

COMS30017

Computational Neuroscience

Week 4: Synapses and Synaptic Plasticity

Video 3: WHAT IS SYNAPTIC PLASTICITY?

Dr. Beatriz E. P. Mizusaki
fv18192@bristol.ac.uk



Intended learning outcomes

- Understand the concept of synaptic plasticity;
- Gain intuition around possible functions for synaptic plasticity;

Synapses change

- The magnitude of a synapse's electrical response to an action potential can change depending on the activity history of the synapse (known as plasticity).
- These changes can be **short**-lasting (ms~s) or **long**-lasting (hours~years)
- Even the way synapses change can change itself, a process called **metaplasticity** (won't be explored in this course).

Synapses have memory?

- Synaptic plasticity is generally believed to be the primary basis of long-term memory in the brain.
- Other neural components are also plastic (intrinsic excitability, neural morphology, etc), but their role in learning and memory is poorly understood. We will not cover them in this unit.
- Synapses increase or decrease their strength according to certain 'rules of plasticity'.

Synapses have memory?

- Linked to learning and memory in the following way:
 - Neural activity during learning triggers synaptic strength changes.
 - Synaptic strength changes alters the propensity for neurons to fire.
 - Next time the same neural circuit receives an input, it responds in a different fashion than it otherwise would have.

Associative memory
(e.g. Pavlov's dogs)

What to consider in a synaptic plasticity rule?

- Spike times
- Spiking rates
- Cooperativity / normalization
- Other kinds of plasticity
- Networks

Summary

- There are many kinds of plasticity in neuroscience;
- Synaptic plasticity is a paradigm of memory;
- Also useful from the point of start of ANNs;