Decision Making Process Under Multiple Sensory Stimuli

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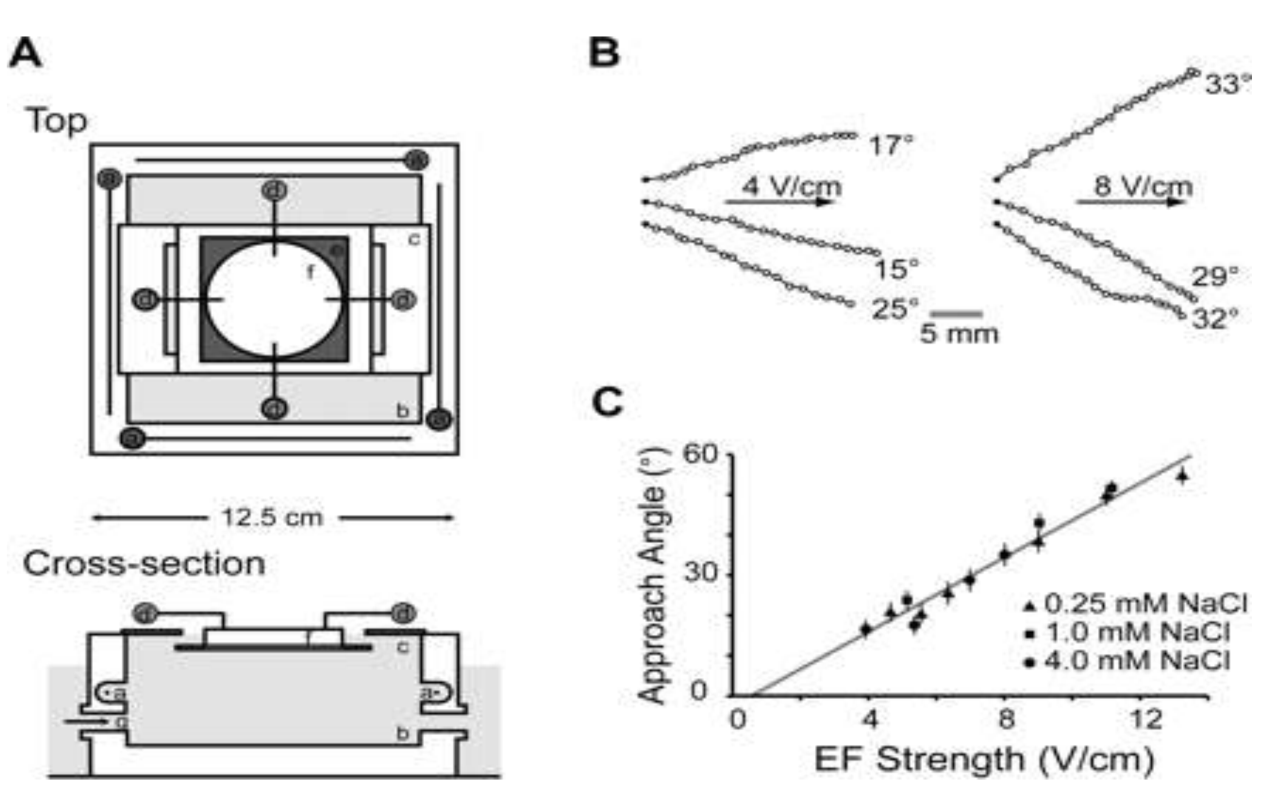
ABSTRACT

The ability to sense and react to environmental stimuli is essential for survival. This experiment seeks to compare the behavior of C. elegans in response to competing stimuli routed through the same known neuronal circuits, namely through the ASJ neuron. The described neuronal pathway through which C. elegans process stimulation by light is known as an avoidance response--omega turns and reversals--in response to photostimulation (Ward et al. 2008). Additionally, via analysis of electrosensory behavior under varying electric field strength, C. elegans were observed to migrate towards the negative pole at angles that increased with higher strength in electric fields (Gabel et al. 2007). Blue light and electric field are two such sensory stimuli processed by the ASJ neuron. Movement towards the negative pole of an electric field and reversal followed by omega turn after specific-wavelength light exposure are observable behavioral patterns expected as a result of multiple stimulations. Furthermore, this experiment seeks to compare the decision making behavior of the C. elegans in response to these stimuli when presented simultaneously in order to establish a potential model for consciousness. Preliminary results suggest electric stimulation may inhibit posterior motor function, preventing the C. elegans from performing reversals. In combination with the effects of blue light, we expect the C. elegans to freeze in place. This experiment seeks to qualify the effects of combining photostimulation with electric field stimulation.

INTRODUCTION



Gabel et al. (2007) analyzed the movements of individual C. elegans under varying electric field strengths to quantify electrosensory behavior

- C. elegans were observed to migrate towards the negative pole of the electric field at angles that increased with higher strength electric fields

Ward et al. (2008) described the neuronal pathway through which C. elegans process stimulation by light

- C. elegans executed known avoidance behaviors (omega turns and reversals) in response to photostimulation

HYPOTHESES

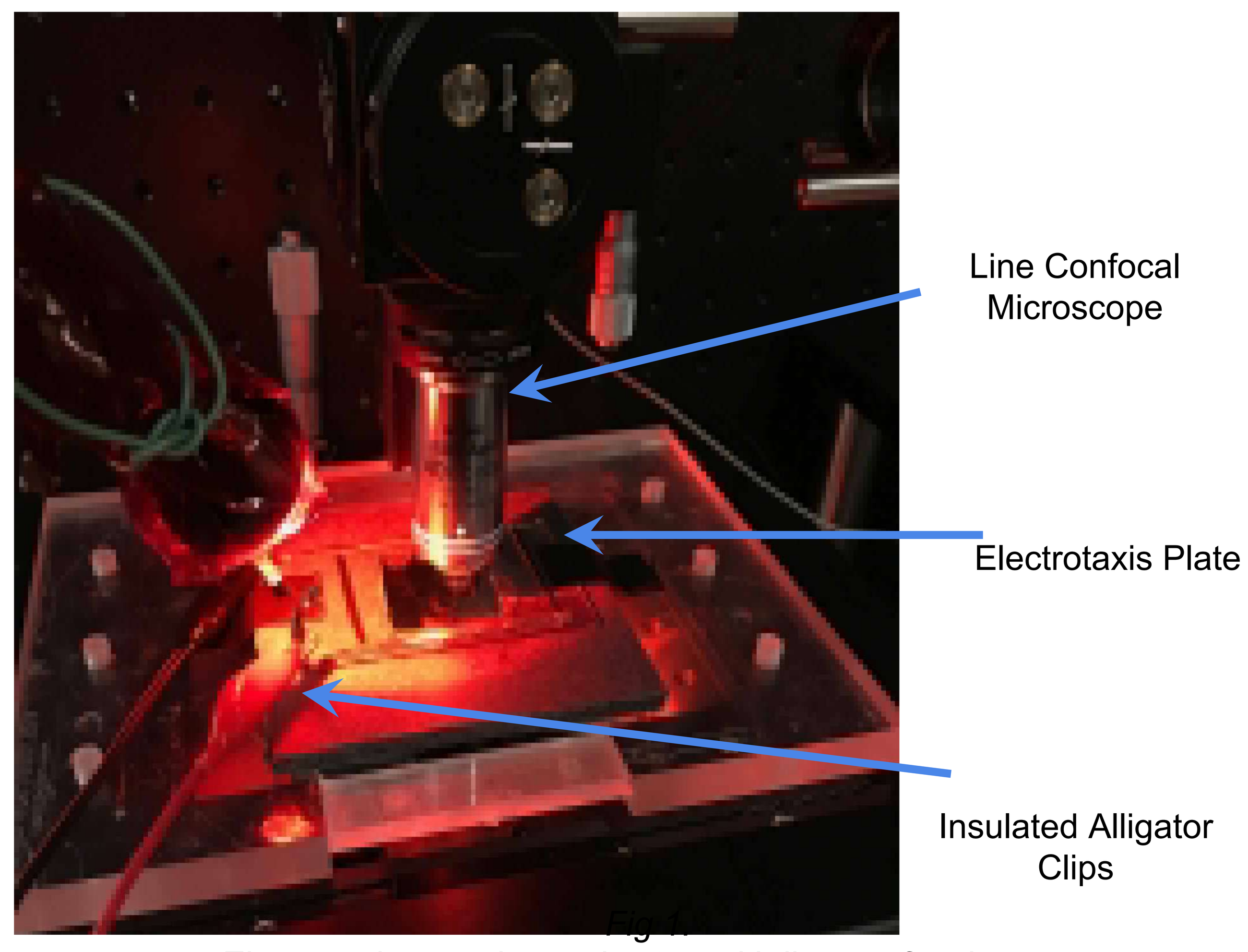
Hypothesis 1: Omega Turns

- Omega turns often observed in free motion, expect overall time spent in omega turns to decrease under electric field stimulation and not occur under blue light stimulation

Hypothesis 2: Speed and Fluency of Motion

- Worms expected to be at a consistent angle towards negative pole when under electric field.
- Expect halting of motion when combined with blue light due to paralyzed bottom half of worm and inability to perform omega turn

EXPERIMENTAL SET-UP



Electrotaxis experimental setup with line confocal on top

- *30 fps*
- *270 mmpp*
- *1020 px * 1020 px*

PROCEDURAL APPROACH

Procedure

- Culture healthy N2 worms on agar plate
- Pick L4 worms from agar plate and put onto 2% gelatin solution on copper wired plate
- Place the plate in a 15° C incubator for approximately 10 to 15 minutes
- After gelatin has properly solidified, place the plate under microscope and find the respective worms in the gelatin
- When a worm is chosen, start the tracking software on the worm
- Track free motion for ~15 seconds, then turn on electric field for 30 seconds, with blue light laser shot at worm for 1.5 seconds
- After experiment is ran, analyze the results within the Image J data software

RESULTS

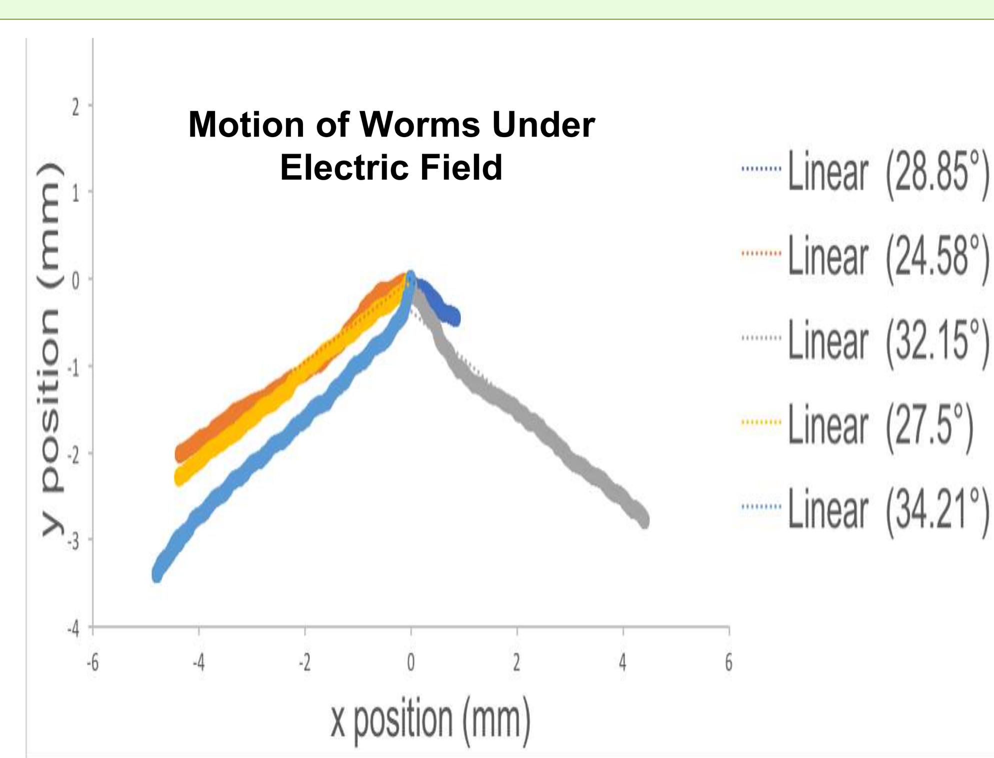
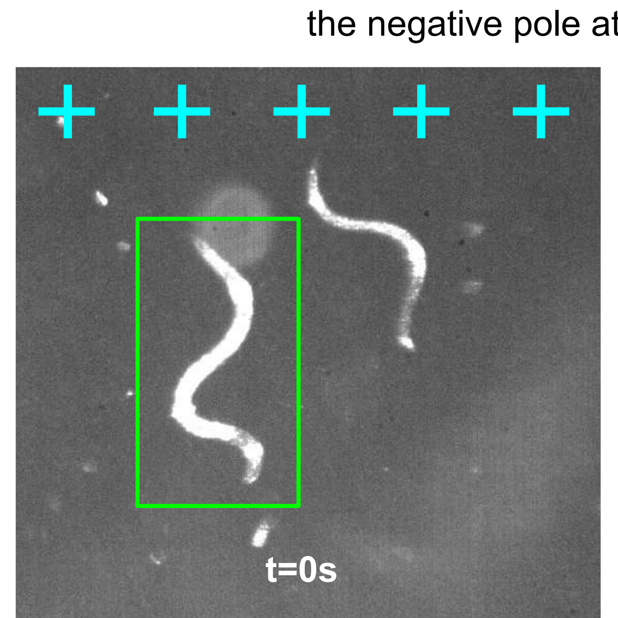
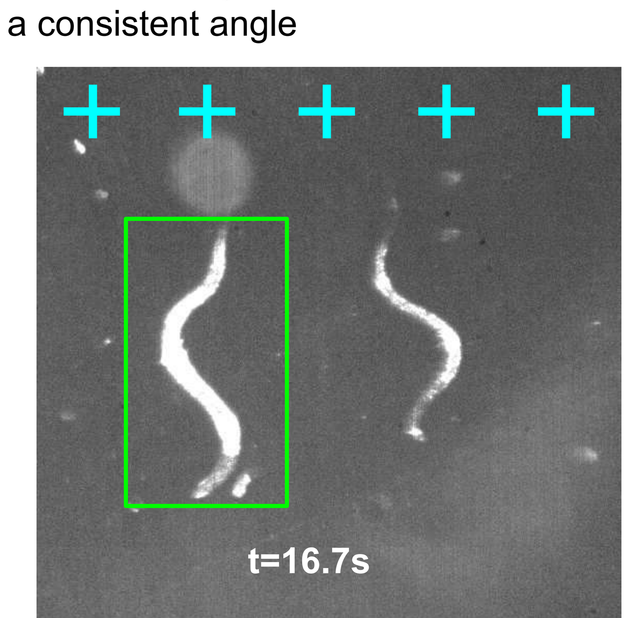


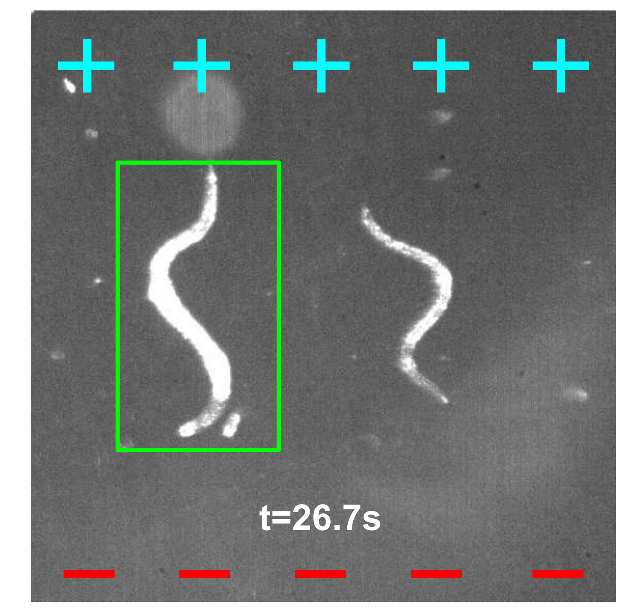
Fig 2.
Worms under 8-9V/cm electric field show migration towards the negative pole at a consistent angle



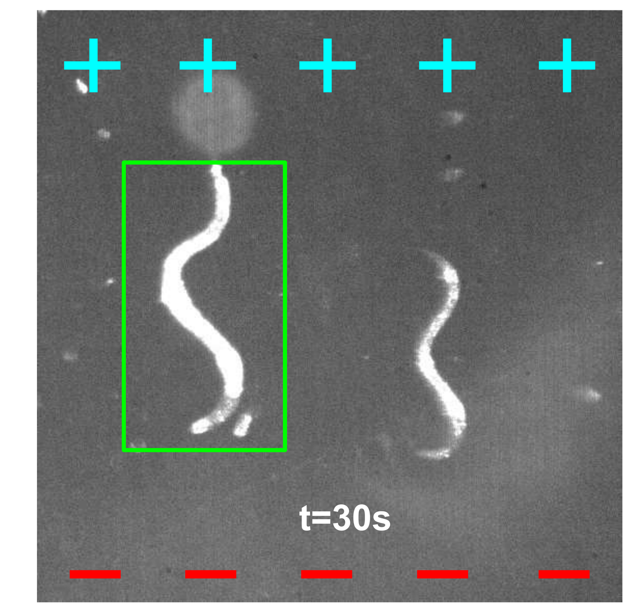
Motion toward negative pole under electric field (8-9 V/cm)



Blue light begins



Blue light continues and worm shows paralysis in movement



Worm continues to show paralyzed behavior

DISCUSSIONS & CONCLUSIONS

- With just the electric field stimulus, worms gravitate towards the negative pole, which is consistent with the results of Gabel (2007).
- Introducing a blue light, stimulus that induces reversal, in conjunction with the electric field paralysis of lower bottom half causes paralysis of worm
- We observed cases where worm paralysis occurred with introduction of both photostimulation (blue light) and electric field stimulation, but more trials need to be ran for greater confirmation.

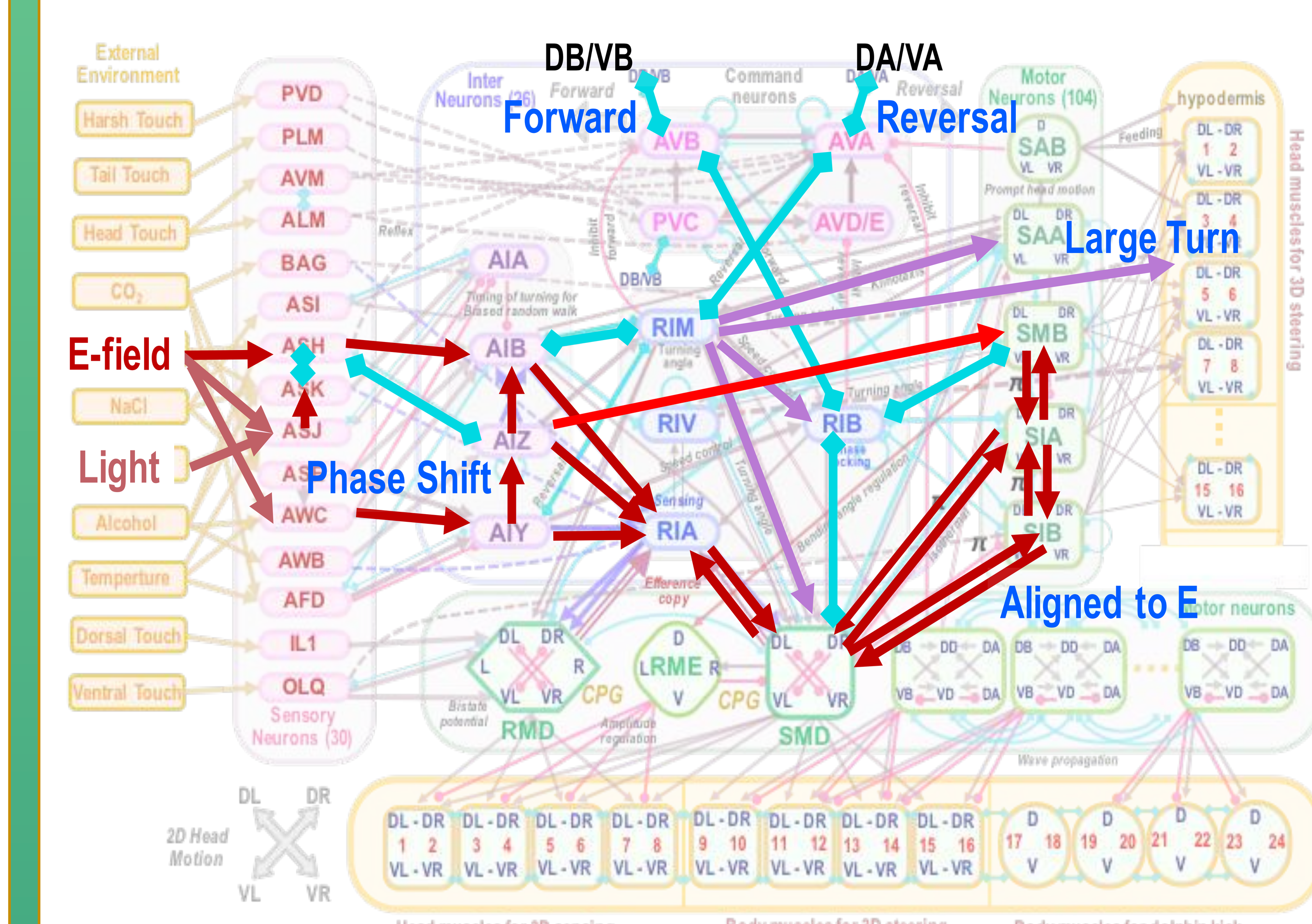


Fig 3.
Possible explanation for worms' damped sine wave oscillation and consistent angle towards negative pole

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