Transport of two types of organelles in *Drosophila* neurons in culture and *in vivo*

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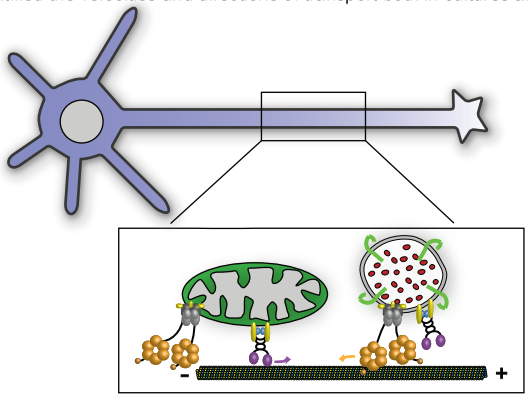
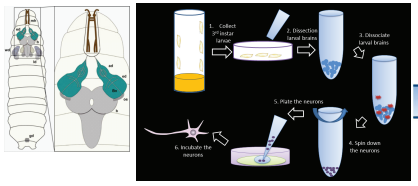
Abstract

Neurons are the core components of animal nervous system. They are the most polarized cells with long processes (axons and dendrites) in the animal bodies. Transport of specific cargoes into the longest process, the axon, is highly regulated. Misregulation of axonal cargo trafficking is linked to multiple neurodegenerative diseases. Microtubules serve as the tracks for cargo transport and microtubule motor proteins are ATPases that carry various cargoes along microtubule tracks in highly polarized neurons. In this laboratory, we employed genetic tools to apply fluorescent markers to two types of neuronal cargoes, axonal-specific synaptic vesicles and general cargo, mitochondria, and study their transport in cultured neurons and motor neurons in live *Drosophila* larvae. We used fluorescent total internal reflection (TIRF) microscopy and confocal scanning microscopy to examine transport in the axons, and quantified the velocities and directions of transport both in cultures and in vivo.

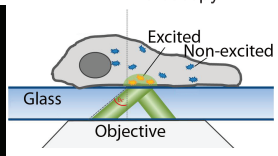


Methods

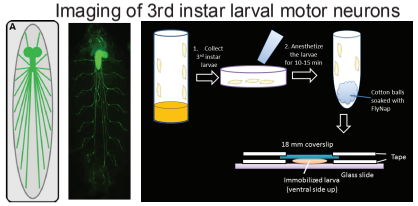
Culture of 3rd instar larval brain neurons



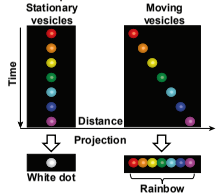
TIRF microscopy



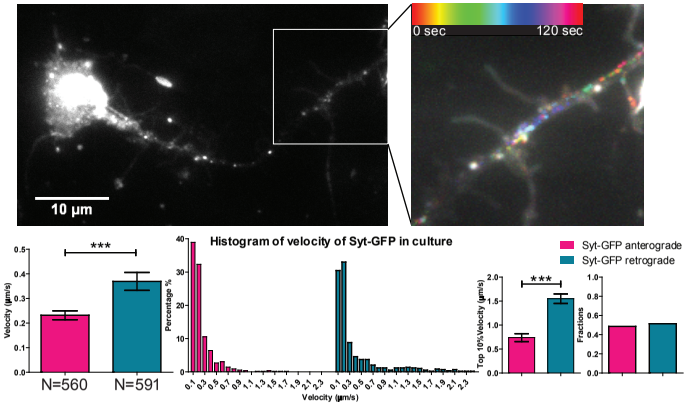
Imaging of 3rd instar larval motor neurons



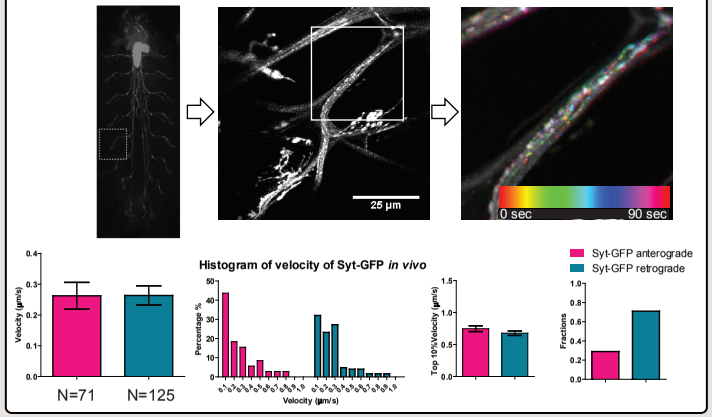
Temporal-color code



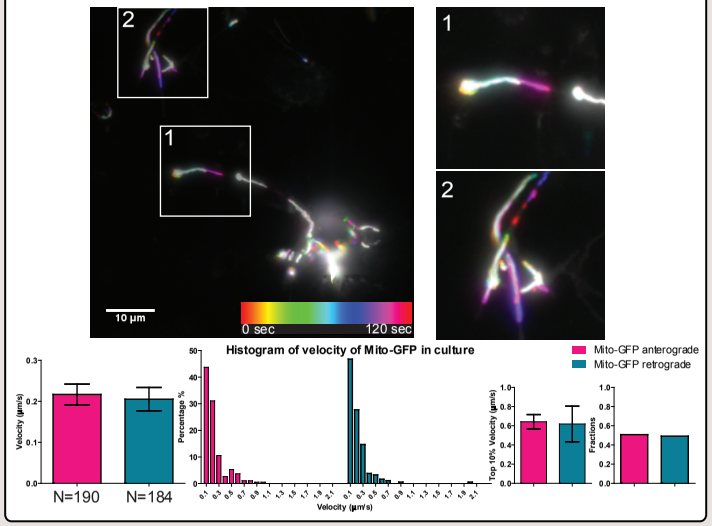
Transport of synaptic vesicles in culture



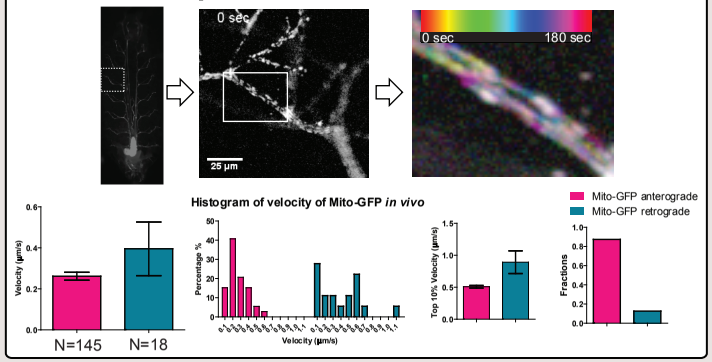
Transport of synaptic vesicles *in vivo*



Transport of mitochondria in culture



Transport of mitochondria *in vivo*



Conclusions:

Based on our quantification data, we found that:

(1) in culture synaptic vesicles enter all processes, suggesting that some factor(s) for axonal/dendritic differentiation are lacking in vitro;

(2) both organelle types move bidirectionally, in neurites both in culture and in vivo, suggesting that they have both plus-end and minus-end motors attached at the same time;

(3) in culture the retrograde velocities of synaptic vesicles are higher than in vivo, suggesting that the in culture some regulation factor of synaptic vesicle retrograde transport is missing;

(4) surprisingly in vivo more synaptic vesicles move retrogradely than anterogradely.

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