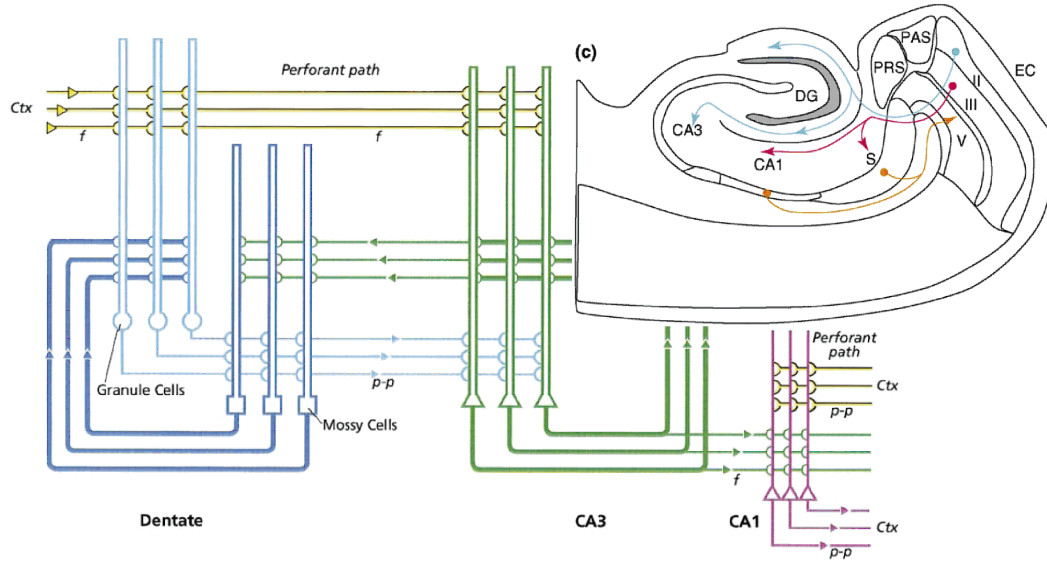


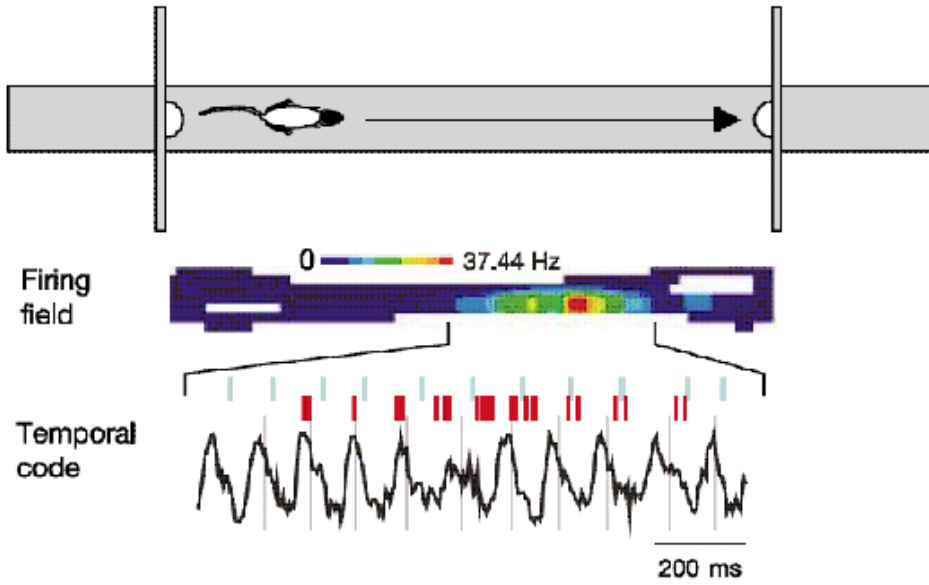
STDP enhances phase-coding in a recurrent network



Hippocampal formation: Trisynaptic circuit through dentate gyrus, CA3, and CA1 originates and terminates in entorhinal cortex (*insert, rat brain*). p-p—point-to-point;f—fanning;S—subiculum;PAS/PRS—pre/parasubiculum[Lisman99,Moser06].

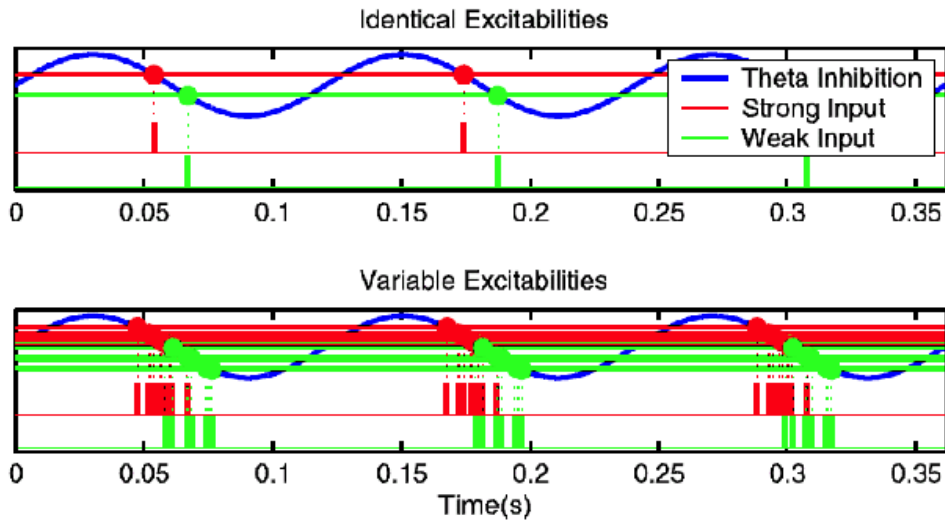
Hippocampal neurons have precise spike timing (~10ms).
How they overcome heterogeneity is unclear.
Hypothesis: Plasticity enhances phase-coding.

Phase and rate coding



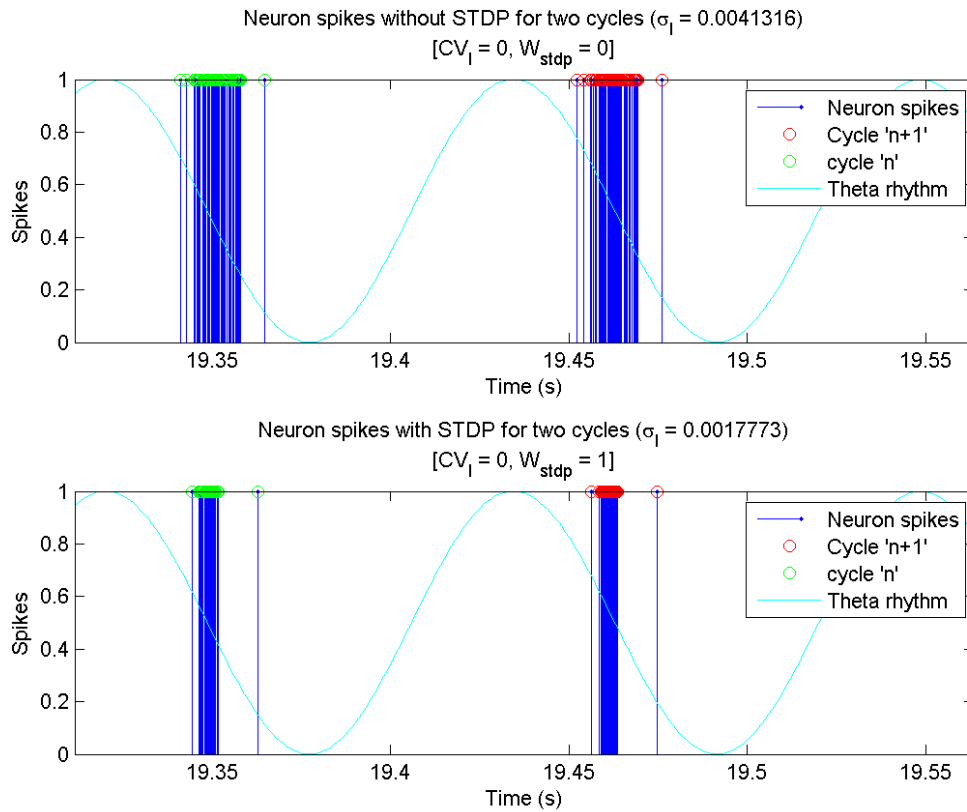
CA1 hippocampal cells' rate (middle) and timing (bottom) codes [O'Keefe'03].

Heterogeneity corrupts phase-coding



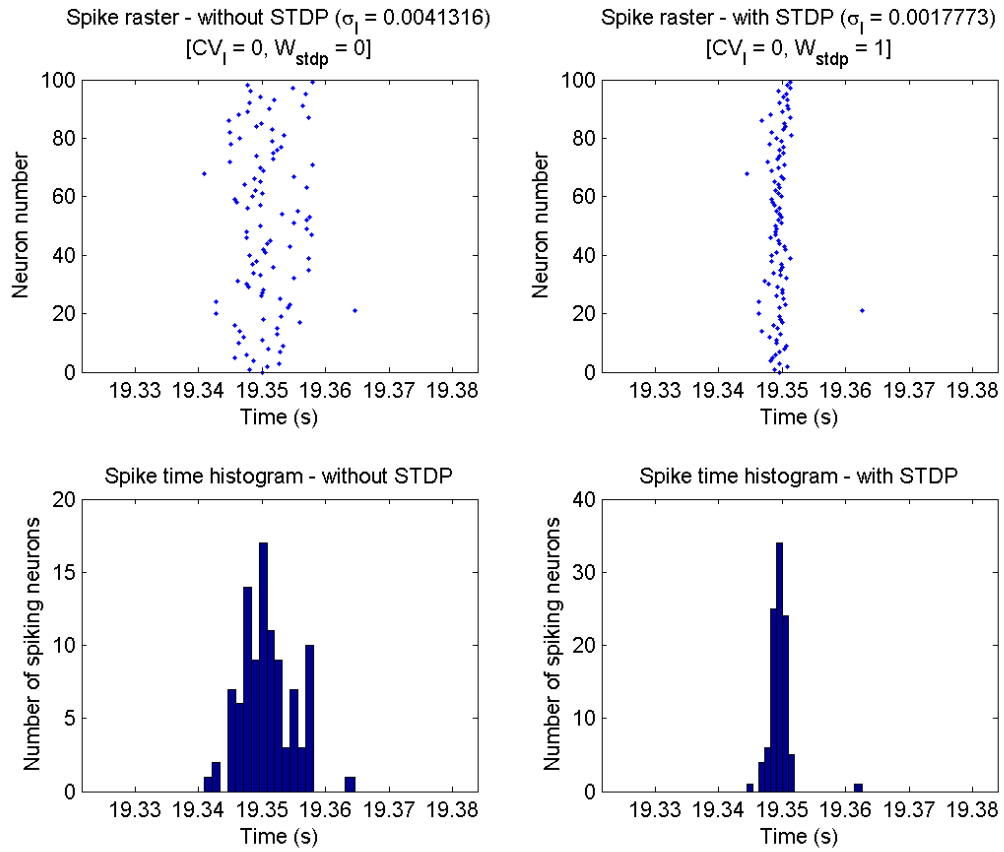
Phase encodes input strength (top) only when excitability doesn't vary (bottom).

STDP combats heterogeneity



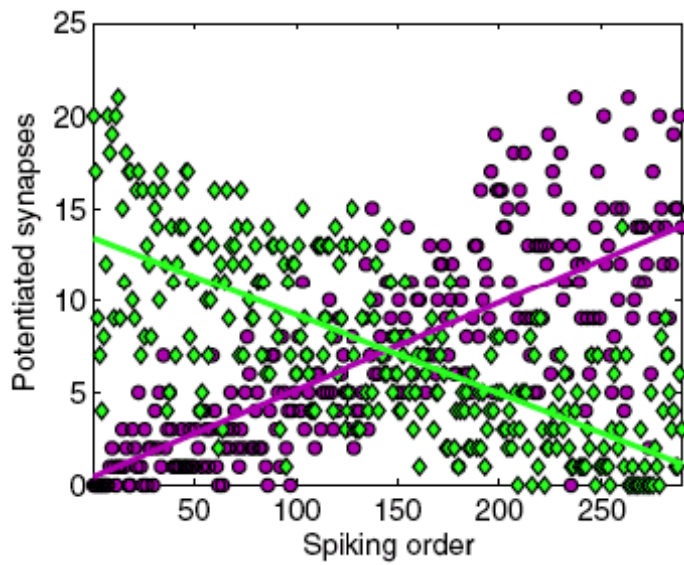
STDP potentiates synapses from excitable to lethargic neurons, advancing their firing.

Spike rasters and histograms



STDP improves timing precision (SD) from 4.1ms to 1.8ms.

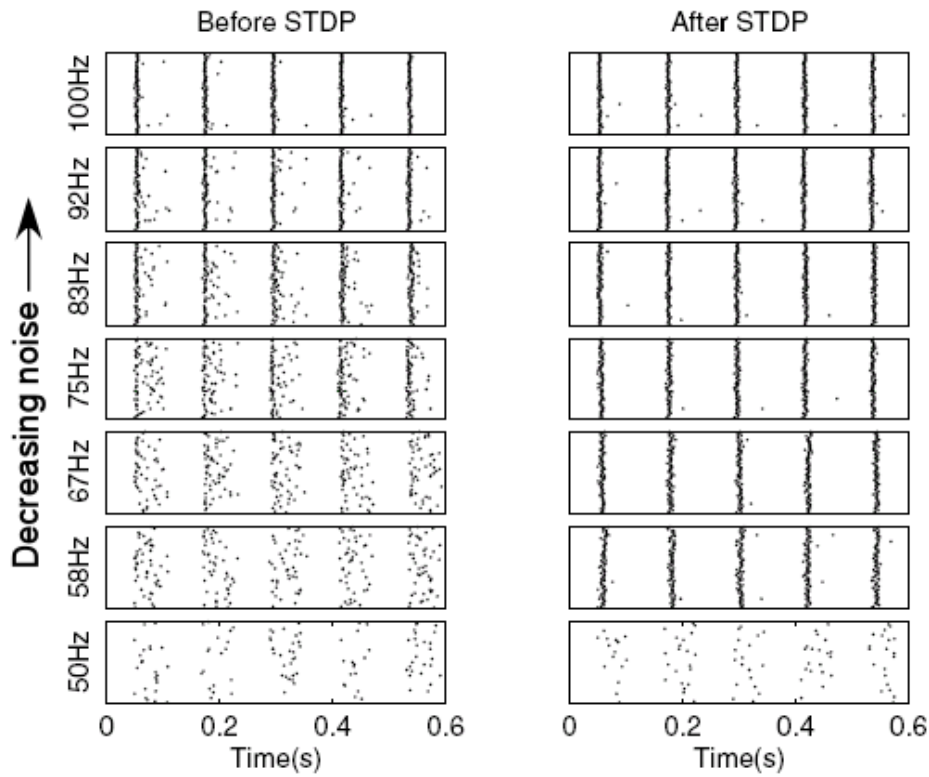
Synapse count versus temporal order



Early neurons make more synapses (green); late ones receive more synapses (purple) [Arthur06].

Navigation controls: four buttons with symbols (⏪, ⏩, ⏴, ⏵) and a page indicator '7 of 7'.

Next Lecture: Limits of STDP



STDP fails to improve phase-coding when input is too noisy (50Hz).