Perception of Motion in *C. elegans* Influence on Avoidance Behavior

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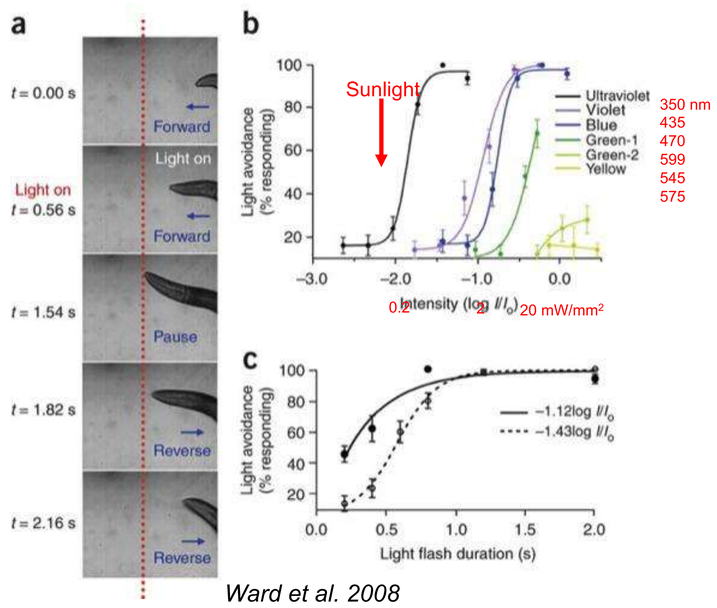
ABSTRACT

- The Central Pattern Generator (CPG) determines self-regulation of motion, but the mechanisms behind different behaviors is not well understood.
- *C. elegans* is our model organism of choice to gain a greater understanding of CPG due to its awareness of its own motion and its simple neural network of 302 neurons.
- We hypothesize that, at higher wave speeds, *C. elegans* escape reflex will be inhibited due to their perception of their own motion as faster.
- We use 405 nm blue light stimulation to induce their phototactic avoidance reflex. We change the gelatin concentration of their environment between 1-4% to artificially alter their wave speed. In lower gelatin concentrations, their wave speed increases. In higher gelatin concentrations, their wave speed is decreased.

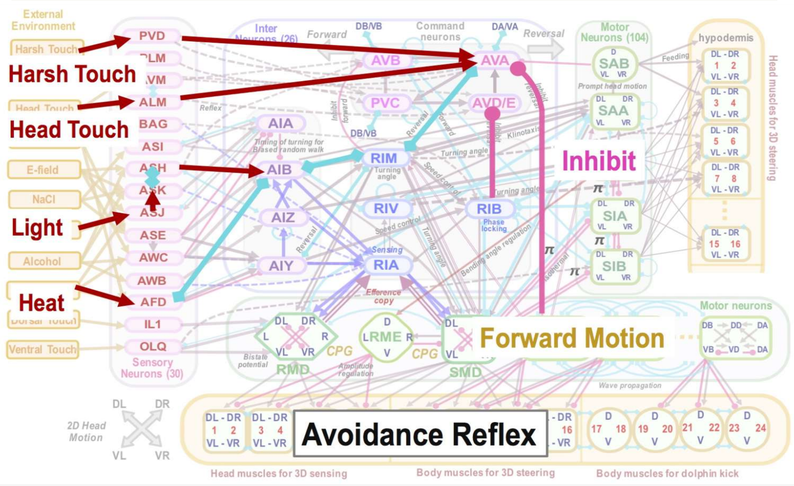
INTRODUCTION

- *C. elegans* is a model organism for studying neural networks and sensory systems
- They exhibit light sensitivity and avoidance response towards violet (435 +/- 10 nm) and blue light (470 +/- 20 nm)[3]
- Main neuron for study of this phototaxis sensitivity is ASJ[2]
- By manipulating environmental condition (such as gelatin concentration), we can study how avoidance behavior changes in response to perceived speed
- Perceived speed and phototaxis behavior is controlled by the CPG



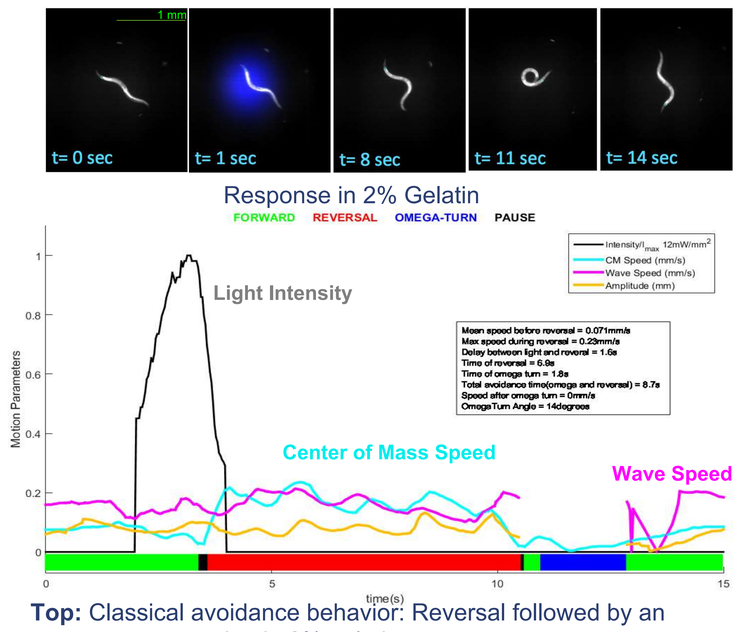
Ward et al. 2008

OUR MODEL

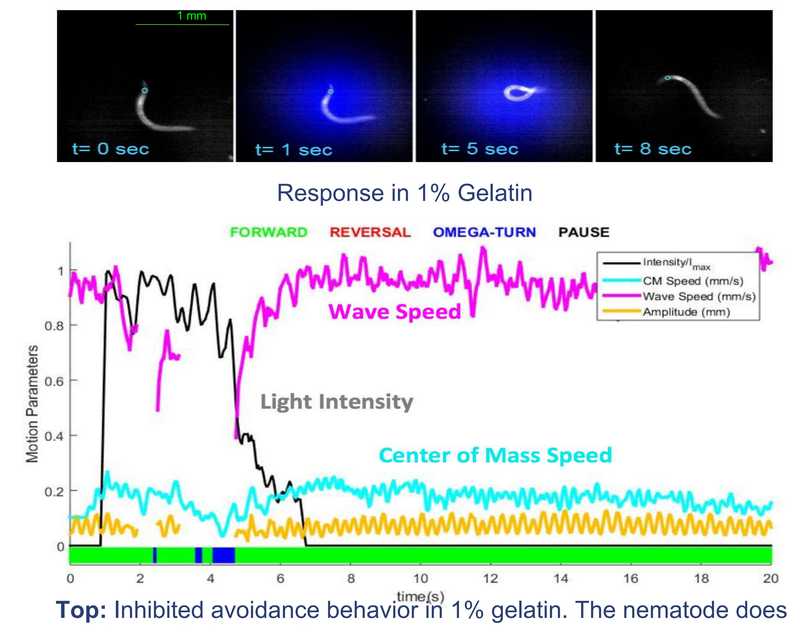


Hypothetical model of the *C. elegans* neural network courtesy of Dr. Katsushi Arisaka. Light stimulation sends a signal beginning with the ASJ neuron and ending at the AVA commander neuron. When uninhibited, the AVA neuron will pass the signal on to induce the avoidance reflex. Forward motion sends an inhibitory signal to the AVA neuron, preventing this reflex.

RESULTS: PHOTOSTIMULATION



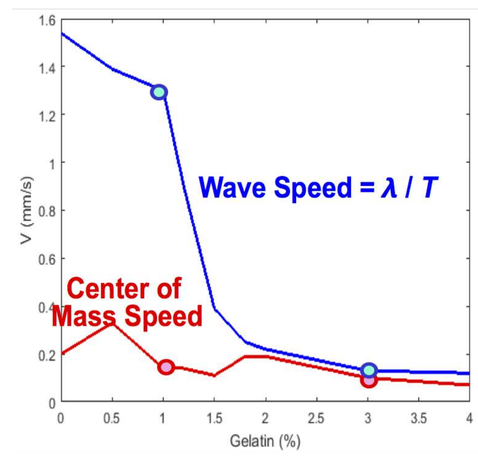
Top: Classical avoidance behavior: Reversal followed by an omega turn occurring in 2% gelatin.
Bottom: MATLAB-generated quantification of photo-induced avoidance behavior in 2% gelatin.



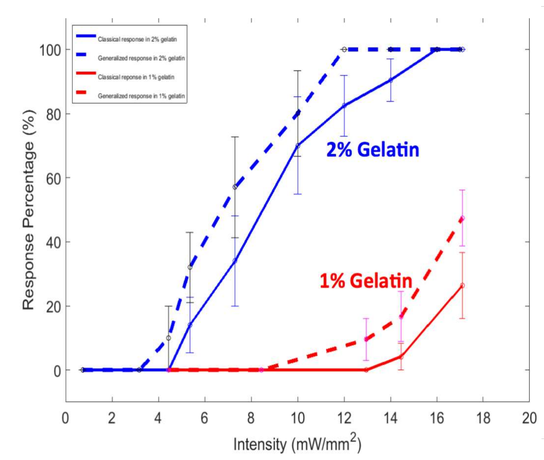
Top: Inhibited avoidance behavior in 1% gelatin. The nematode does not demonstrate a reaction.
Bottom: MATLAB-generated quantification of behavior in 1%. Note the higher wave speed (pink) as compared to the 2% response.

RESULTS: INHIBITION OF AVOIDANCE REFLEX

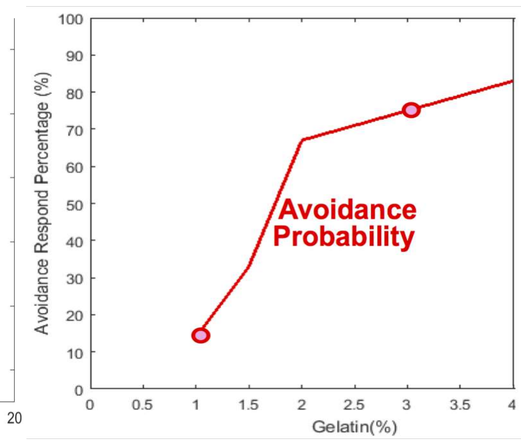
Two Types of Speed vs. Gelatin Concentration



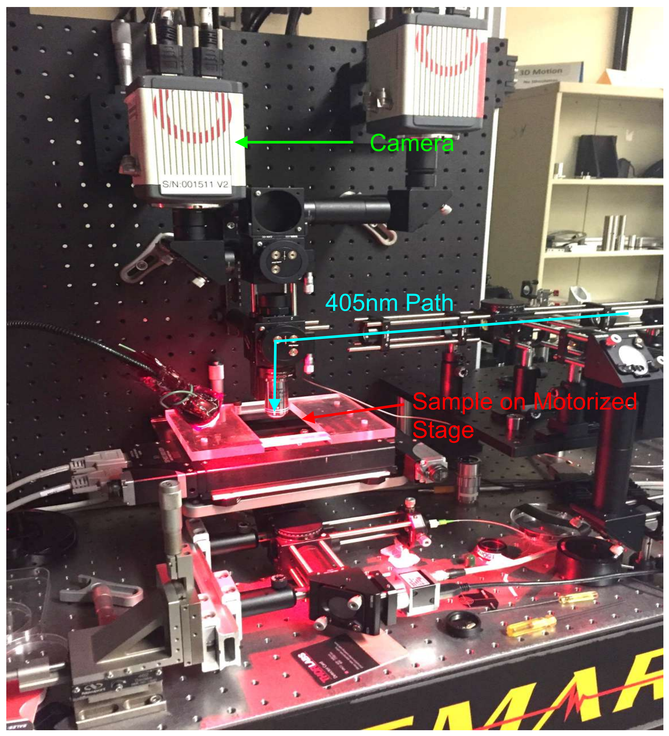
Avoidance Probability vs. Light Intensity



Avoidance Probability vs. Gelatin Concentration



MATERIALS & METHODS



Layout of line-confocal microscope located in Knudsen B-171. Our setup allows for automatic worm tracking using a stationary camera and laser apparatus with a motorized stage. Blue light stimulation can be applied at varying intensities and durations.

CONCLUSIONS

- Frequency of wave motion increases in lower gelatin concentrations, with a drastic increase between 1% and 2%.
- As previous studies demonstrated, higher laser intensity results in a higher rate of response.
- Avoidance response rate decreases in lower gelatin concentrations, which is concurrent with increases in wave speed.
- Worms perceive their motion by the clock speed of the CPG, not by the physical speed of the center of mass.
- Altogether, this data indicates that the CPG is the origin of awareness of motion in neural netwokrs.

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