Sensory Integration and Temporal Coding Notes

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1. point...

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Papers from previous notes file *below*!

12 Timing Rules for Synaptic Plasticity Matched to Behavioral Function [1]

from http://www.neuroanatomy.wisc.edu/cere/text/P4/climb.htm A single action potential from a climbing fiber elicits a burst of action potentials in the Purkinje Cells that it contacts. This burst is called a complex spike. Climbing fibers are "lazy" (but strong), thus Purkinje cells exhibit complex spikes at a rate of about 1 per second.

going to come back to this paper at some point...

1. Synaptic plasticity rules themselves can be highly specialized to match the functional requirements of a learning task

2. The fundamental requirement of associative learning is to store information about the correlations between events

i) synaptic plasticity mechanisms have been described that can capture the correlations between coincident, or nearly coincident events

a) **Feldman, D.E. (2012). The spike-timing dependence of plasticity. Neuron 75, 556571.**

ii) Behavioral observations indicate the brain is also able to associate events separated in time, with requisite temporal precision

a) During feedback–based learning, a delayed error signal must selectively modify synapses active at the specific, earlier time when the neural command leading to an error was generated

A) known as the "temporal credit assignment" problem – think of feedback delay when throwing a ball

3. During cerebellum–dependent learning, delayed feedback about performance errors is conveyed to the cerebellum by its climbing fiber input.

i) Each spike in a climbing fiber produces a "complex spike", and concomitant calcium influx in its Purkinje cell targets. Related pairings of climbing fiber (CF) activation with the activation of parallel fiber (PF) synapses onto the Pukinje cells result in depression of the parallel fiber–to–Purkinje cell (PF–to–PC) synapses.

a) Thus, error signals carried by the climbing fibers are thought to sculpt away, through associate synaptic depression, PF–to–PC synapses that were active around the time that an error was generated

13 Homeostatic Plasticity of Subcellular Neuronal Structures: From Inputs to Outputs [2]

Coming soon...

14 Mind the Gap Junctions: The Importance of Electrical Synapses to Visual Processing [3]

Coming soon...

15 Relational associative learning induces cross-modal plasticity in early visual cortex [4]

Coming soon...

16 Neuroscience: When perceptual learning occurs [5]

"A study now finds that visual perceptual learning of complex features occurs due to enhancement of later, decision-related stages of visual processing, rather than earlier, visual encoding stages. It is suggested that strengthening of the readout of sensory information between stages may be reinforced by an implicit reward learning mechanism."

Note: Just glanced at paper, but this suggests that the approach I want to take with the visual system, having groups of neurons cluster together in effect, (described above), may be exactly what is happening in the brain.

17 Why Neurons Have Thousands of Synapses, a Theory of Sequence Memory in Neocortex [6]

Coming soon...

18 Integrating Hebbian and homeostatic plasticity : introduction [7]

Coming soon...

19 Homeostatic plasticity mechanisms in mouse V1 [8]

NEXT AS WELL PAPER
Coming soon...

20 Synaptic scaling rule preserves excitatoryinhibitory balance and salient neuronal network dynamics [9]

NEXT NEXT NEXT NEXT PAPER
Coming Soon...

21 Rapid Encoding of New Memories by Individual Neurons in the Human Brain [10]

1. individual neurons were measured upon showing subjects a picture of a family member, the Eiffel tower, and both together in order to attempt to create an association. The family member alone caused a mean firing rate of 13.1 spikes/s, the Eiffel tower along caused a mean firing rate of 3.6 spikes/s, After a single exposure to the composite picture, the mean response to the Eiffel tower alone rose to 7.6 spikes/s. The study did tests to ensure that the change in firing rate was a result of the association rather than familiarity.

2. The authors suggest this is a result of single–cell encoding, however, to me:

    i) NOTE: This suggests that there is an immediate change in the structure of the brain, that occurs as a result of new associations forming

    ii) NOTE: Further, as it was individual neurons that were being measured, there must be a chain of reactions (or numerous parallel reactions) occurring, that cause formation and strengthening of synapses (otherwise, it seems highly unlikely that the study happened to measure the one neuron that would undergo changes).

        a) NOTE: this suggests a global rule...

3. "repetition suppression" is a neural mechanism that gradually decreases the intensity of response to a repeated stimulus

    i) can have repetition suppression with plasticity; which might be why it's better to learn things over a long period of time rather than all at once. due to repetition suppression, the stimulus decreases in intensity, so the strengthening of new synapses slows. But, if you do it over time, the repetition suppression decays, and you get the full strength of the stimulus back.

22 Functional and structural underpinnings of neuronal assembly formation in learning [11]

NEXT NEXT PAPER
Coming Soon...

23 Mirror Neurons from Associative Learning [12]

Coming Soon...

24 Associative learning and sensory neuroplasticity: how does it happen and what is it good for? [13]

NEXT NEXT NEXT PAPER
Coming Soon...

25 Associative learning rapidly establishes neuronal representations of upcoming behavioral choices in crows. [14]

Coming Soon...

26 Associative Learning Drives the Formation of Silent Synapses in Neuronal Ensembles of the Nucleus Accumbens [15]

Coming Soon...

27 The neurobiology shaping affective touch: Expectation, motivation, and meaning in the multisensory context [16]

Coming Soon...

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