Observing Developmental Stages Under Electrotaxis

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ABSTRACT

- Caenorhabditis elegans are small, soil-dwelling nematodes often used as model organisms in neuroscience research to gain a deeper insight into the neural pathways of more complex organisms.
- Our research delves into the schematic of motor development under an electric field stimulus within the developmental stages of C. elegans.
- Past experiments established that, in adults with fully-developed muscles, ASJ neurons are responsible for the sensory perception of an electric field
  - Experimentally observed the C. elegans to migrate towards the negative pole at angles that increased proprotionally to electric field strength, looking specifically at the motor development through different larval stages (L1 and adult)
  - L1 C. elegans are expected to exhibit little to no bias under an electric field as a result of their underdeveloped muscles, whereas the adult C. elegans continue to exhibit their normal behavior under an electric field (Gabet et al. 2007).
- By closely examining L1 and adult C. elegans under an electric field stimulus, we argue that muscular development is essential for observing behavioral responses under an electric field stimulus. This project sheds light on the rarely acknowledged issue of motor development through substantially different life stages within the nematode.

INTRODUCTION

- C. elegans is a soil-dwelling nematode that goes through several different stages of development in its life cycle.
- Previous findings in the Arisaka Lab have shown that adult C. elegans demonstrate a preference for the negative pole under an electric field
- An adult C. elegans has 302 neurons, but 80 of these (mostly motor neurons) are formed after hatching, in the L1 and L2 stages of development.

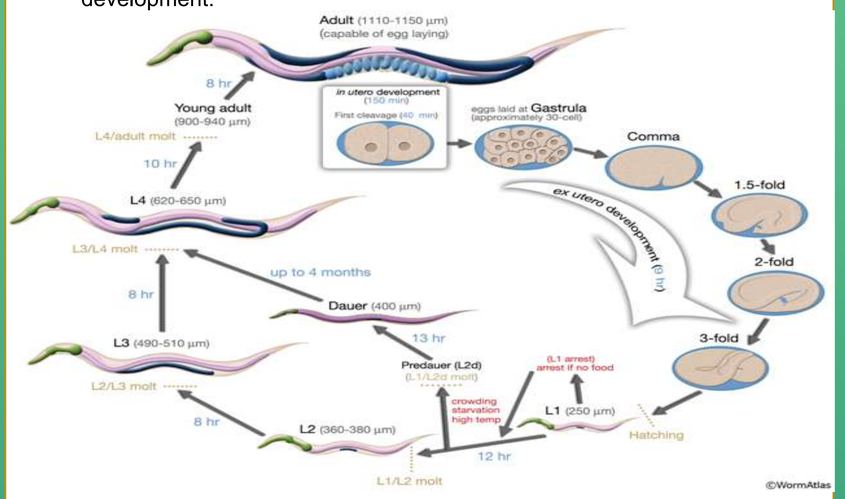


Fig. 1.
Developmental cycle for C. elegans with the corresponding time period and approximate body length for each stage.

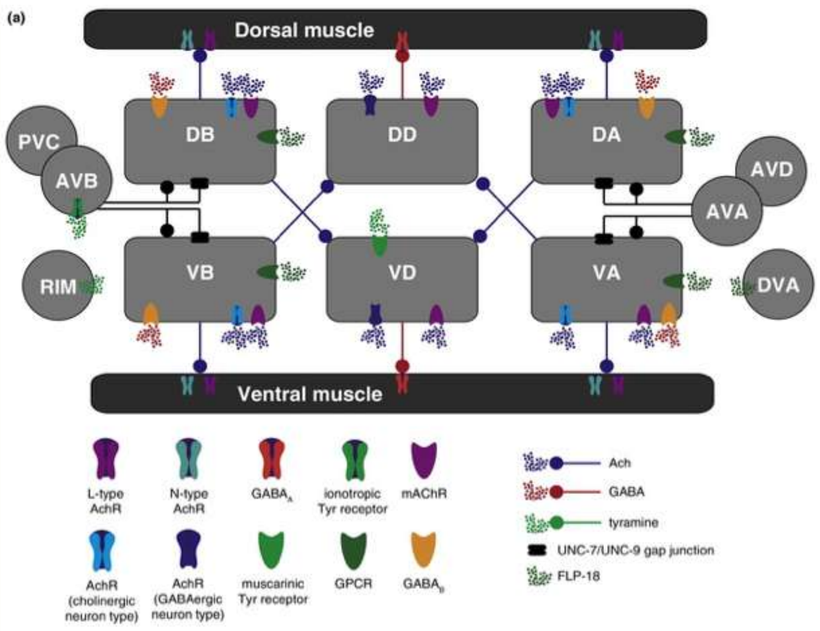


Fig. 2.
Dynamic connectome of motor neurons and muscles in C. elegans

EXPERIMENTAL SET-UP

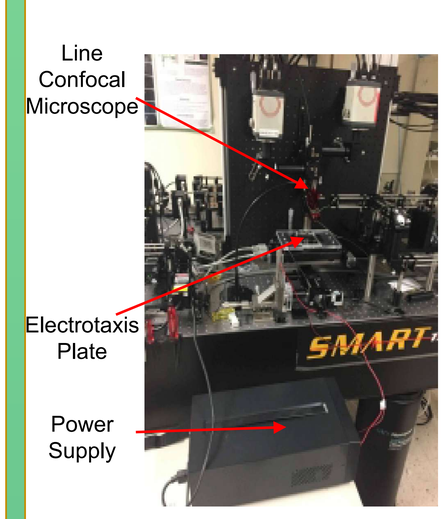


Fig 3.
Electrotaxis experimental setup with line confocal on top

Field of view:
(confirmed later)
Resolution:
*1020px * 1020px*

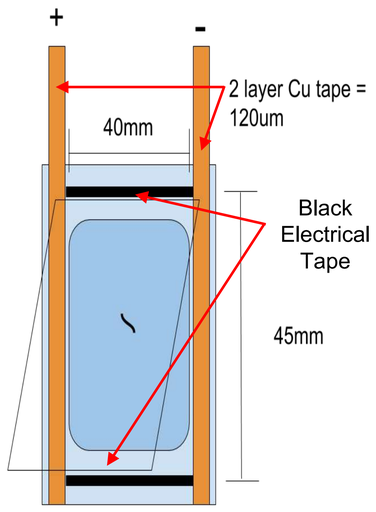


Fig 4.
2-dimensional gelatin medium electrotaxis set-up

Utilized to observe the C. elegans migrating towards the negative pole

METHODS

- N≥10 healthy L1 and adult C. elegans placed on gelatin plate following 30 minutes of starvation
- Gelatin plate situated on worm tracker
- Trials conducted between 8-9V/cm
- Results analyzed with MATLAB and Image J

RESULTS

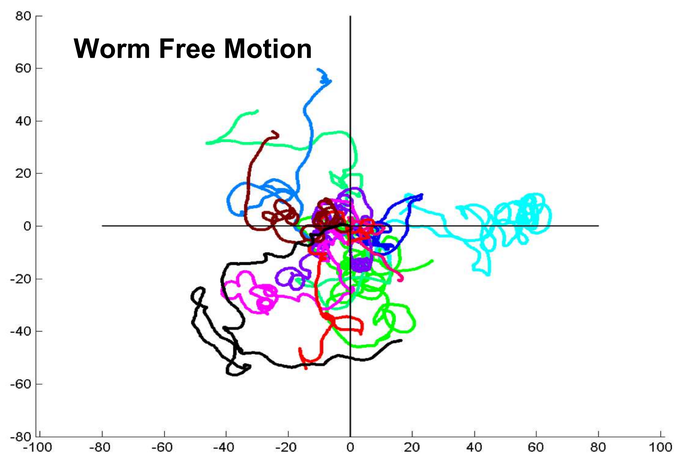
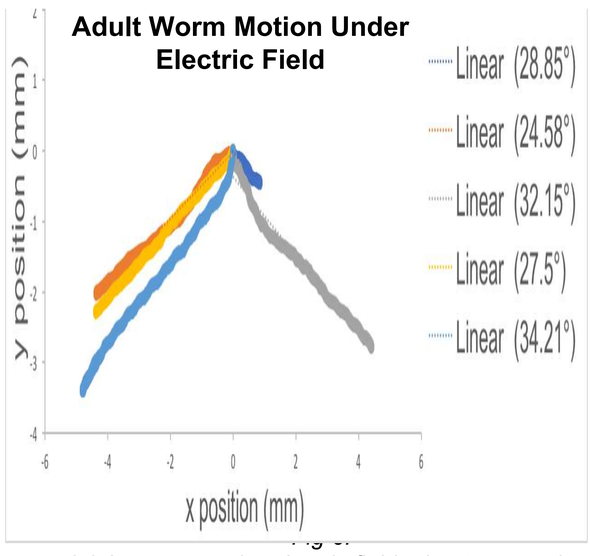


Fig 5.
Worms show random behavior under free motion



Adult worms under electric field migrate towards negative pole at a consistent angle

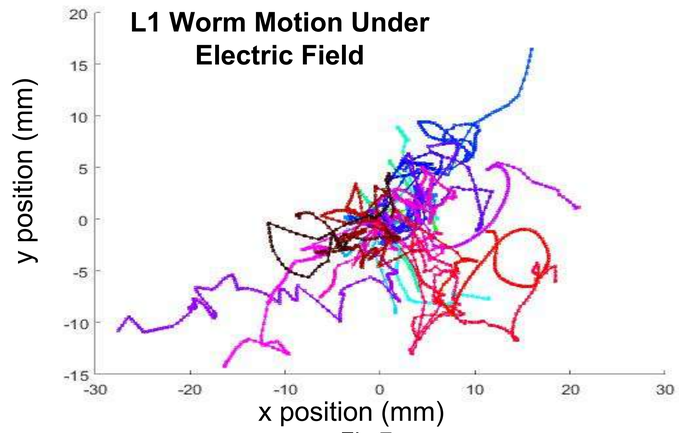


Fig 7.
L1 worms exhibit random movements under electric field

DISCUSSIONS & CONCLUSIONS

- We have not been able to observe any quantifiable electric field behavior in L1 stage *C. elegans*
- This behavioral data could indicate the fact that L1 stage cannot perform the electric field bias, because their muscles have not fully developed yet

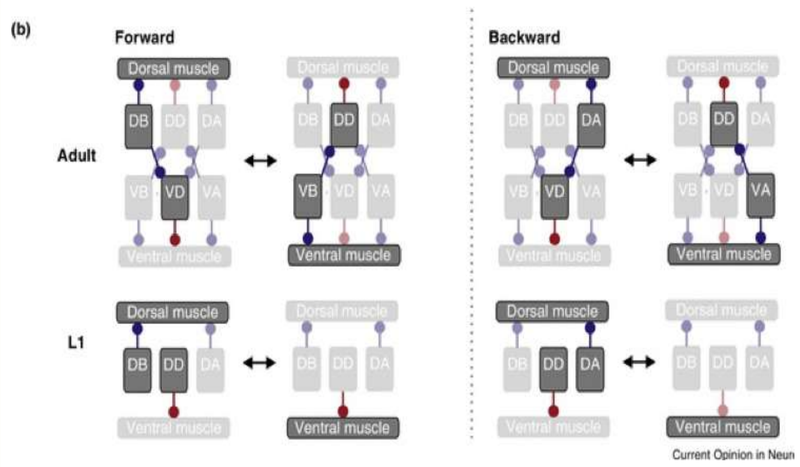


Fig 8.
Diagram of the C. elegans motor circuit. In L1 worms, only the DA, DB, and DD motor neurons are present.

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