

Are synapses binary or analog?  
-Yes.

Tea Talk

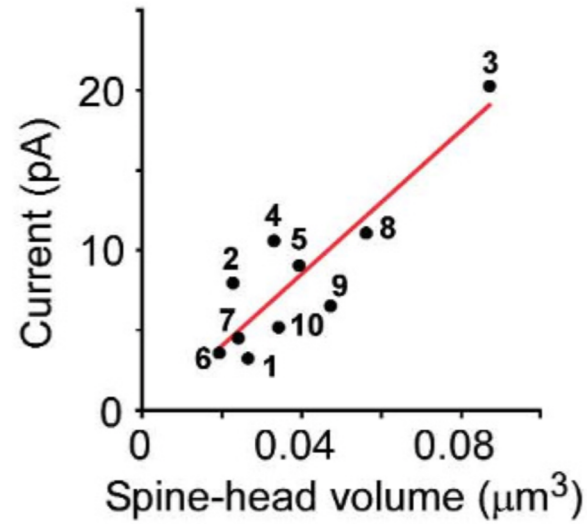
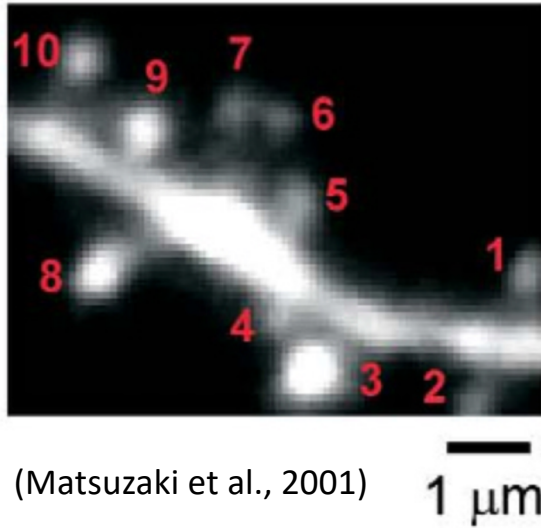
Naoki Hiratani

2020-01-29

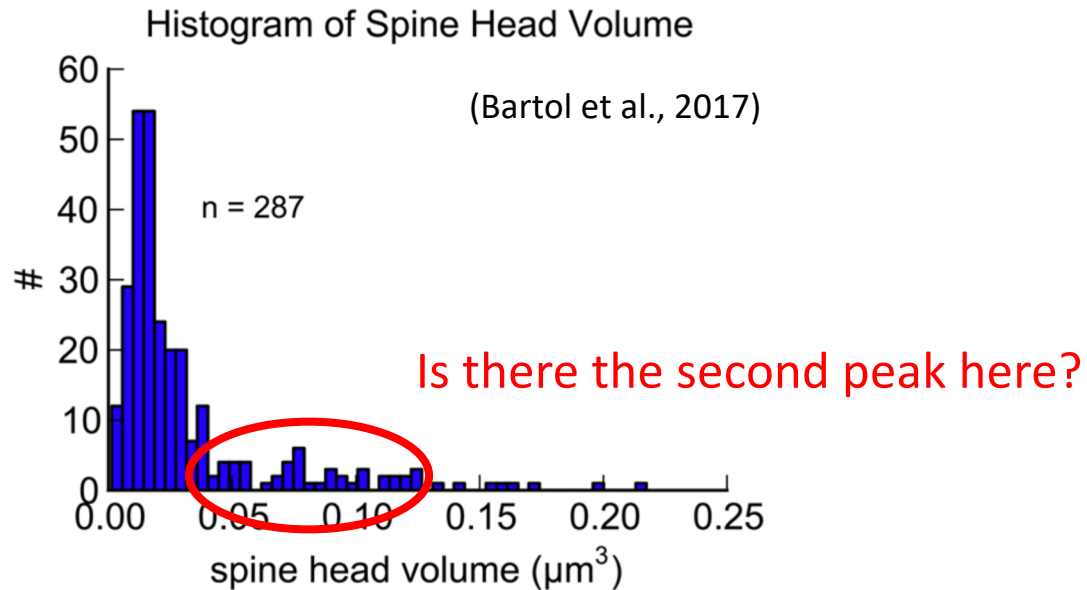
Reference:

Dorkenwald, Seung et al., Binary and analog variation of synapses between cortical pyramidal neurons.  
BioRxiv, 2019

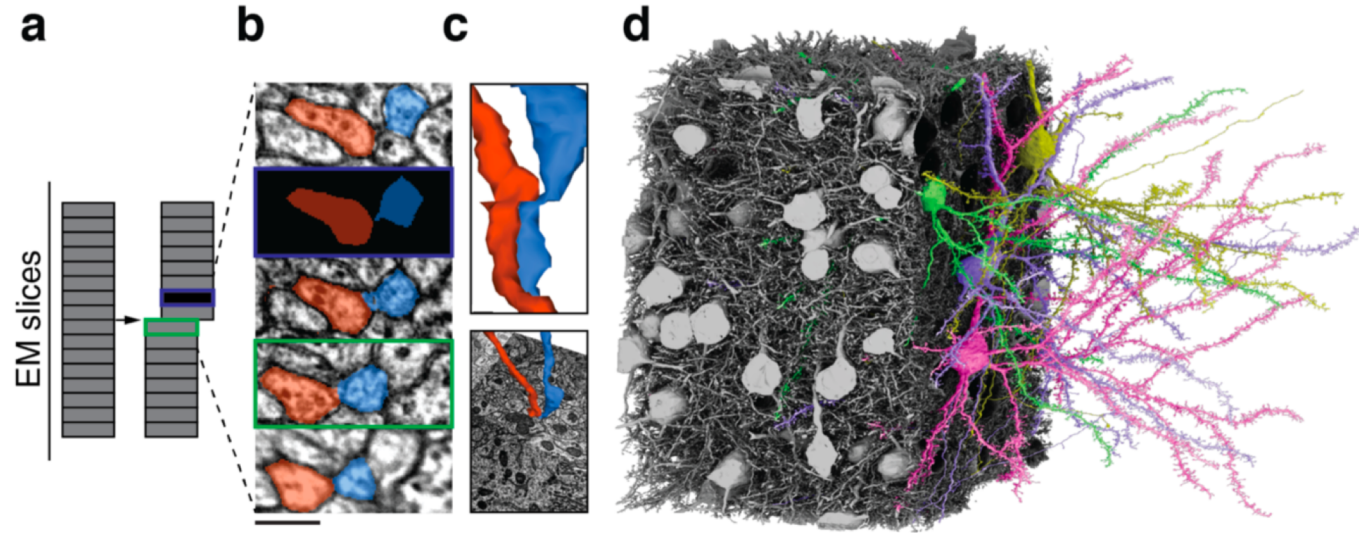
Spine head volume is proportional to the “synaptic weight”



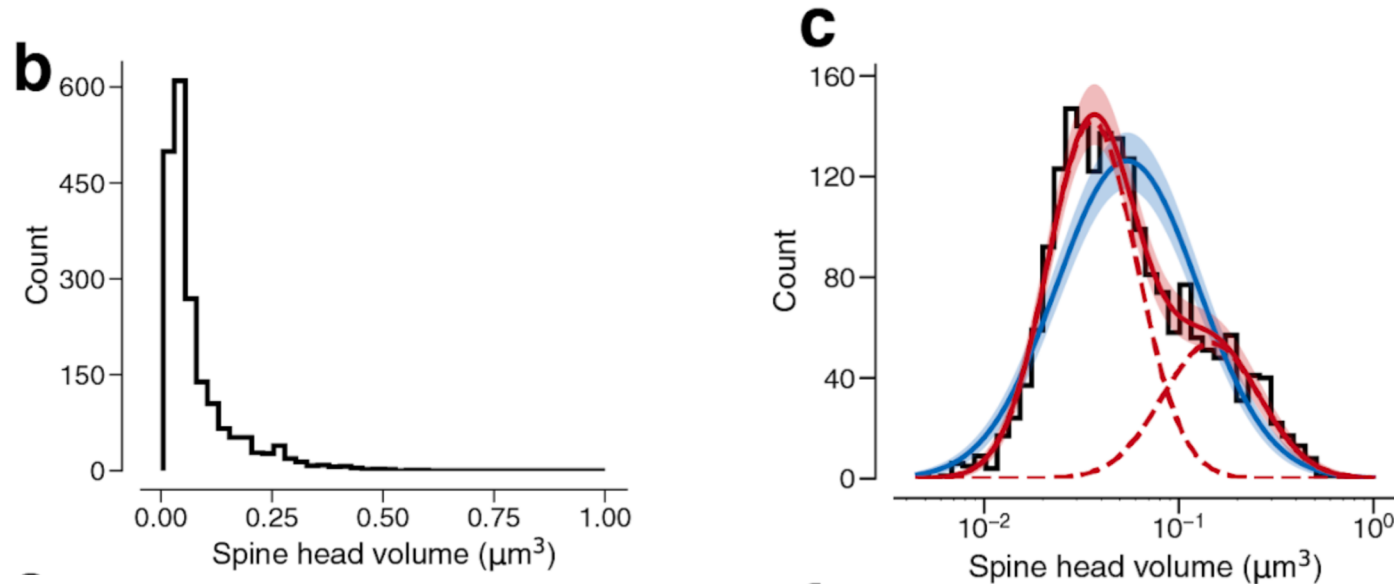
Spine head volume seemingly follows **unimodal** log-normal distribution



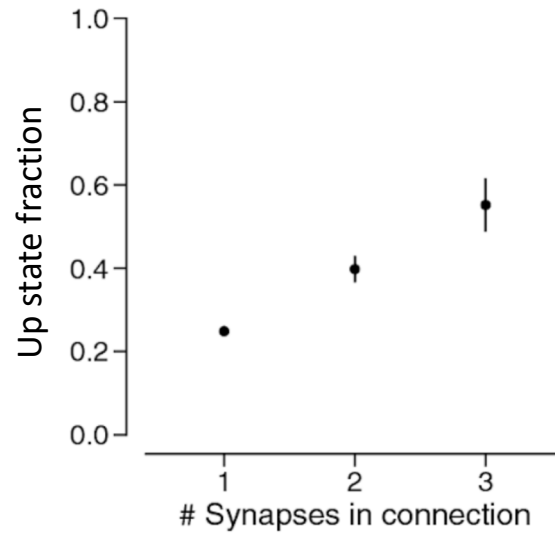
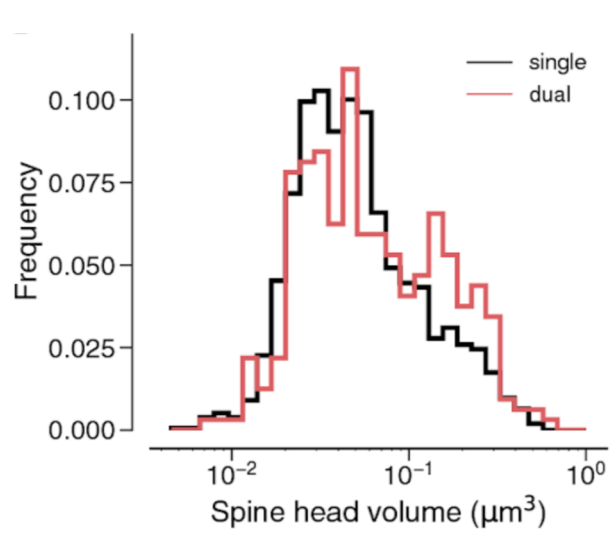
# Precise measurement of the spine head volume distribution by EM reconstruction



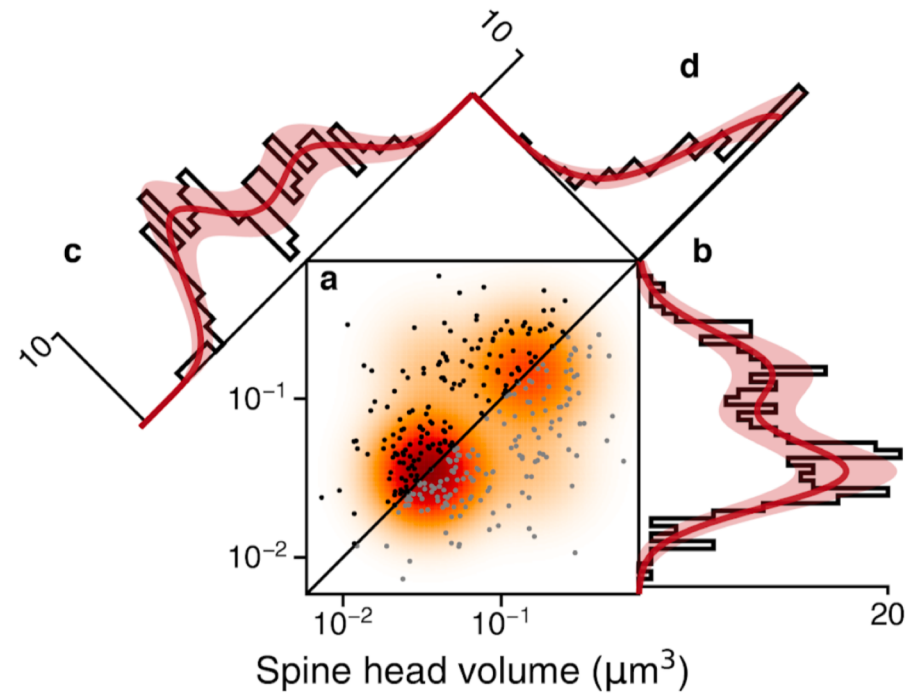
Spine head volume is better fitted by a **bimodal** distribution



Spines belongs to a multi-synaptic connection are more likely to be in the up state



Sister synapses (multi-synaptically connected synapses) have correlated binary component



## Summary

- Spine head volume is given by the binary + analog components
- Binary components are correlated among sister synapses

## Caveats

- Reconstruction is limited to a small volume (~100  $\mu\text{m}$ )
- No longer true if other type of synapses are included  
(analysis is limited to Pyr-Pyr connections in L2/3 of V1)