Neural Pathways of UV and IR Avoidance in *C. elegans*

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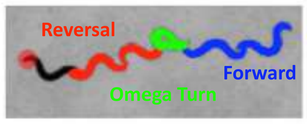
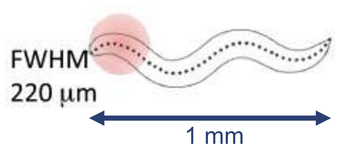
ABSTRACT

- *C. elegans* is a model organism for neuroscience based on its sensory network of only 302 neurons.
- Light stimulation by laser induces avoidance behavior. When stimulated, it immediately reverses (red), makes an omega-shaped U-turn (green), and continues moving forward (blue) (See figure below).
- Past research shows that both blue light (405 nm) and infrared light (1490 nm) induce a response in *C. elegans*.
- However, there is a notable time delay when comparing stimuli. *C. elegans* takes about 1 second to respond to blue light, but only about 0.25 seconds to respond to infrared light.
- We hypothesize that this discrepancy is due to a discrete difference in the number of chemical synapses for each neural circuit.





BACKGROUND

Past research has shown that *C. elegans*' response time shortens as intensity increases, for both blue light (Figure a) and infrared light (Figure C).

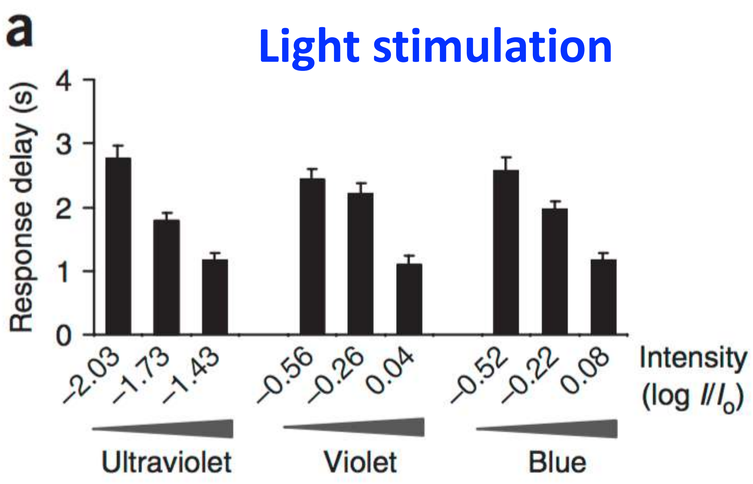


Figure a. At the highest intensity, it takes about 1 second for *C. elegans* to respond to blue light.

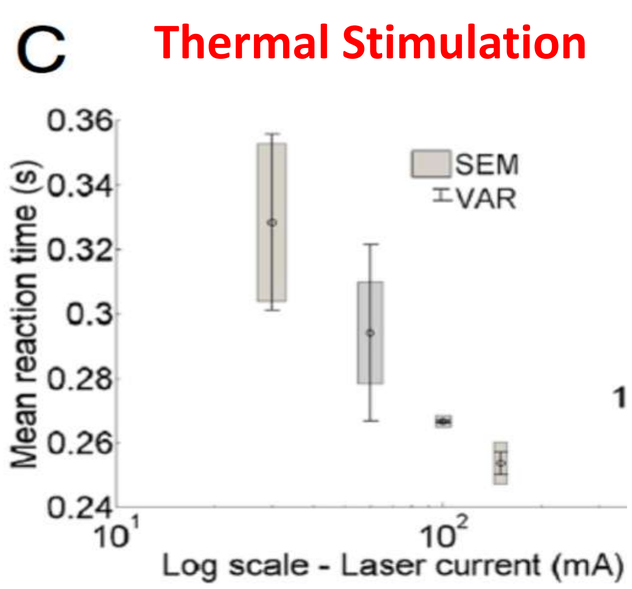
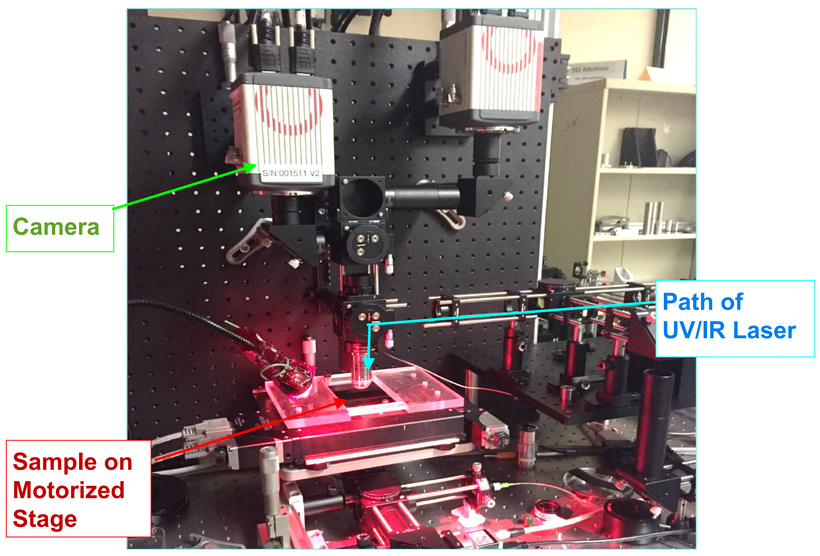


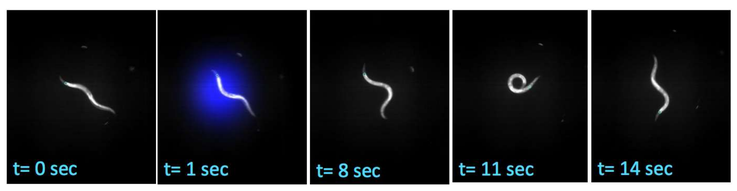
Figure C. At the highest intensity, it takes about 0.25 seconds for *C. elegans* to respond to a head-applied infrared laser stimulus.

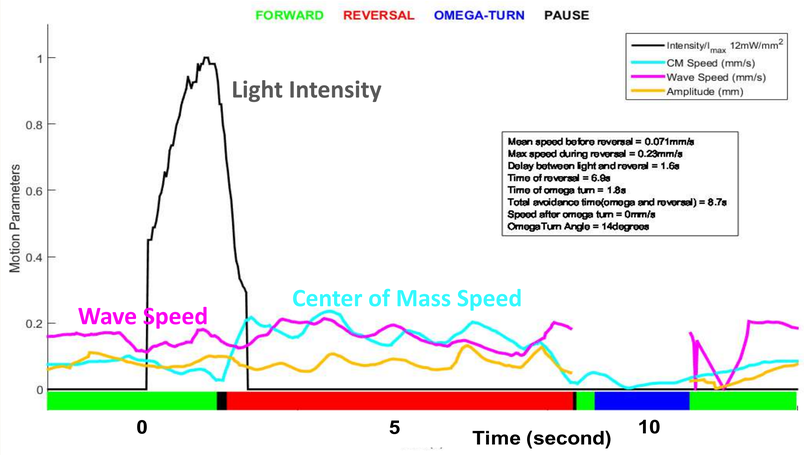
MATERIALS & METHODS



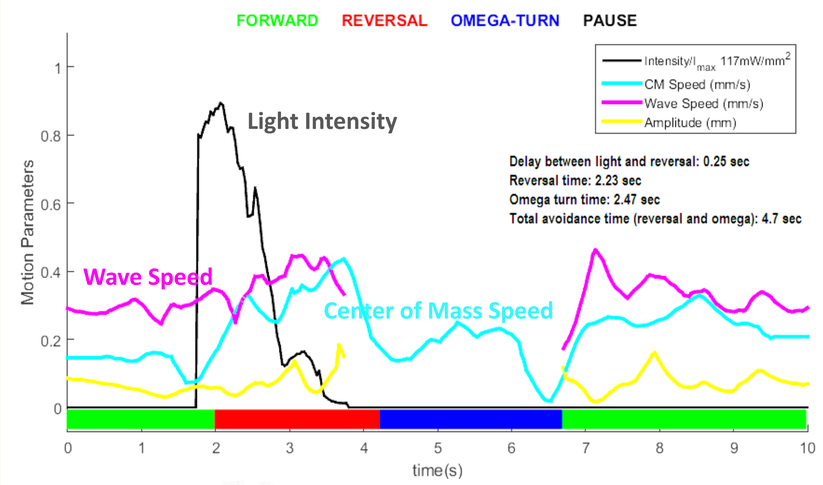
RESULTS

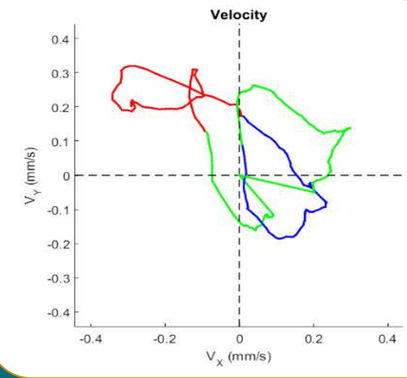
Response to Blue Light (405 nm), 2% Gelatin Medium





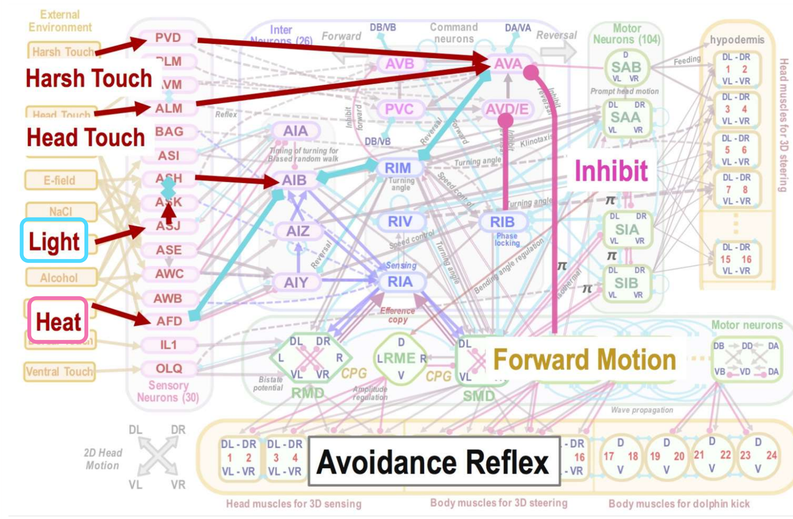
Response to Infrared Light (1490 nm), 2% Gelatin Medium





Laser Calibration Data
- Blue Light: 11 mA of current
- Infrared: 300 mA of current
- 2 second long pulses

OUR MODEL



Each red arrow represents a chemical synapse, which takes ~0.25 seconds to transmit a signal.
Each blue segment represents a gap junction, which acts on an order of milliseconds to transmit a signal.

- According to our model, if we compare the pathways prior to the AIB neuron, after which the pathways are the same, we see that the former has three chemical synapses, while the latter only has one.
- Specifically, the blue light pathway has three chemical synapses and two gap junctions, while the IR pathway has one chemical synapse and one gap junction.
- If we consider the milliseconds associated with the gap junctions as negligible, and add the time required to cross each chemical synapse, then the time required for a light response (~0.25 x 3) versus heat (~0.25 x 1) matches our observed results.

DISCUSSION & FUTURE DIRECTIONS

- Our next step is to observe all 302 neurons under a line confocal microscope in order to confirm our model.
- Using the worm strain QW1217, activated neurons will flash when the worm is stimulated. Through careful analysis, we will be able to track which neurons are firing, and the order they fire in.

REFERENCES

- Ghosh, R., Mohammadi, A., Kruglyak, L., and Ryu, W. S. (2012, October 31). *Multiparameter behavioral profiling reveals distinct thermal response regimes in* Caenorhabditis elegans. Retrieved from https://bmcbiol.biomedcentral.com/articles/10.1186/1741-7007-10-85.
- Mohammadi, A., Rodgers, J. B., Kotera, I., and Ryu, W. S. (2013, July 3). *Behavioral response of* Caenorhabditis elegansto *localized thermal stimuli.* Retrieved from https://bmcneurosci.biomedcentral.com/articles/10.1186/1471-2202-14-66.
- Ward, A., Liu, J., Feng, Z., and Xu, S. (2008, July 6). *Light-sensitive neurons and channels mediate phototaxis in* C. elegans. Retrieved from http://www.nature.com/neuro/journal/v11/n8/full/nn.2155.html.

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