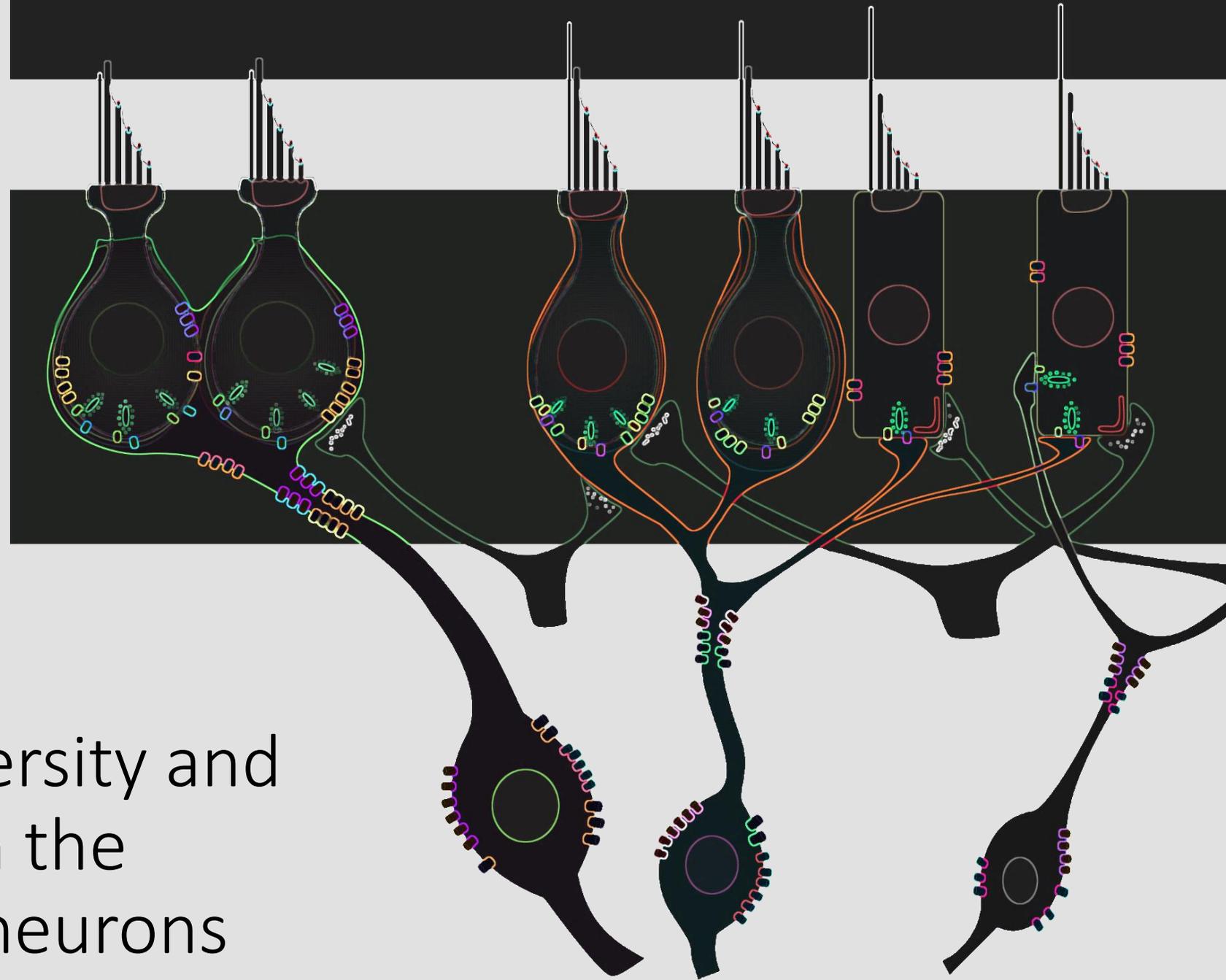




Selina Baeza Loya

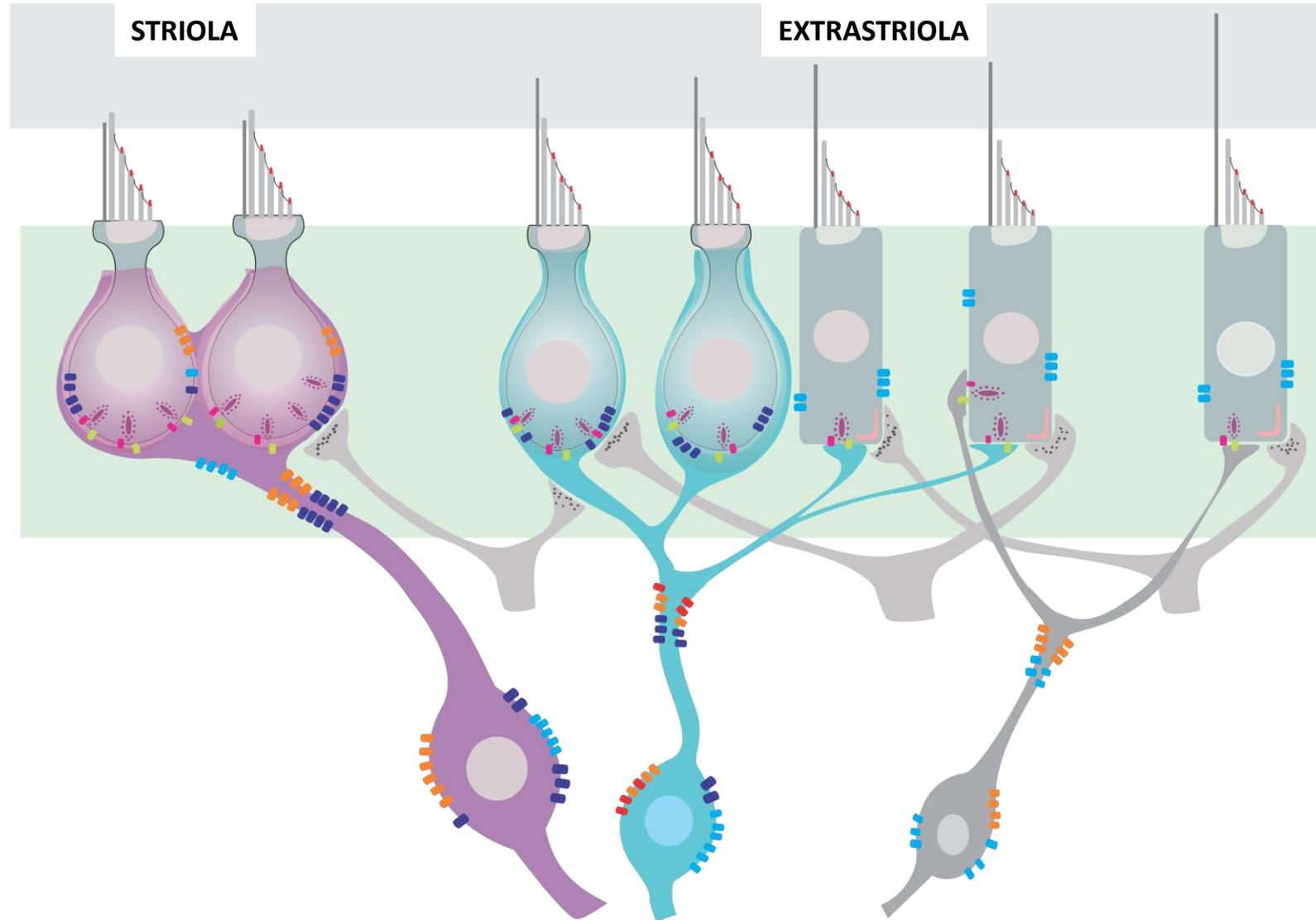
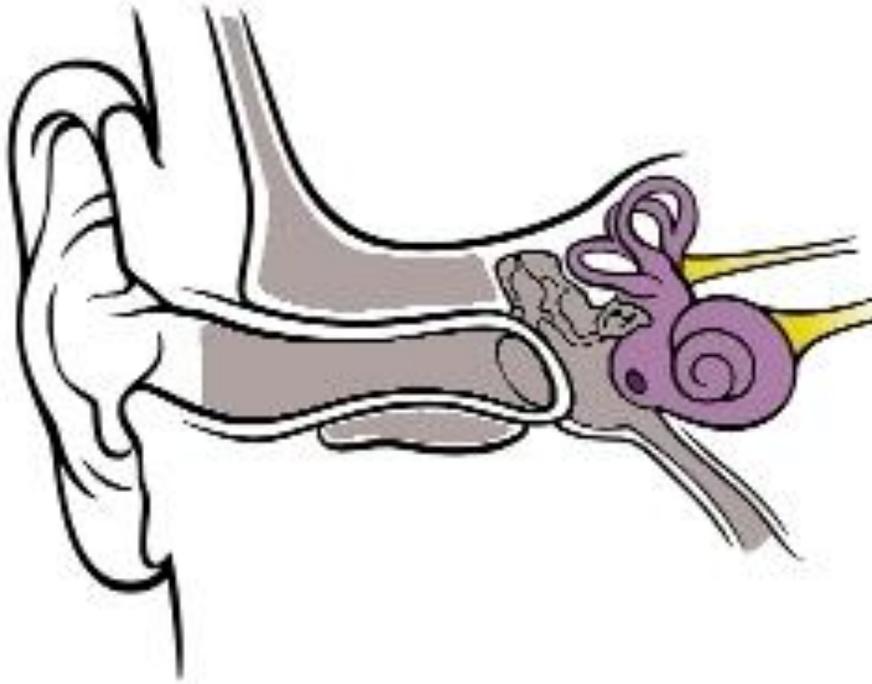
Eatock Lab

February 8th, 2020



Sodium current diversity and
sensory encoding in the
vestibular afferent neurons

The peripheral vestibular organs are the primary balance receptors



How do vestibular ganglion neurons (VGN) encode info about head motion?

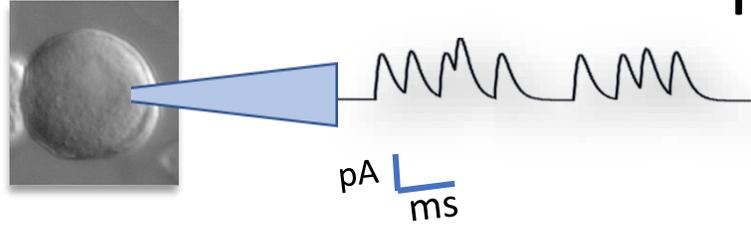


Goldberg and Fernández, 1971a



Spike timing *in vivo*

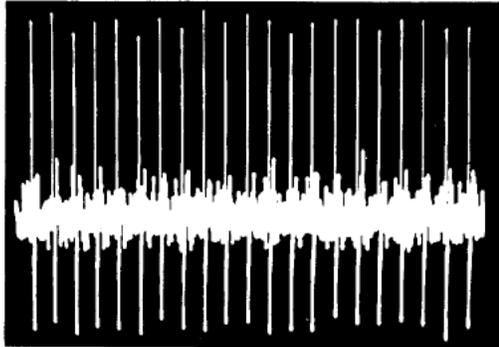
Kalluri et al., 2010



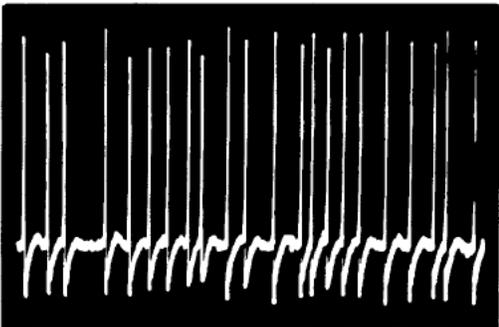
Firing patterns *in vitro*

Spike timing in VGN

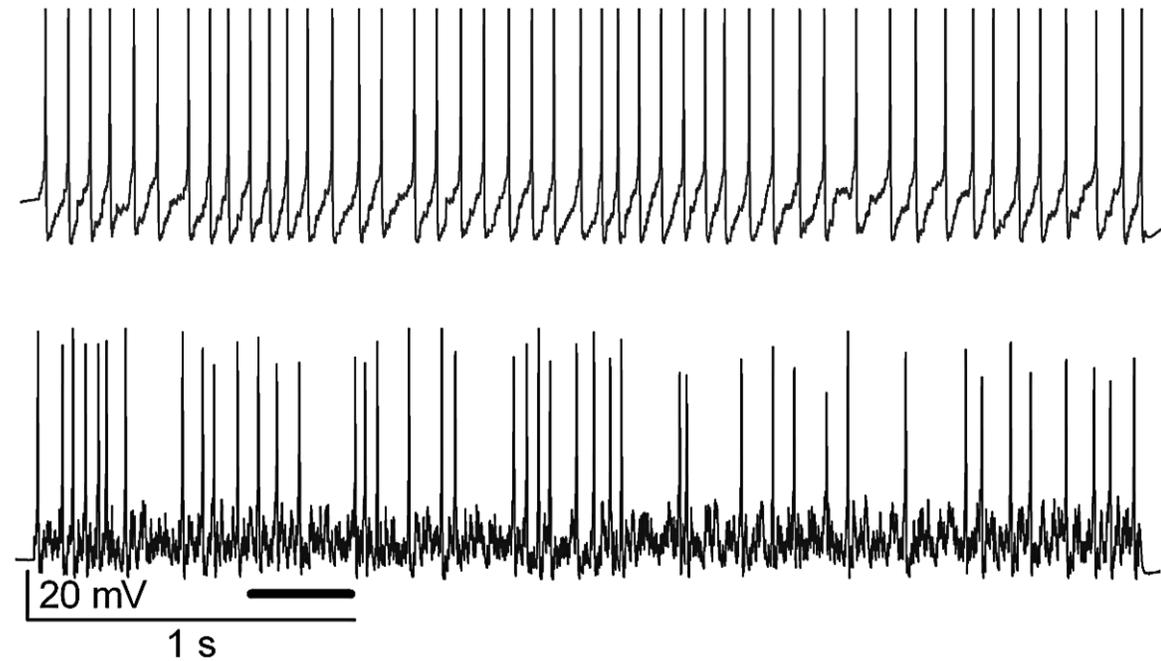
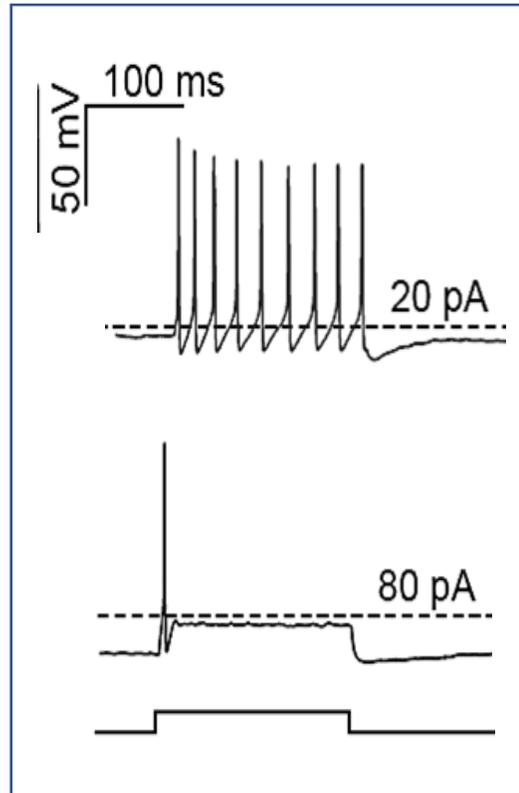
Regular



Irregular

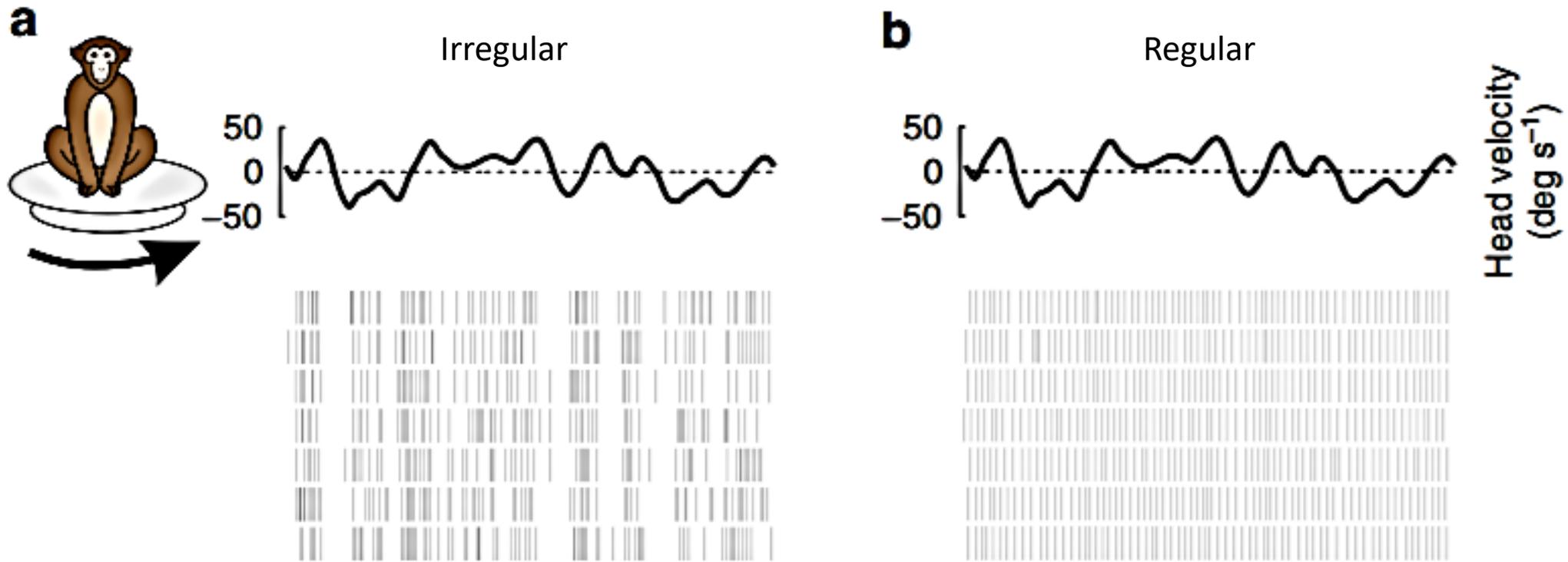


50 msec



Two parallel channels of information

- **Regular** (sustained) afferents and **irregular** (transient) afferents
- Two encoding strategies; rate encoding and precise spike time encoding, suited for different ranges of sensory information (Jamali et al., 2016).



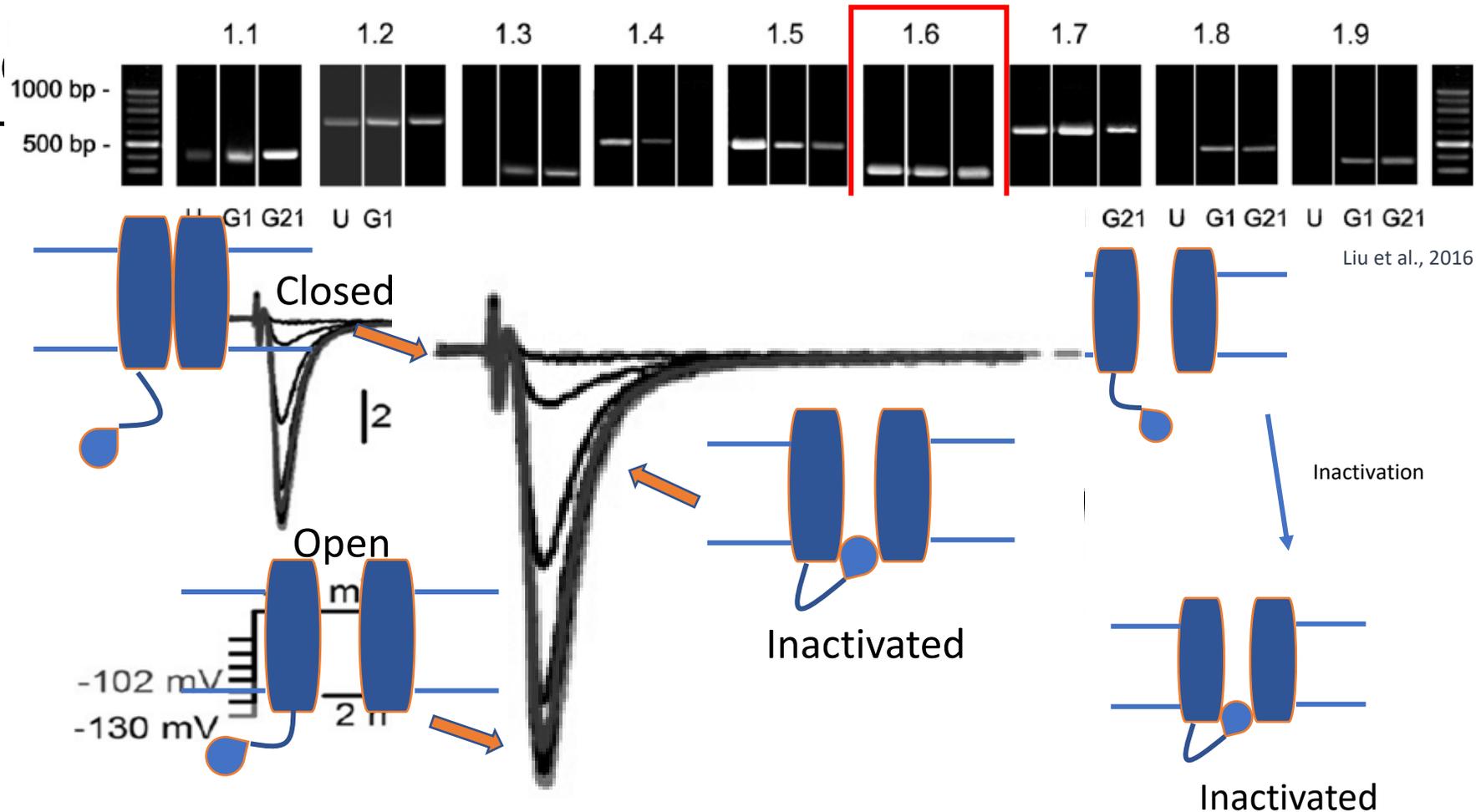
But how?

Sodium current diversity can arise from:

- Channel forming (α) subunits that carry current

- Curr

•



Sodium current diversity can arise from:

- Channel forming (α) subunits that carry current
- Current “modes” that reflect different channel states
 - Transient (traditional, quickly inactivating) (**Na_vT**)
 - Persistent (slowly or non-inactivating) (**Na_vP**)
 - Resurgent (blocked from inactivation) (**Na_vR**)

Do VGN express persistent or resurgent sodium currents?

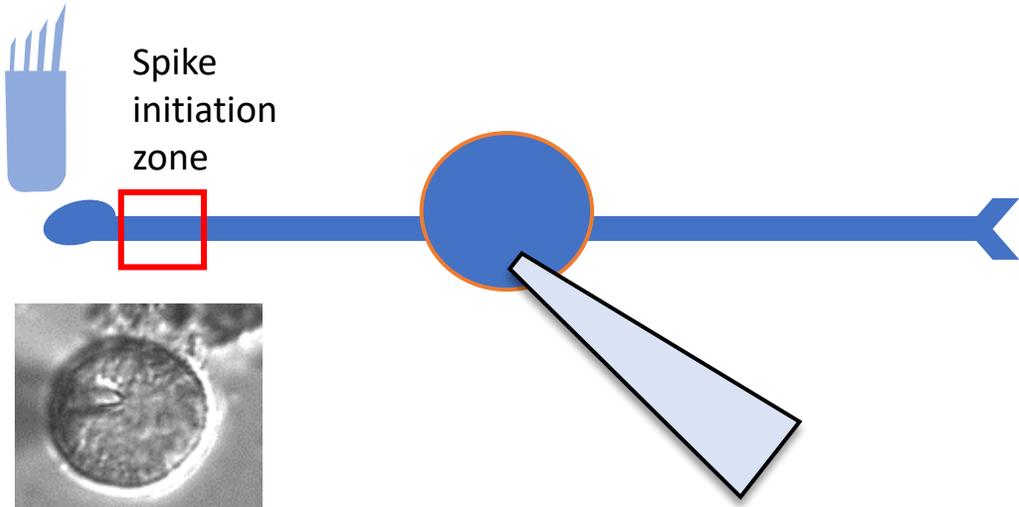
What channels are they carried by?

How do they influence spiking behaviors?

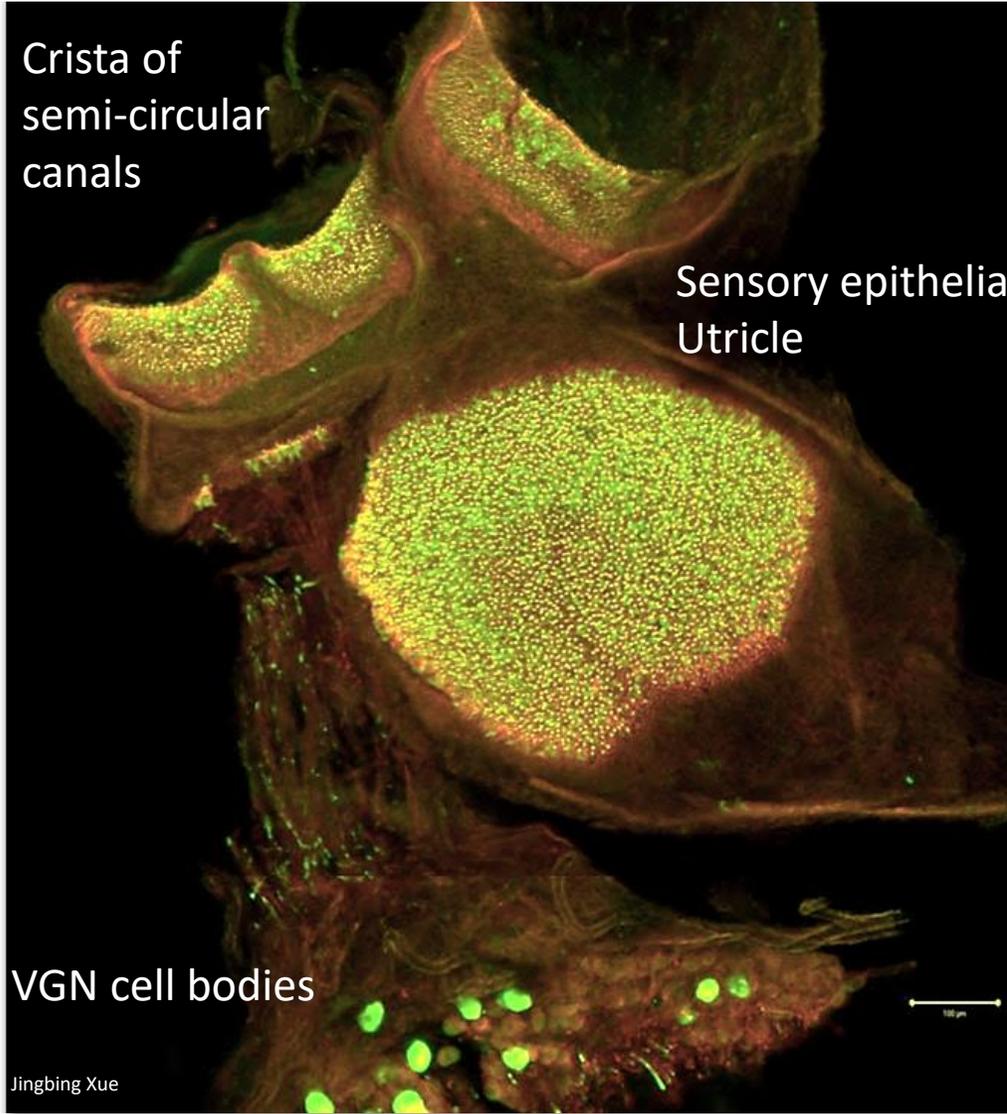
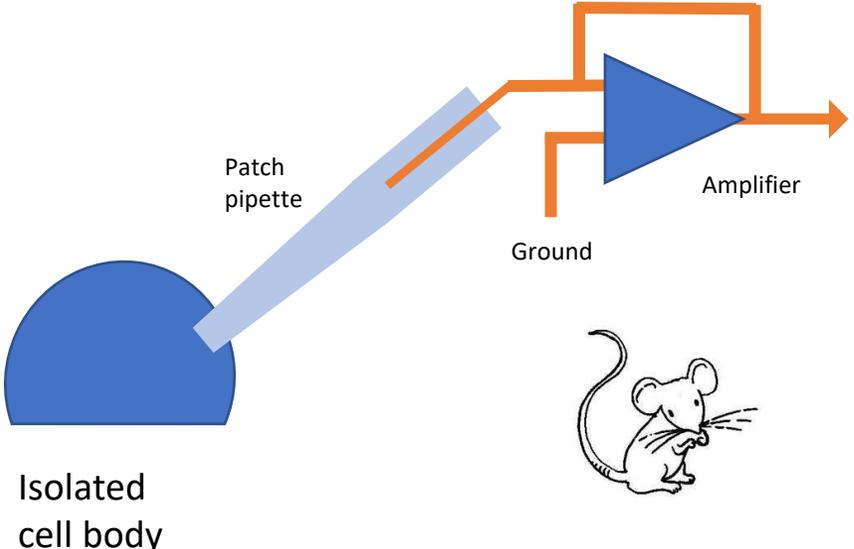
HYPOTHESIS

Since Na_vP or Na_vR currents are subthreshold and increase excitability, their presence will enhance spike regularity.

Experimental approach

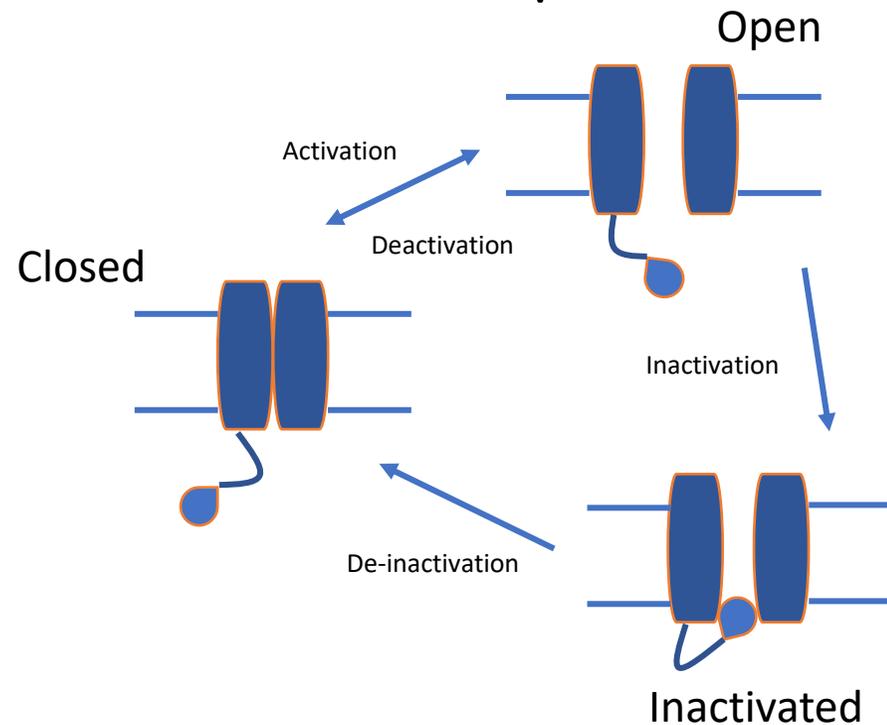
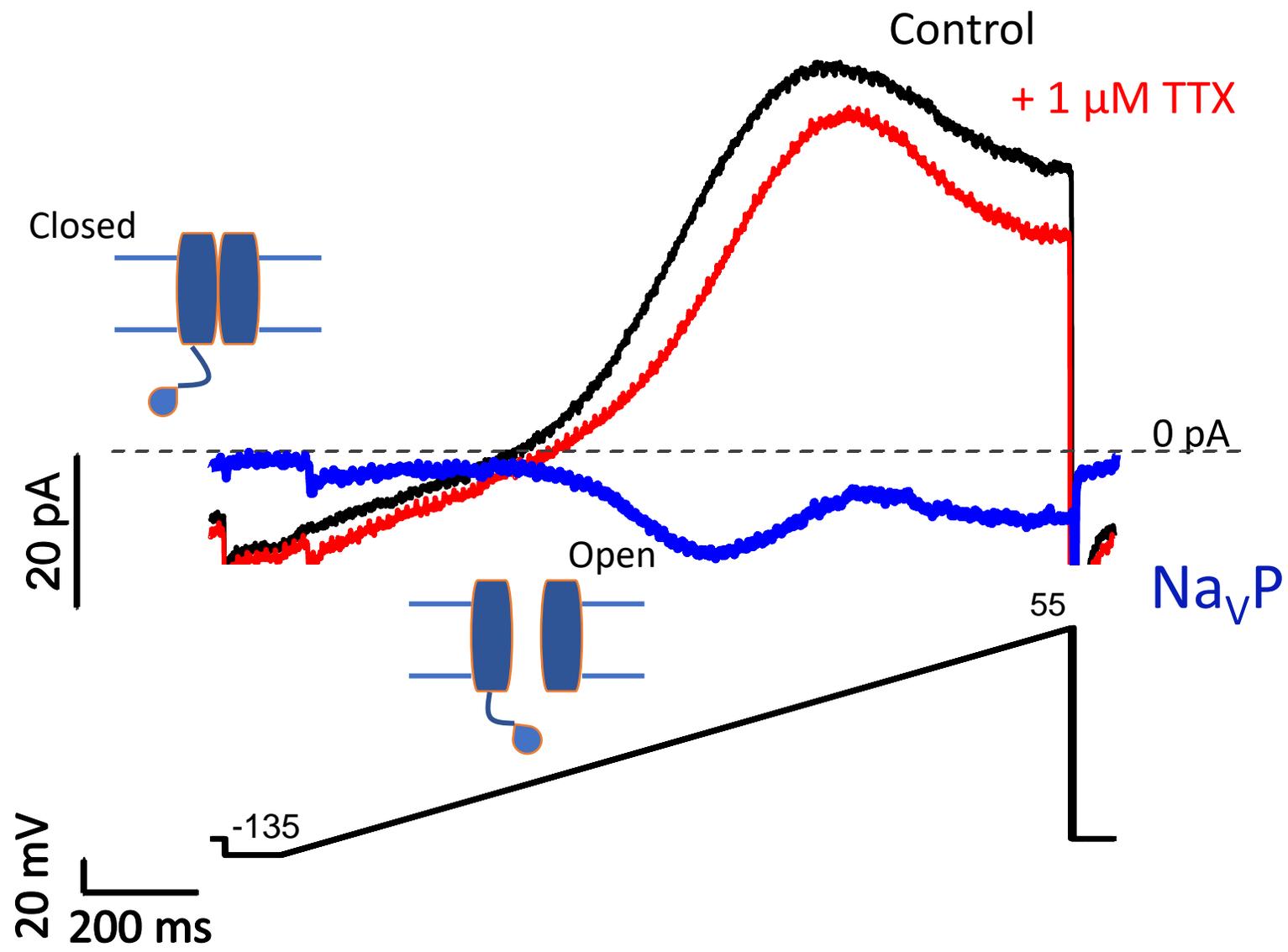


Whole-cell patch clamp electrophysiology

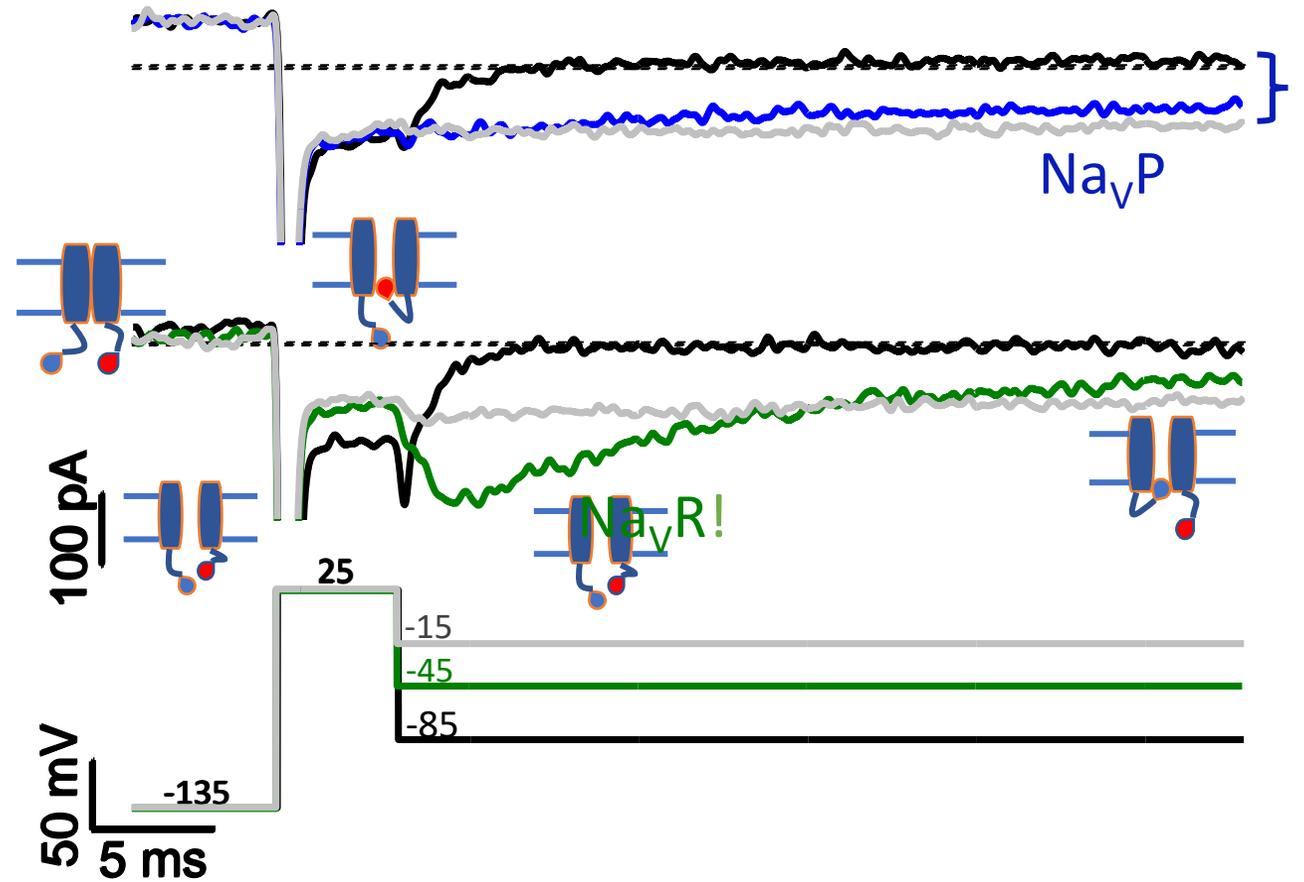
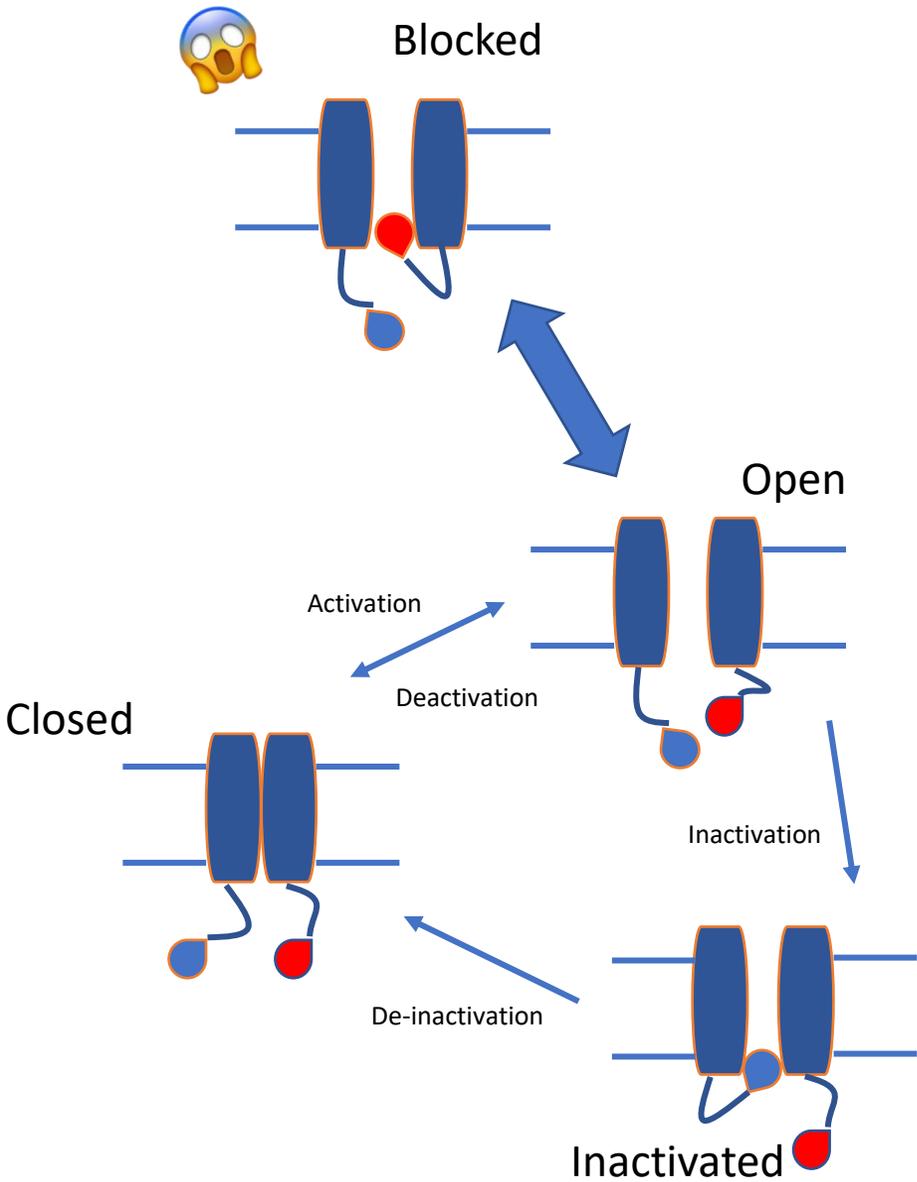


Design:
-Sodium current blocker (**TTX**, **4,9-ah-TTX**) to isolate currents for analysis

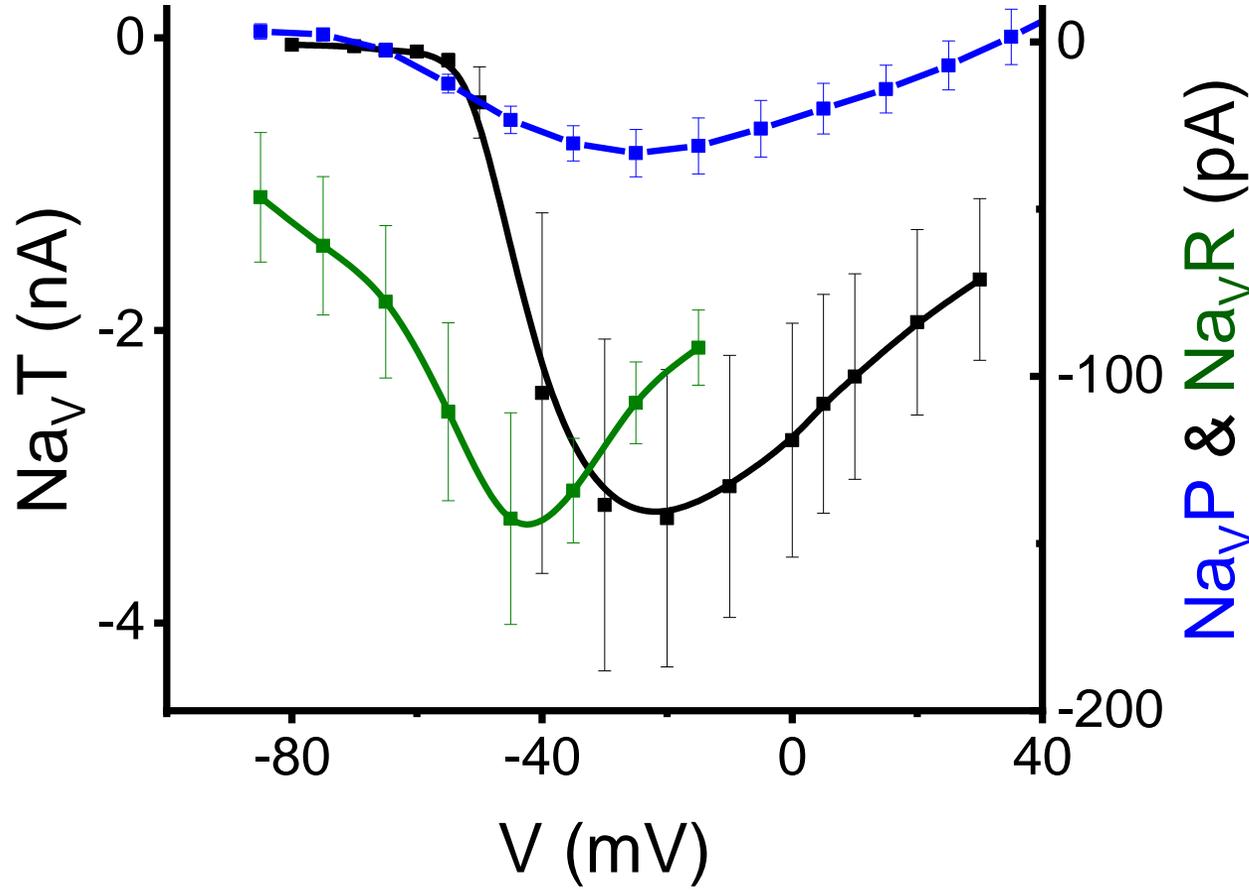
Some VGN show persistent Na_V currents



Some VGN show resurgent Na_v currents

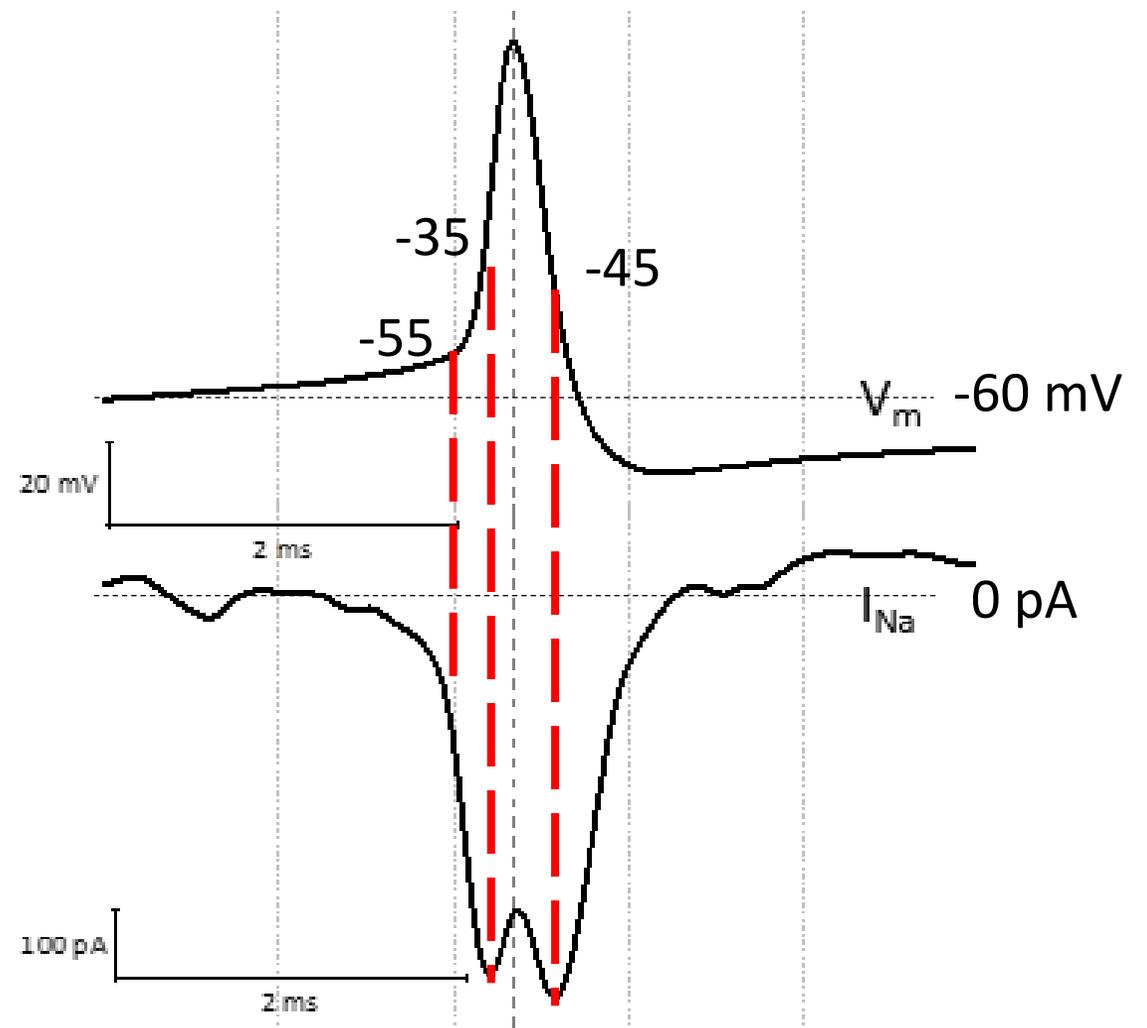


—■— Na_VR (n=5) —■— Na_VP (n=13) —■— Na_VT (n = 8)

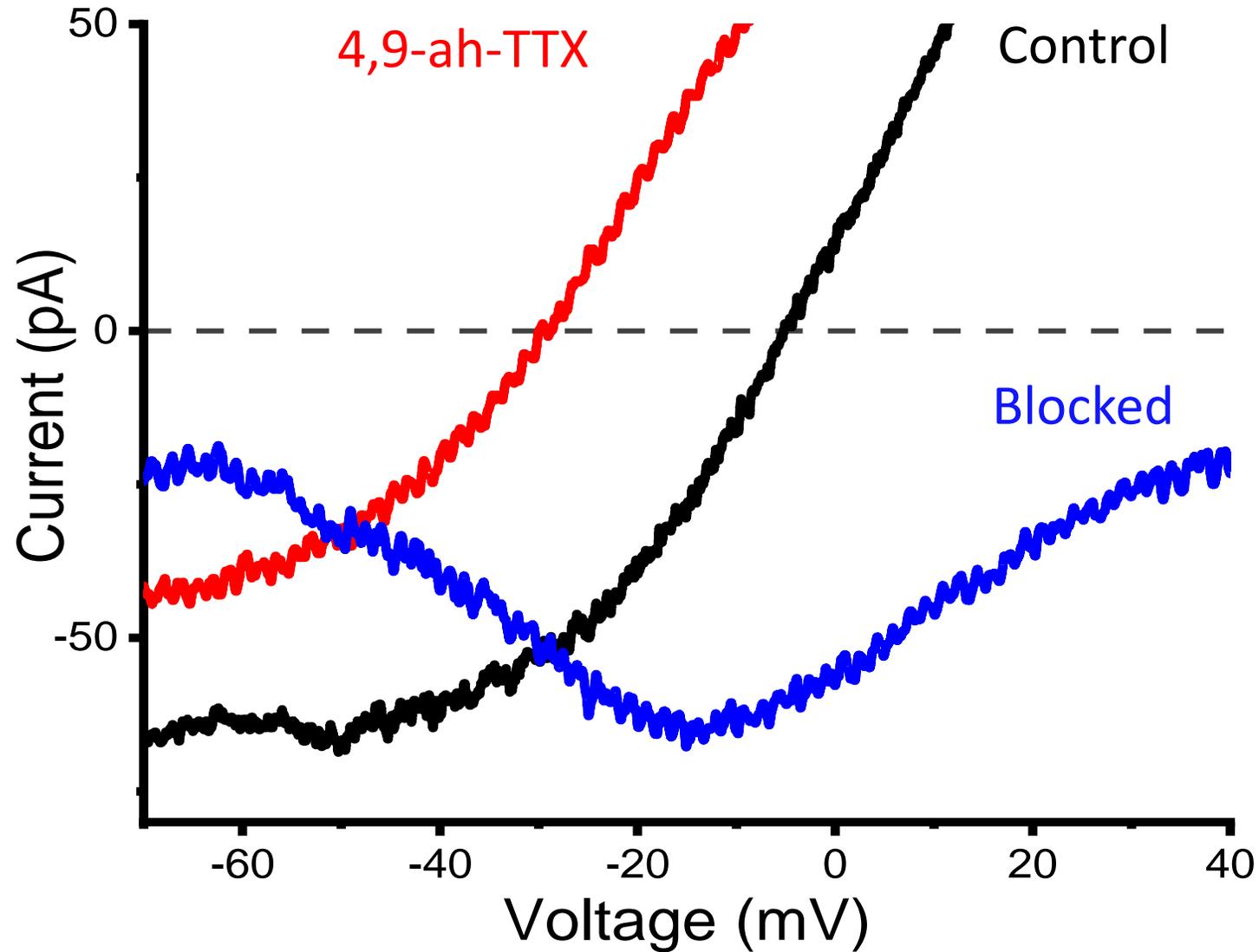


Voltage range of activation:

Subthreshold currents are significant near AP threshold, and may affect neuronal excitability.



Na_vP is blocked by Na_v1.6 blocker, 4,9-ah-TTX



Non-inactivating inward current is blocked by 4,9-ah-TTX, suggesting persistent sodium current is being carried through Na_v1.6 channels.

Do VGN express persistent or resurgent sodium currents?

Yes, they can.

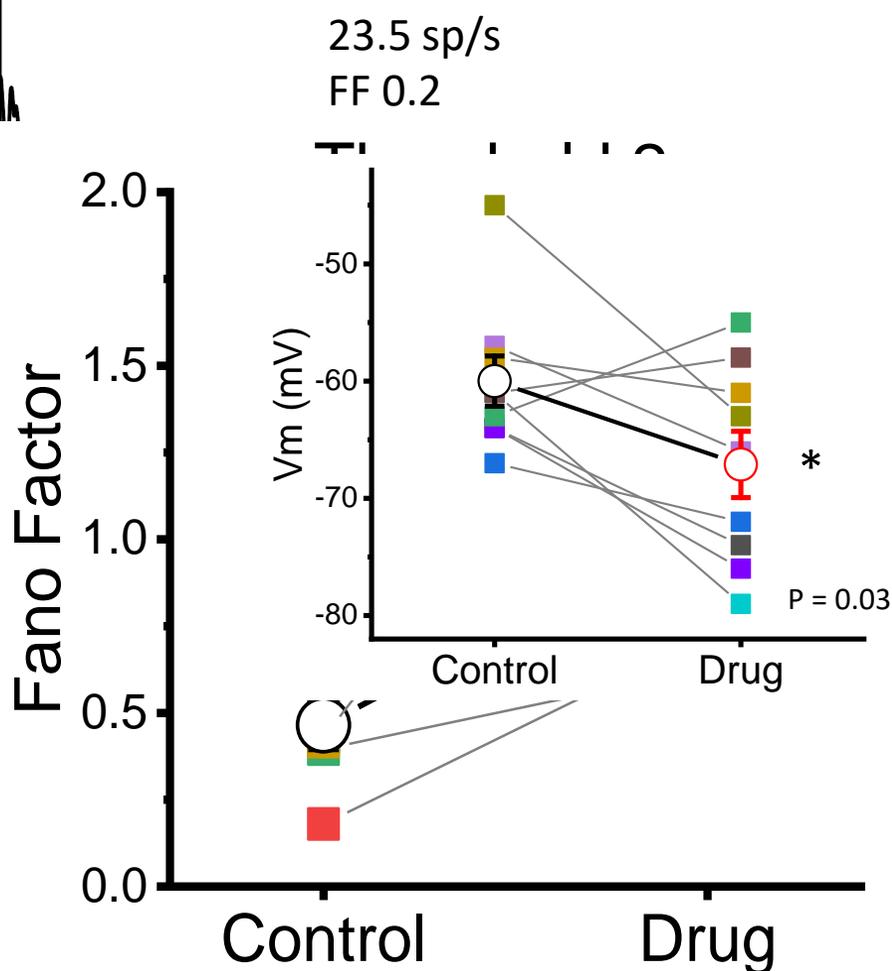
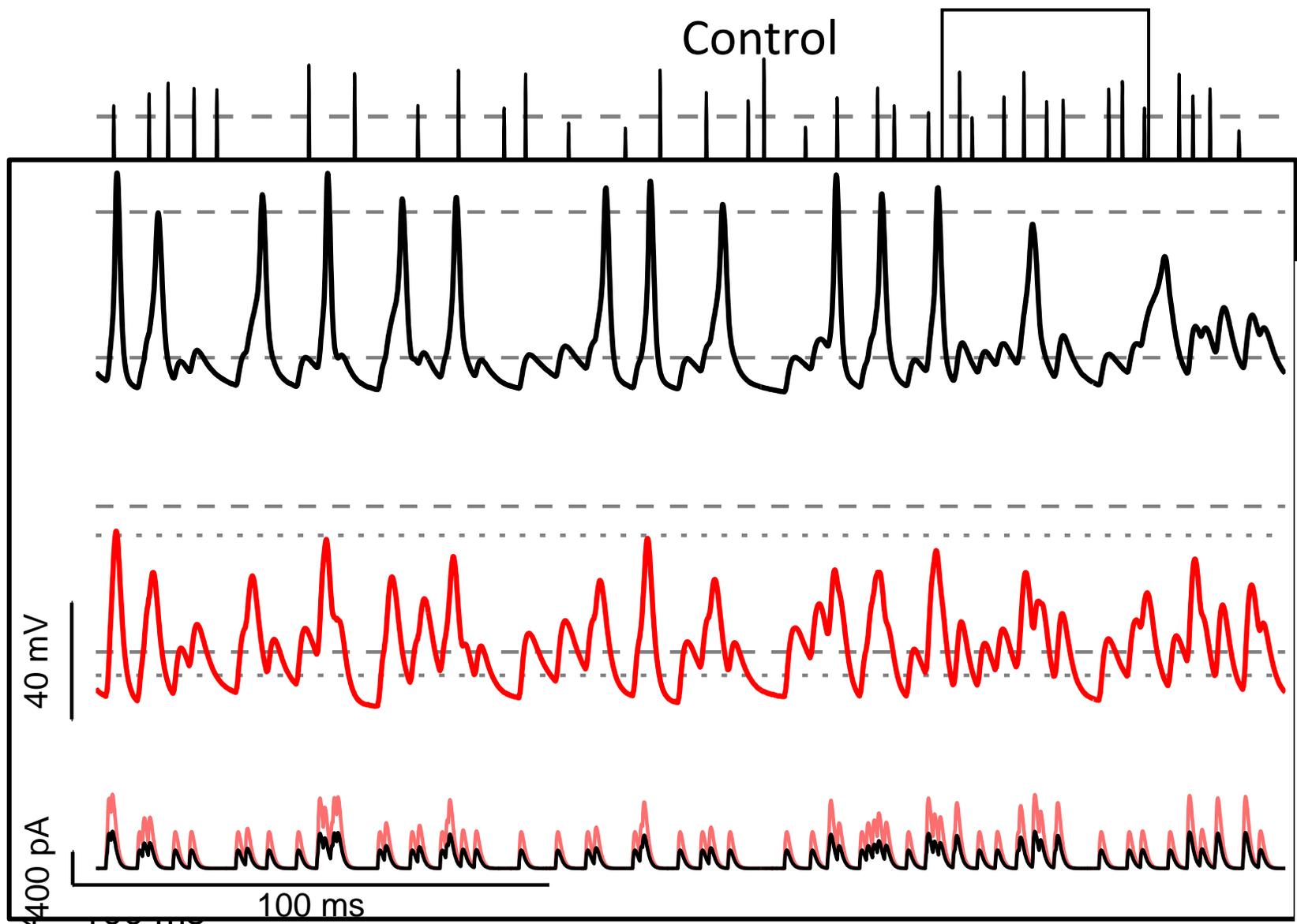
What channels are they carried by?

Na_vP is likely carried by $\text{Na}_v1.6$

How do they influence spiking behaviors?

Evoking AP trains with pseudo-EPSCs shows change in regularity

In individual neurons, CV tends to vary according to background discharge or stimulus conditions. FF is a measure that is less influenced by such variations.



Do VGN express persistent or resurgent sodium currents?

Yes, they can.

What channels are they carried by?

Na_vP is likely carried by $\text{Na}_v1.6$

How do they influence spiking behaviors?

They may impact spiking excitability and regularity at high firing rates.

Questions?



Acknowledgements:

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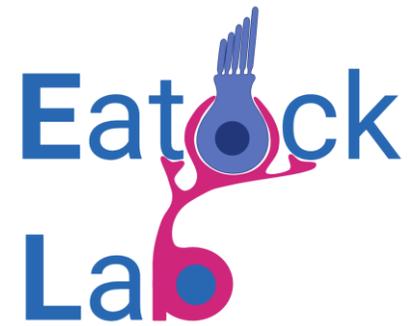
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Mi familia 🌵

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Initiative for Maximizing Student Development

(IMSD)



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