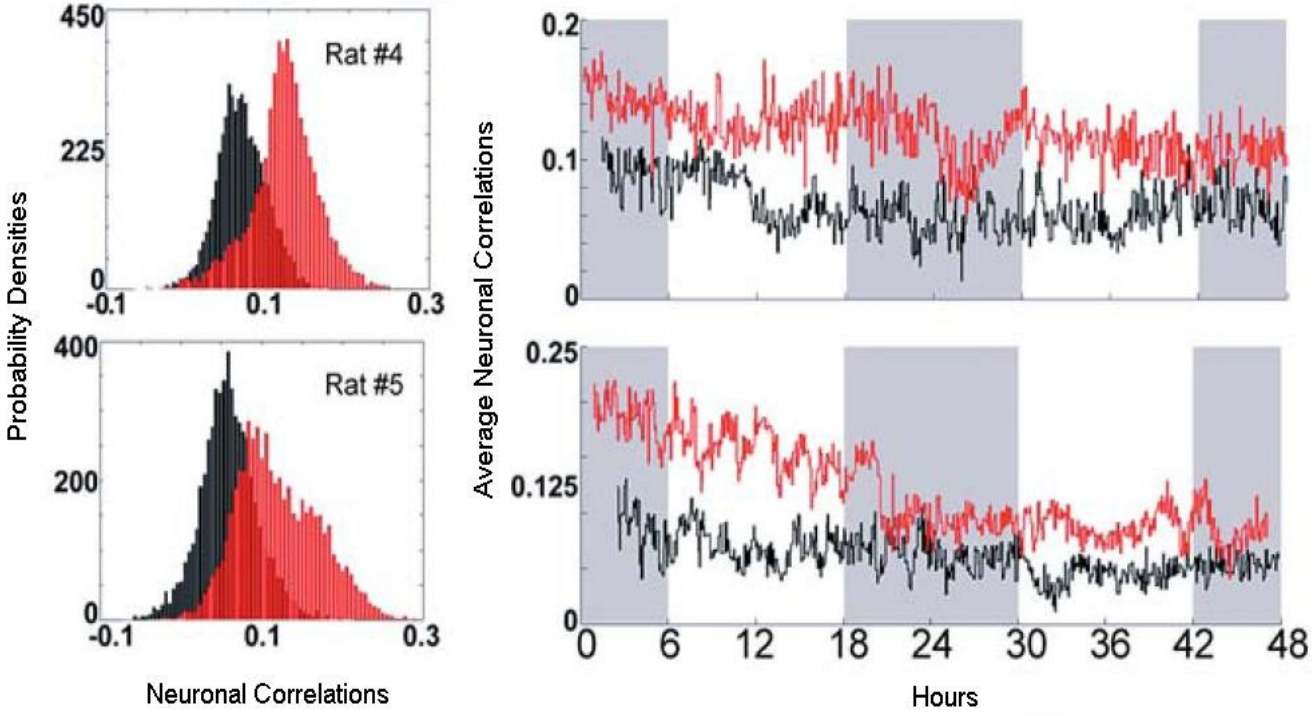


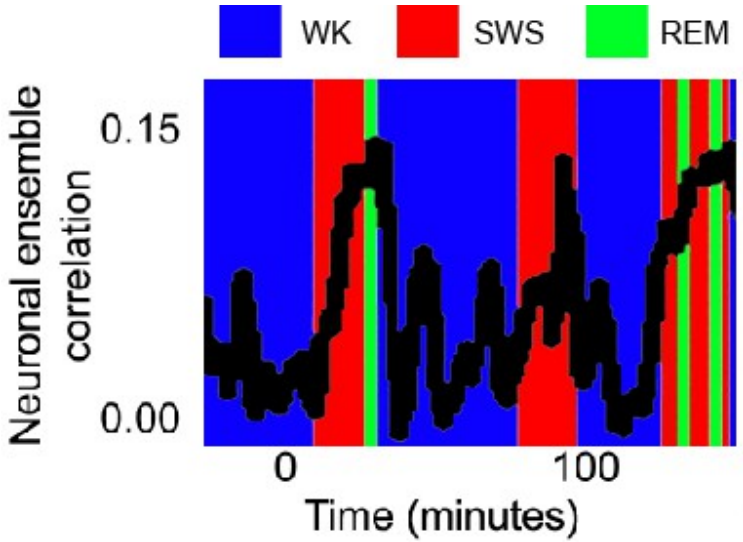




Louie & Wilson (2001) Neuron 29:145-56

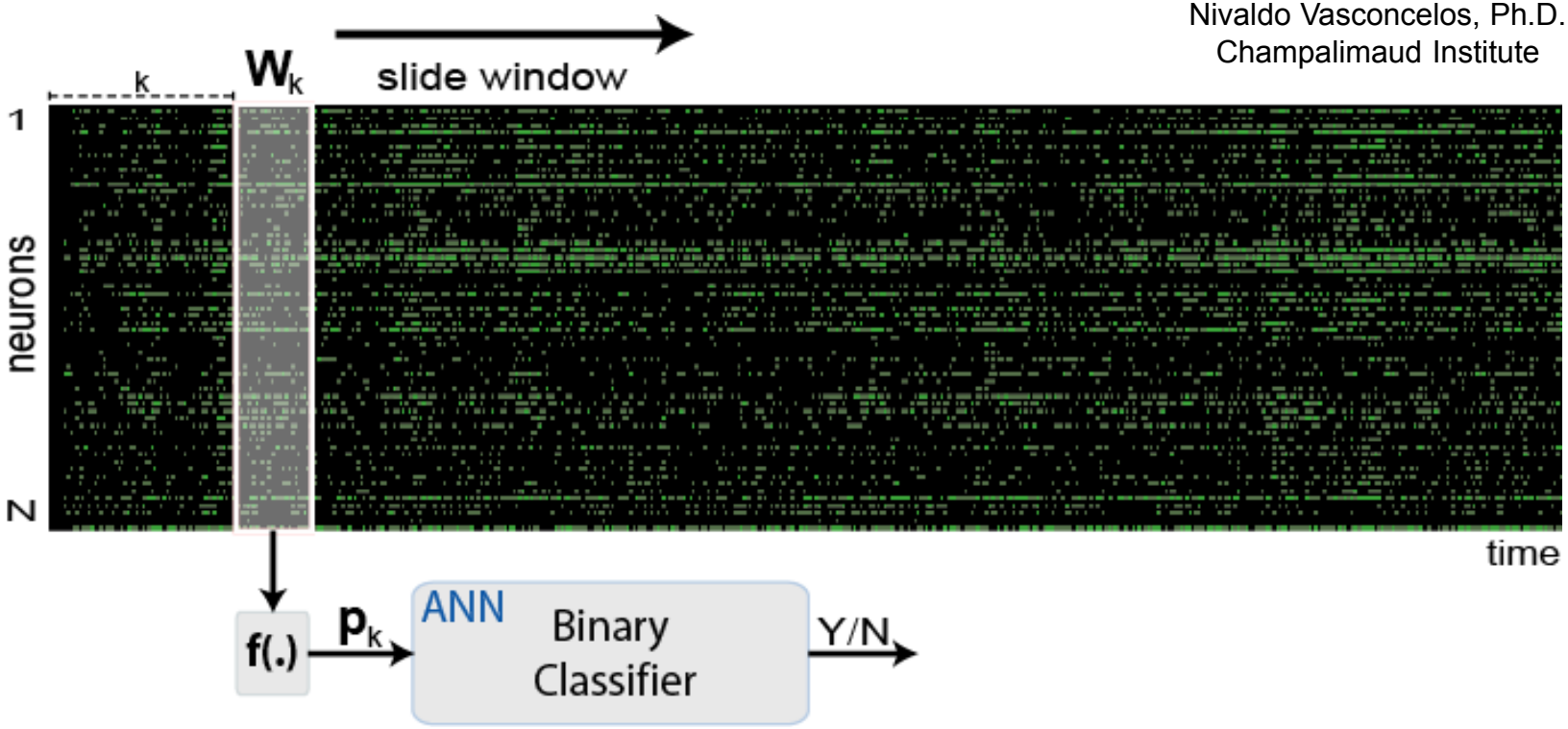
$$COR = \frac{\sum_{c=1}^{N}\sum_{m=1}^{M}(x_{cm}-\bar{x})(y_{cm}-\bar{y})}{\sqrt{\sum_{c=1}^{N}\sum_{m=1}^{M}(x_{cm}-\bar{x})^2}\sqrt{\sum_{c=1}^{N}\sum_{m=1}^{M}(y_{cm}-\bar{y})^2}},$$



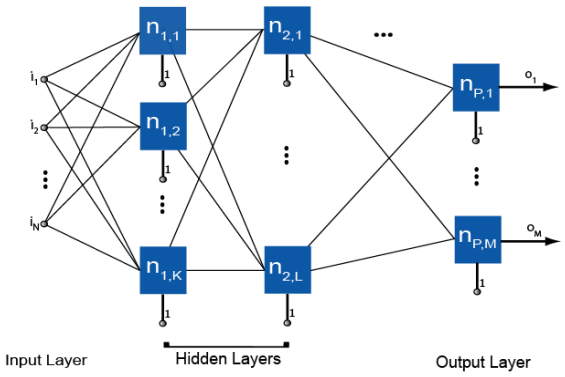


Ribeiro et al. (2004) PLoS Biology 2: 126-137

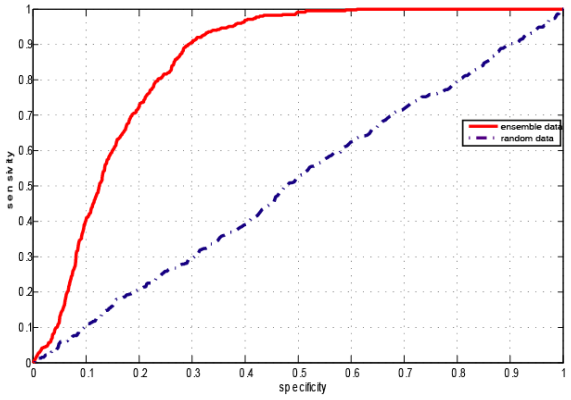
Nivaldo Vasconcelos, Ph.D.
Champalimaud Institute

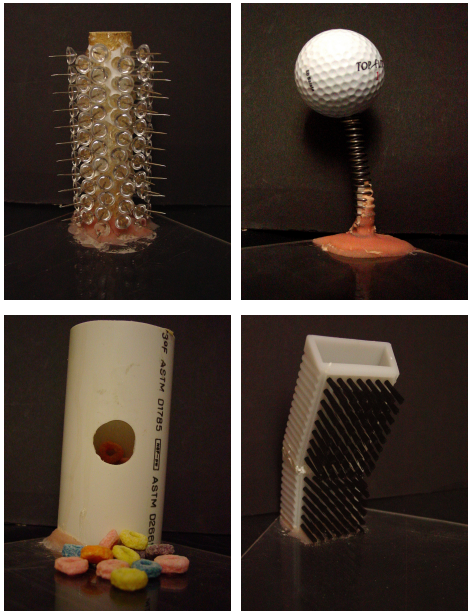


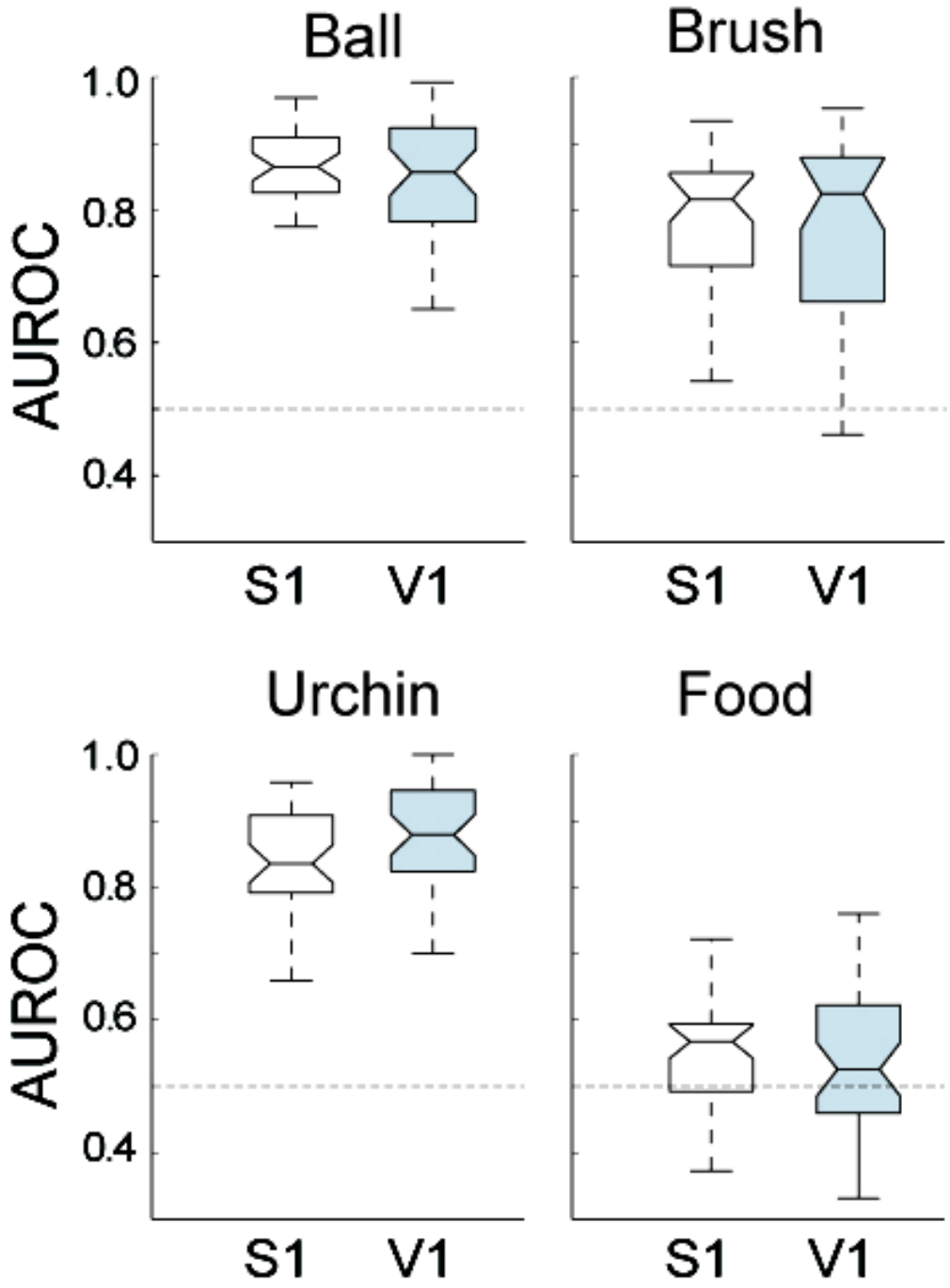
Multi-Layer Perceptron Architecture

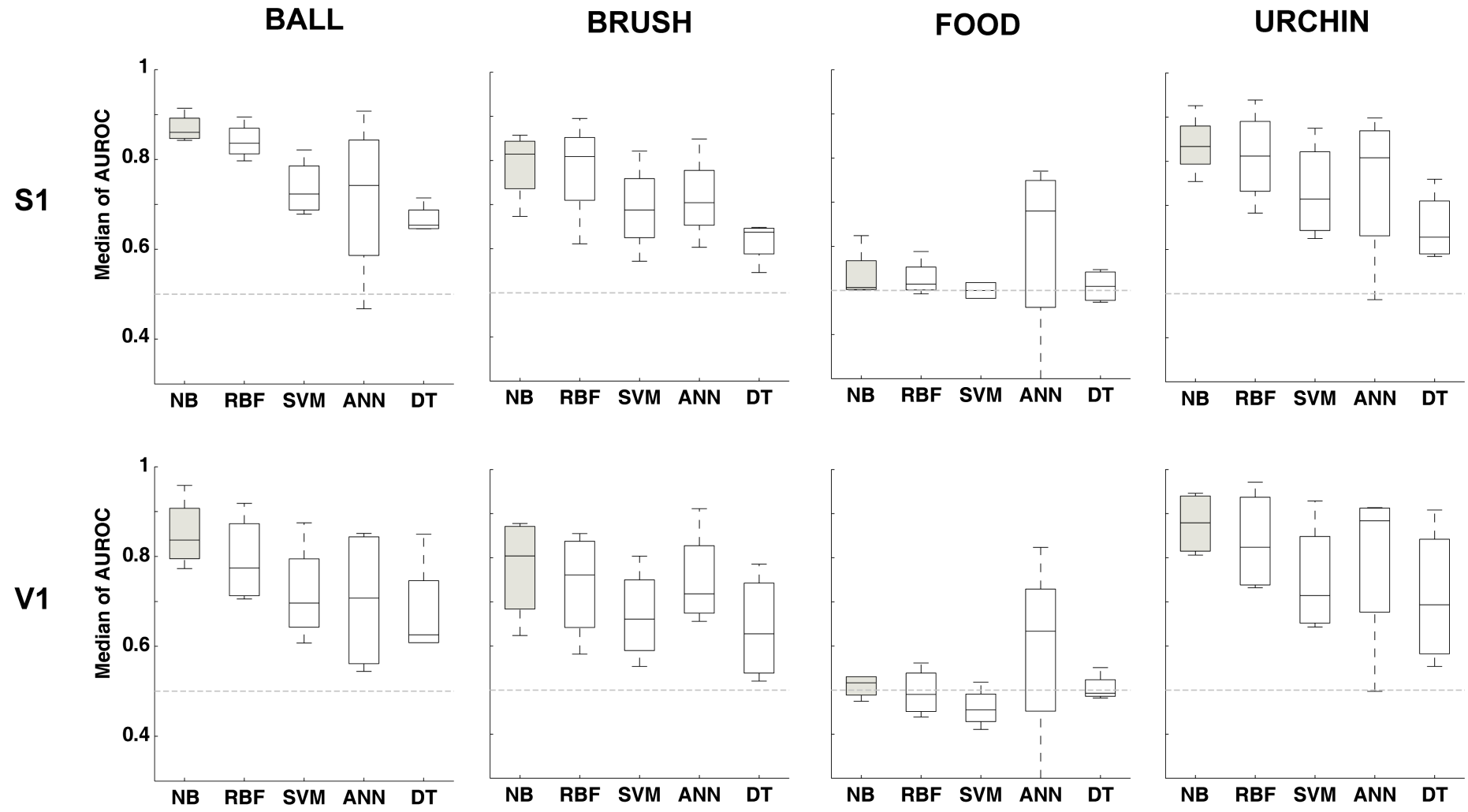


ROC Curve






Ball
Brush
Urchin
Food
AUROC
1.0
0.8
0.6
0.4
S1
V1



NB: Naive Bayes classifier

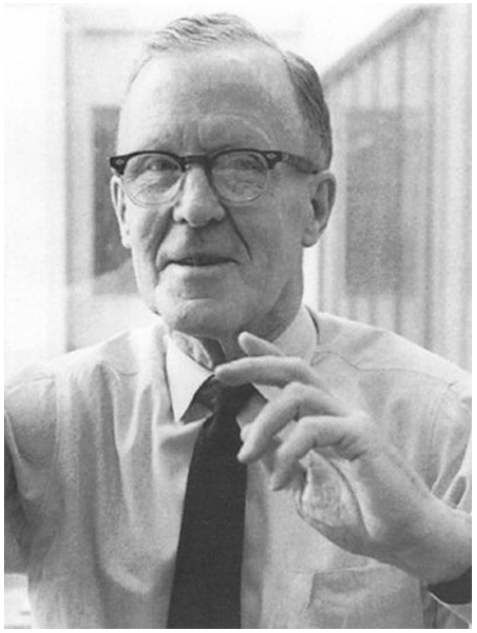
RBF: radial basis functions

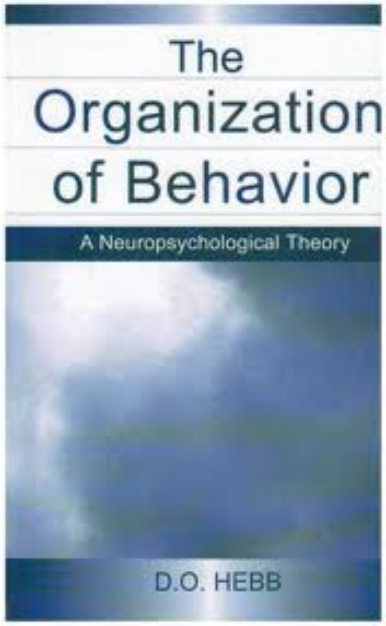
SVM: support vector machines

ANN: artificial neural network (multilayer perceptron)

DT: decision tree

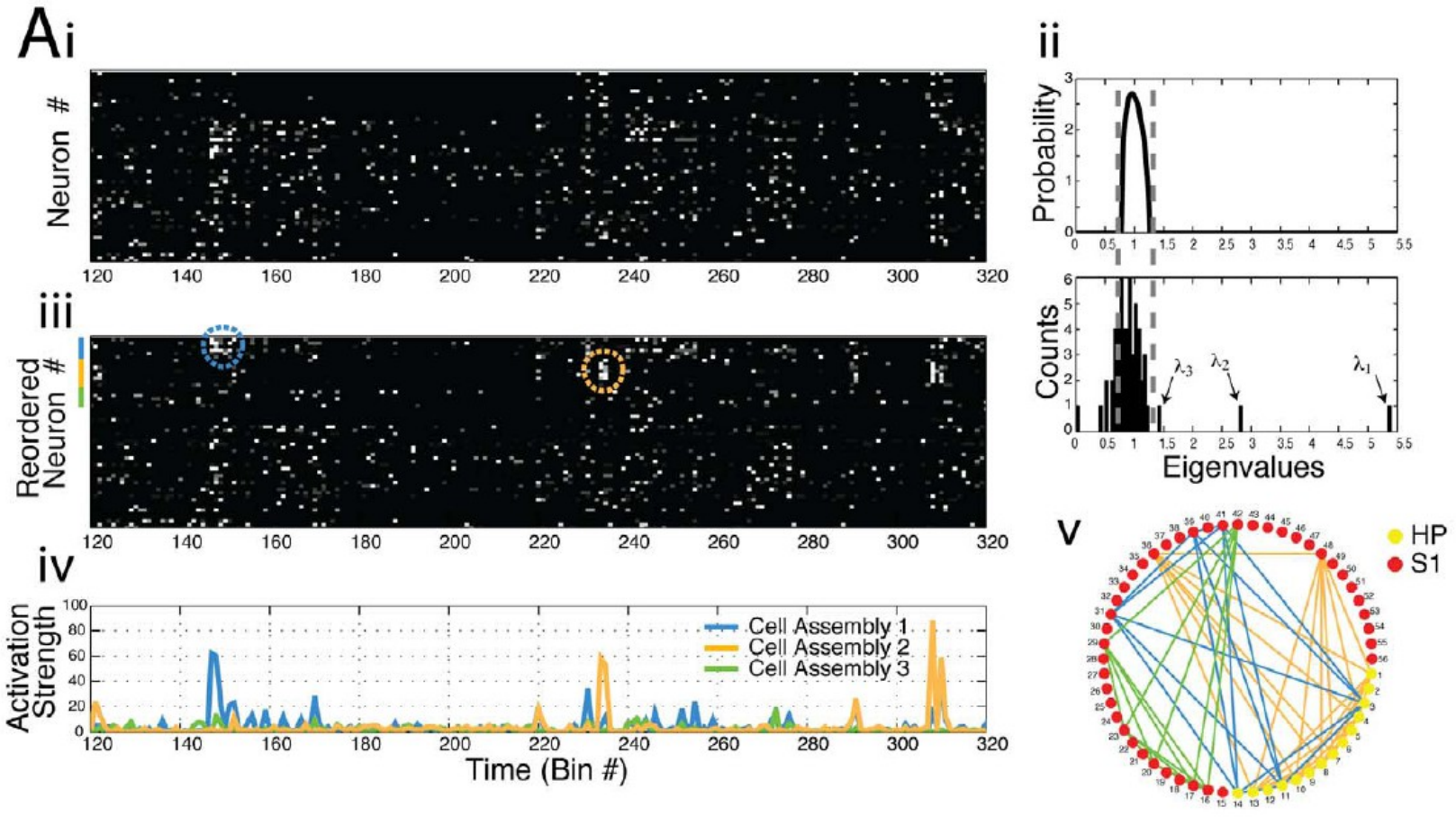
Vasconcelos, N. ; Pantoja, J. ; Belchior, H. ; Caixeta, F. V. ; Faber, J. ; Freire, M. A. M. ; Cota, V. R. ; de Macedo, E.A.; Laplagne, D. A. ; Gomes, H. M. ; Ribeiro, S. (2011) Cross-modal responses in the primary visual cortex encode complex objects and correlate with tactile discrimination. PNAS 108: 15408-15413.



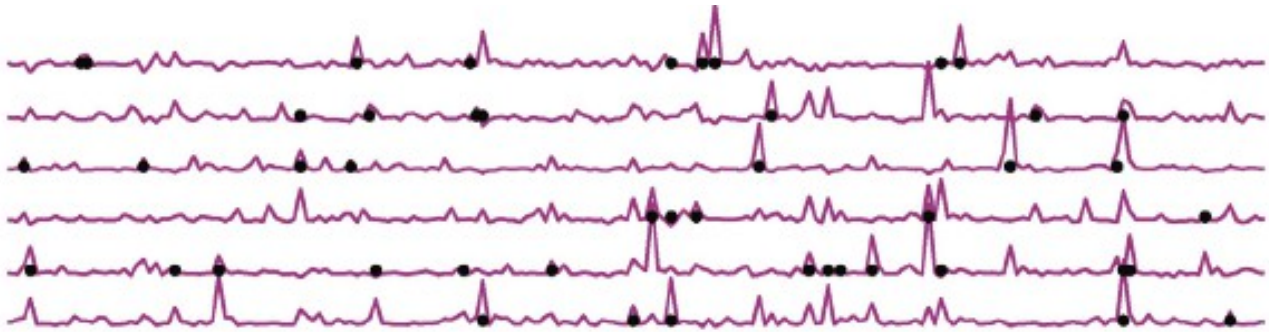


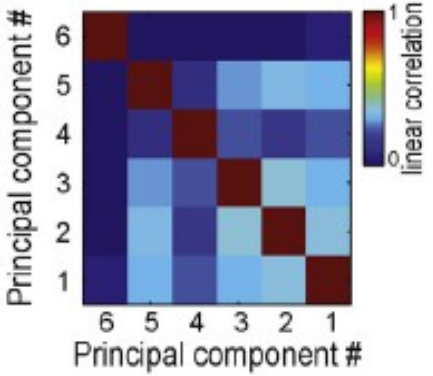
Hebb proposed that new memories are encoded by sequences of distributed neuronal assemblies that emerge during novel experience through firing synchronization.

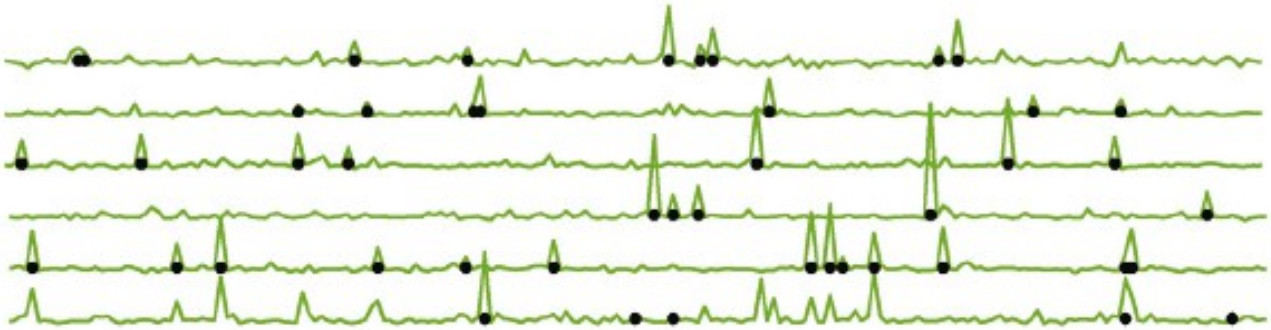
Vitor Lopes-dos-Santos
Ph.D. student

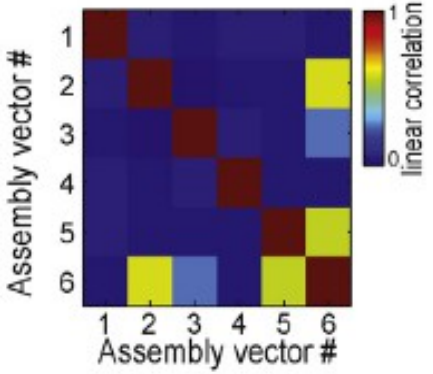


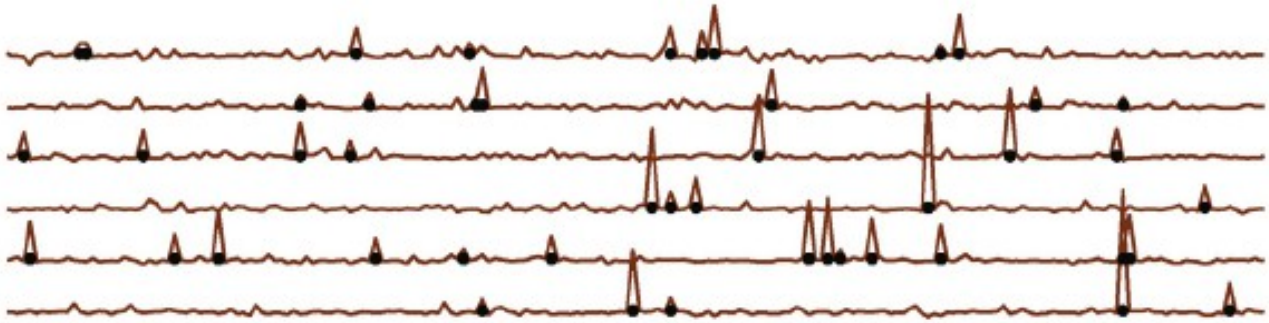
Lopes-dos-Santos, V; Conde-Ocazionez, S; Nicolelis, MAL; Ribeiro, S; Tort, ABL (2011) Neuronal Assembly Detection and Cell Membership Specification by Principal Component Analysis. Plos One 6: e20996.

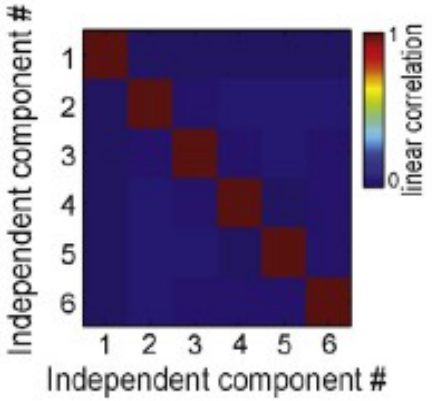






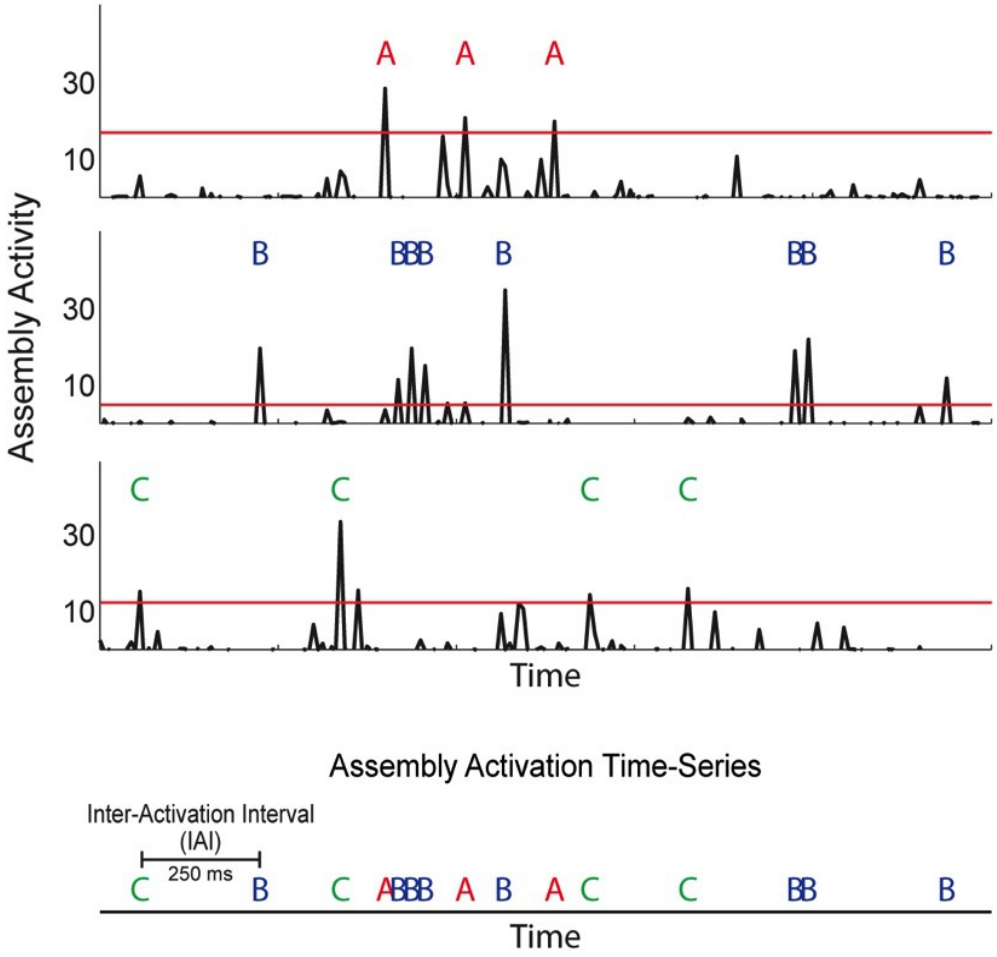


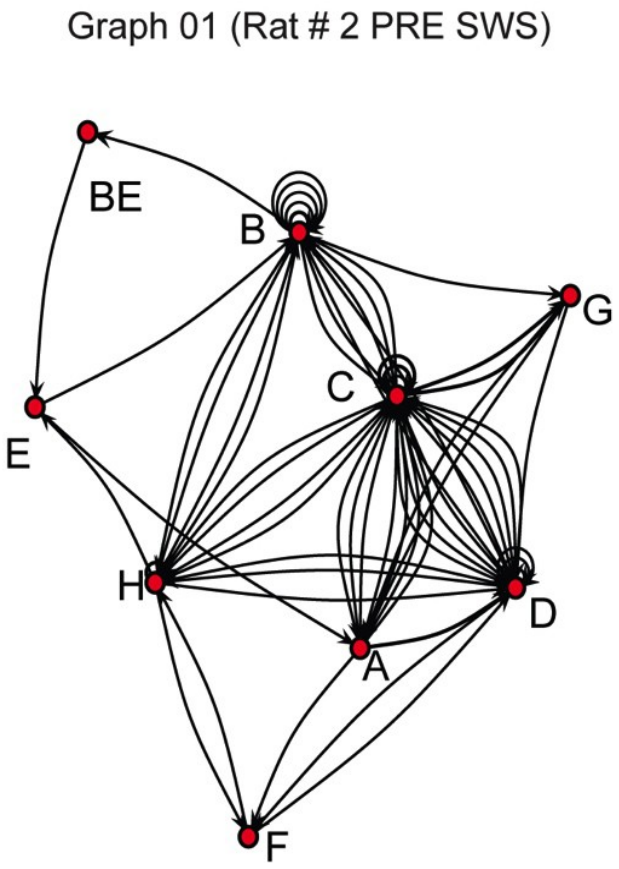




Lopes-Dos-Santos V, Ribeiro S, Tort AB (2013) Detecting cell assemblies in large neuronal populations. J Neurosci Methods 220(2):149-66

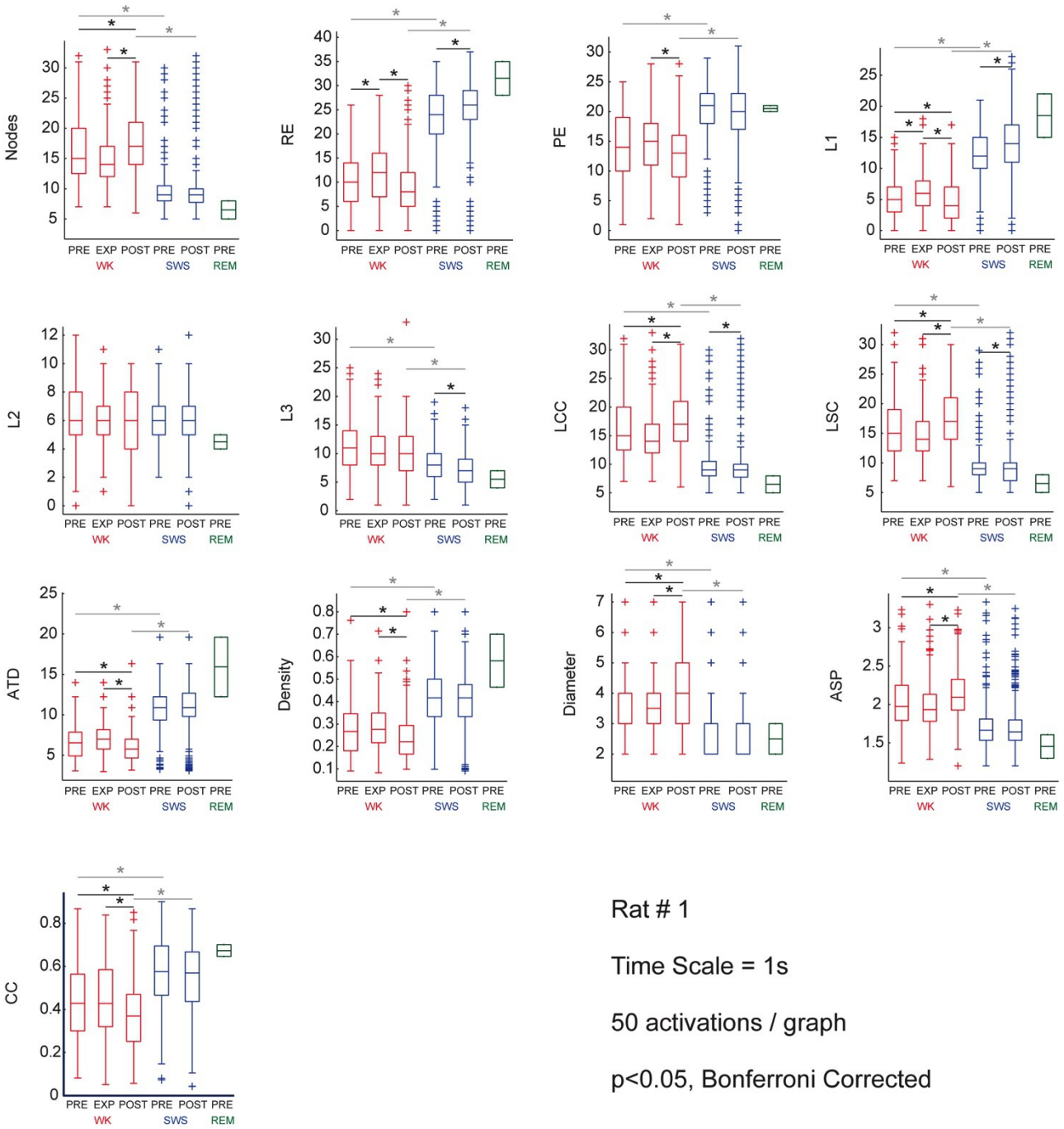
Daniel Almeida-Filho, Ph.D. student





Almeida-Filho DG, Lopes-dos-Santos V, Vasconcelos NAP, Miranda JGV, Tort ABL and Ribeiro S (submitted to Frontiers in Neural Circuits) An investigation of Hebbian phase sequences as assembly graphs.

Distribution of Graph Attributes Values

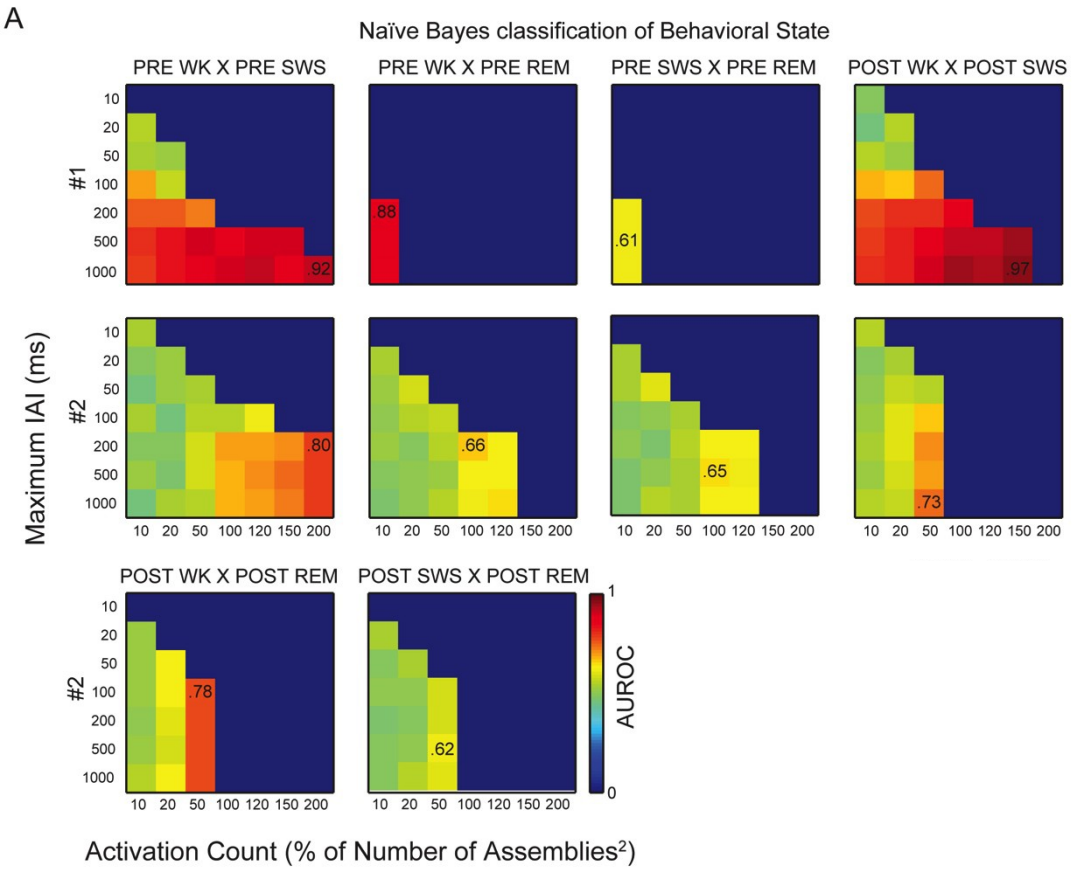


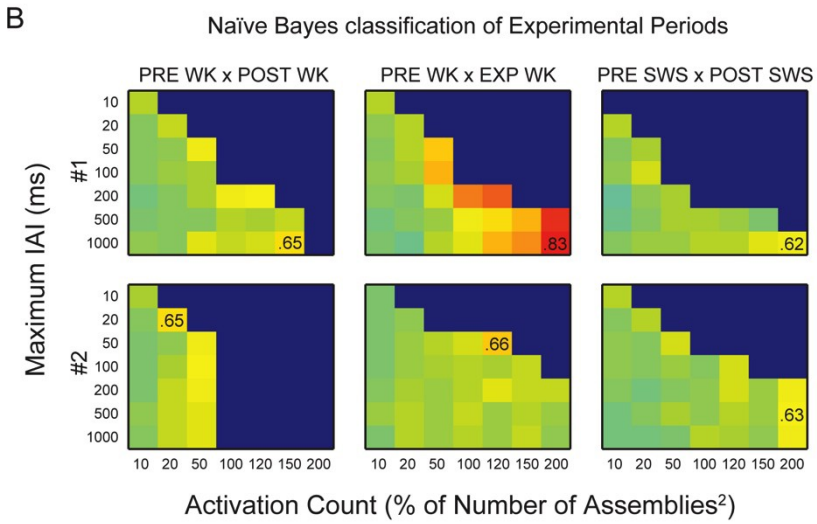
Rat # 1

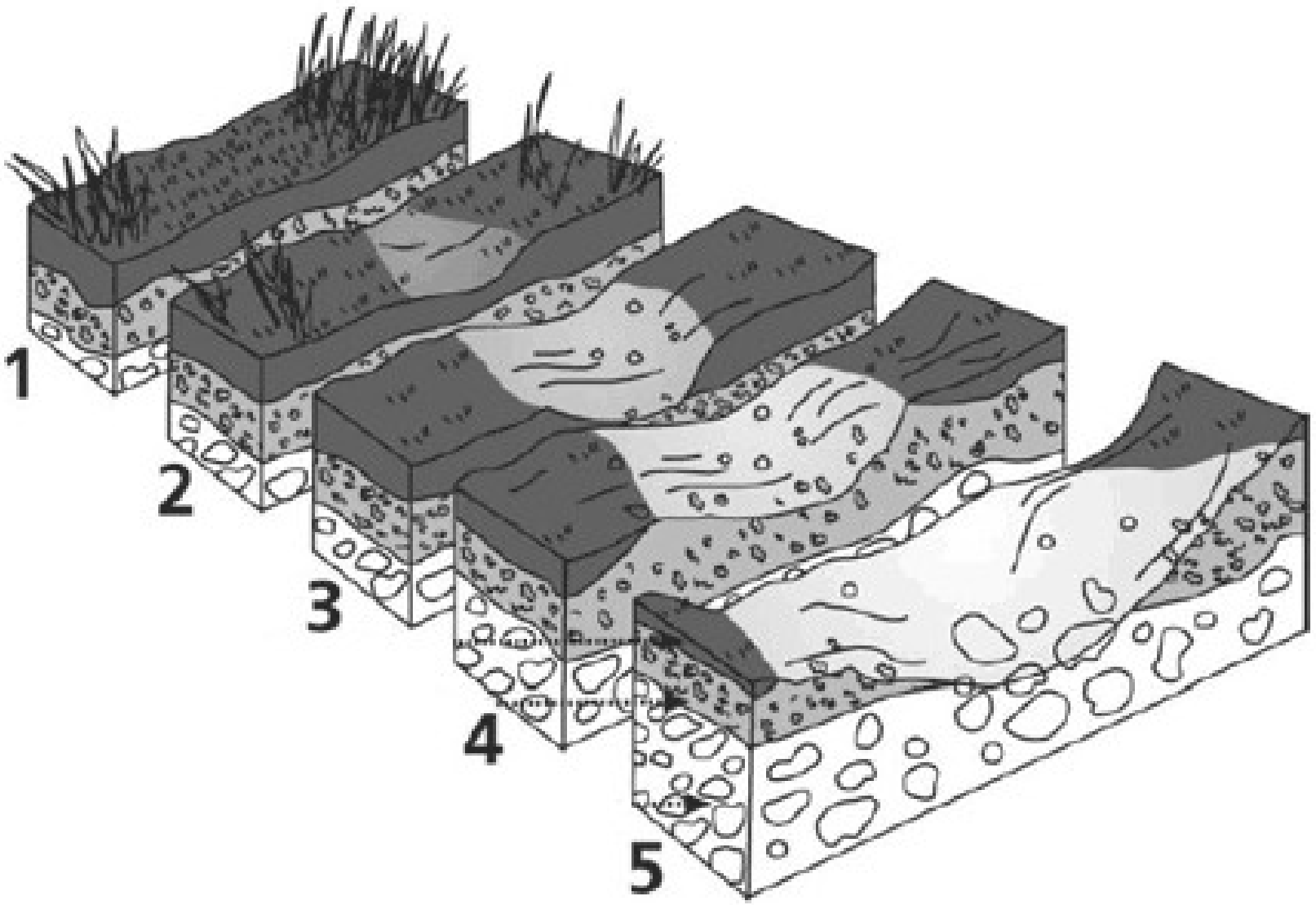
Time Scale = 1s

50 activations / graph

p<0.05, Bonferroni Corrected


A
Naïve Bayes classification of Behavioral State
PRE WK X PRE SWS
PRE WK X PRE REM
PRE SWS X PRE REM
POST WK X POST SWS
POST WK X POST REM
POST SWS X POST REM
Maximum IAI (ms)
#1
#2
10 20 50 100 200 500 1000
10 20 50 100 120 150 200
.92
.88
.61
.97
.80
.66
.65
.73
.78
.62
AUROC
1
0
Activation Count (% of Number of Assemblies²)


B
Naïve Bayes classification of Experimental Periods
PRE WK x POST WK
PRE WK x EXP WK
PRE SWS x POST SWS
Maximum IAI (ms)
#1
#2
10 20 50 100 200 500 1000
10 20 50 100 120 150 200
.65
.83
.62
.65
.66
.63
Activation Count (% of Number of Assemblies²)


1
2
3
4
5