

**Discussion Points Questions for Debanne et al. (2012)**

[list of questions below is just to provide a jumpstart to thinking about things and is not intended to exhaustively cover all the 'essential' aspects of the paper; discussion points that may lead to fruitful insight are denoted via \*\*]

- Definitions. What is/are?
  - o synapses
  - o vesicle
  - o synaptic strength
  - o pre-synaptic element
  - o graded tonic release
  - o EPSC
  - o EPSP
  - o mossy fiber
  - o analog versus digital
- What is the distinction between pre- and post-synaptic neurons?
- What precisely defines an 'analog synapse'?
- How does the 'size' of a synapse factor in? What physical properties define 'size'? (e.g., channel density? surface area?)
- What are the various pros and cons of 'digital' versus 'analog' synapses?
- Is there a direct way to compare between analog and digital with respect to information encoding? For example, is one more efficient than the other?
- How precisely does a neuron behave in an 'analog' fashion? Are graded potentials via cable theory (e.g., space constant) sufficient in itself?
- How precisely does a neuron behave in an 'digital' fashion? Are APs via HH theory sufficient in itself?
- Is the cable model sufficient to explain the noted observation that the space constant is frequency-dependent (low-pass)?
- **\*\* ADF (analog-digital-facilitation):** Is this jargon? Or an important biophysical concept? [that is, the notion of ADF itself rather than the mechanisms underlying ADF]
- **\*\* Does a good model for ADF yet exist?** Biophysically, what should such a model encompass? Could such a model validate whether or not the notion of ADF actually carries any weight?
- With regard to mechanisms of ADF:
  - o **\*\* How does the notion of a range of different types of ion channels (e.g., low-threshold voltage-inactivation K<sup>+</sup> channels) relate back to the central tenets of the Hodgkin-Huxley model?**
  - o Fuzziness of hypotheses regarding [Ca<sup>2+</sup>] changes: Purely speculative?
  - o Fig.2a (bottom) in context of HH: Less K<sup>+</sup> current leads to slower reset?
  - o **\*\* How 'biophysical' are the models of ADF shown in Fig.2?**
- **\*\* How, precisely, does a pre-synaptic spike cause a post-synaptic response (EPSP)?** What conditions lead an EPSP to create a spike in that post-synaptic neuron?
- **\*\* How does the notion of ADF affect synaptic strength?** Is synaptic strength merely a static thing that affects how a pre-synaptic spike translates into an EPSP? Or can an ADF mechanism dynamically affect synaptic strength? [Note: jargon-wise, changes in synaptic strength relates to the notion of **plasticity** and the notion of **Hebbian learning**; these are important notions in the context of memory and learning]
- What precisely is the role of Ca<sup>2+</sup> at the synapse? Is it important chiefly inside the pre-synaptic cell? In the synaptic cleft? In the post-synaptic cell?
- How might an ADF mechanism relate to ephaptic coupling?