

# C. elegans learning strategy in T-mazes and aging-related interventions

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## 1. Motivation

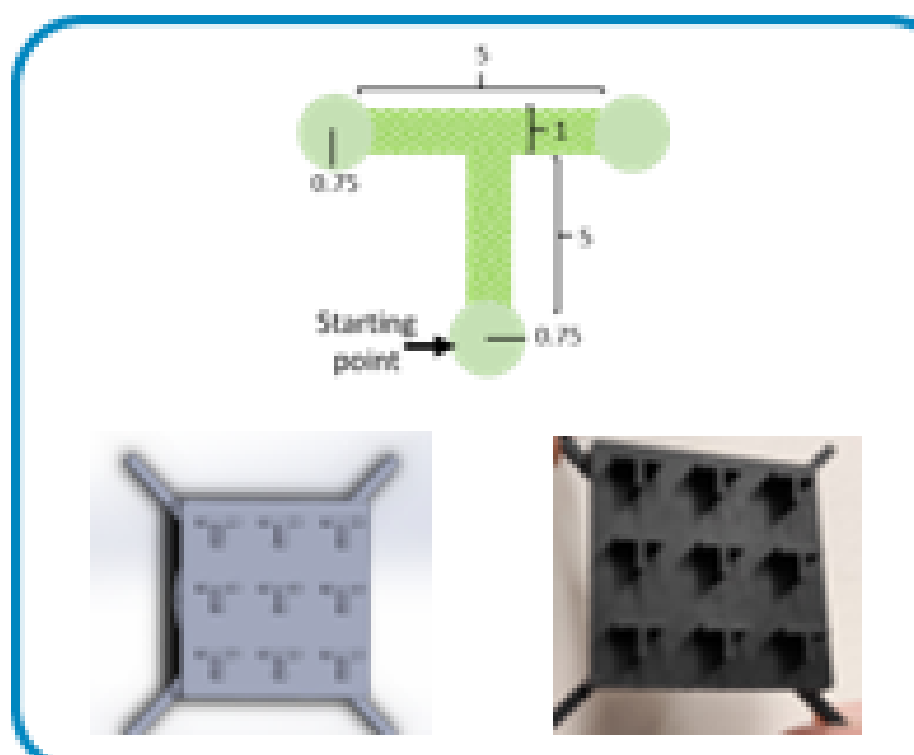
**Spatial learning** refers to the process through which animals encode information about their environment to facilitate navigation through space and recall the location of motivationally relevant stimuli.

*Encyclopedia of Psychopharmacology, 2014*

Is *C. elegans* capable of such learning? How does aging affect the underlying mechanism?

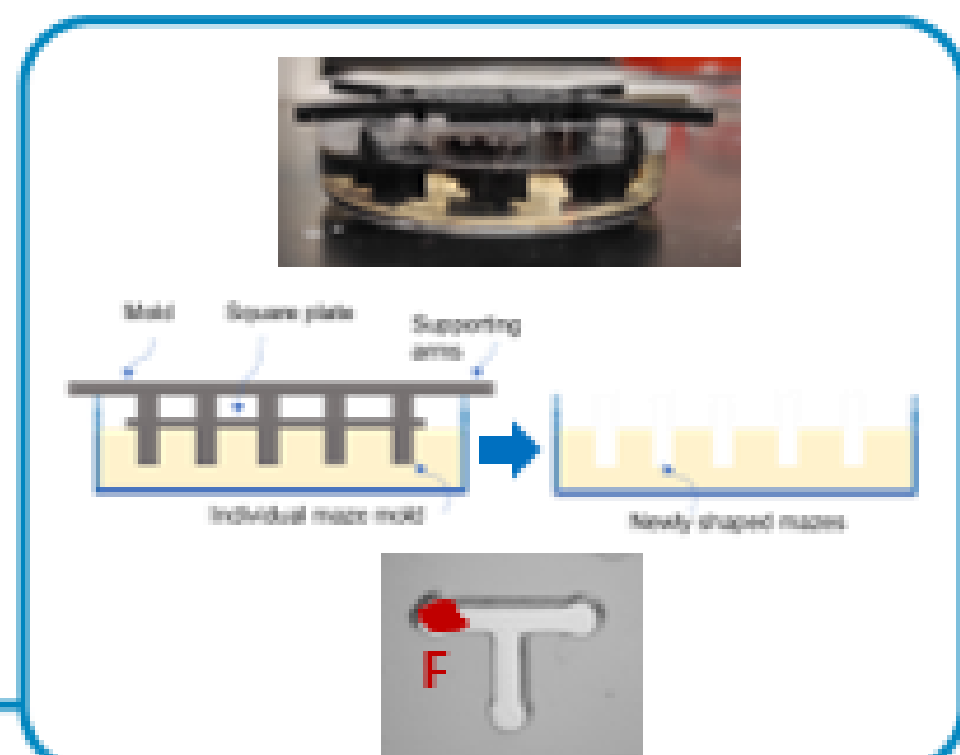
## 2. Experimental process

Step 1



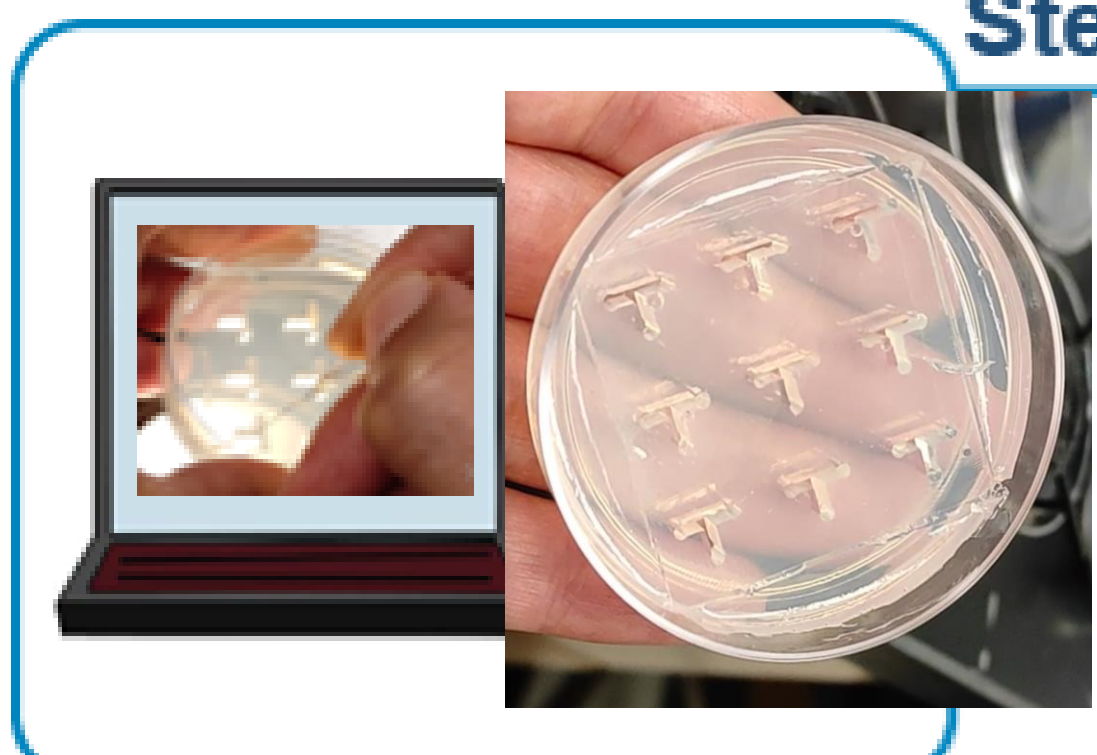
**Design and 3D-print Molds**  
Design maze  
Design mold  
3D-print mold

Step 2



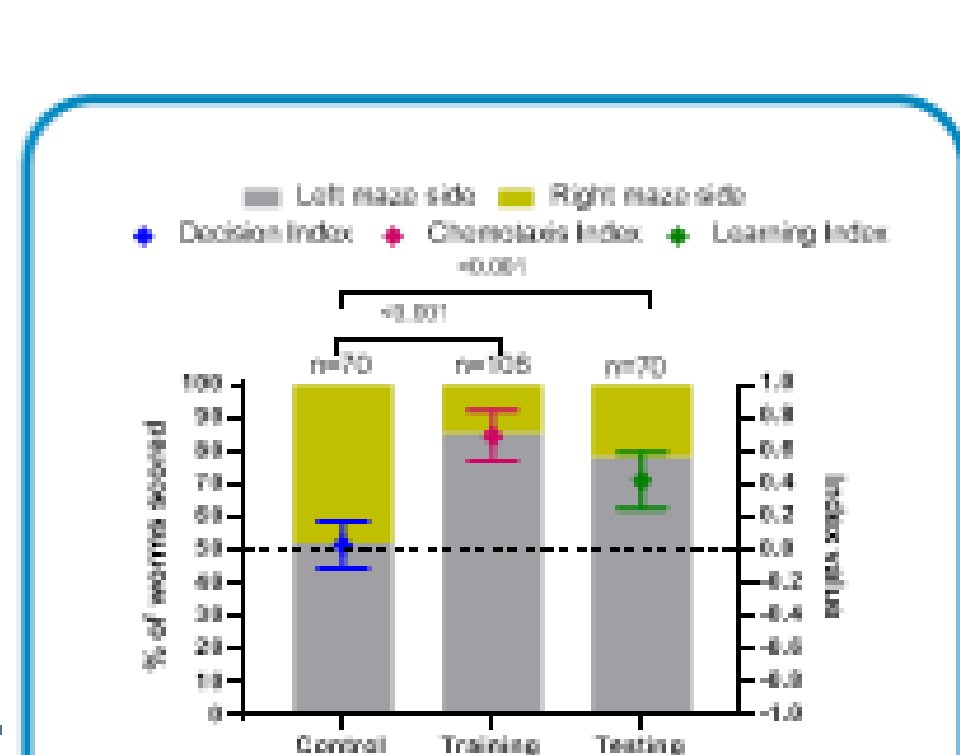
**Maze Fabrication and Maze Baiting**  
Immerse mold in liquid NGM  
NGM solidification & drying  
Baiting

Step 3



**Introduce and Record C. elegans**  
Behavioral assay  
Video recording

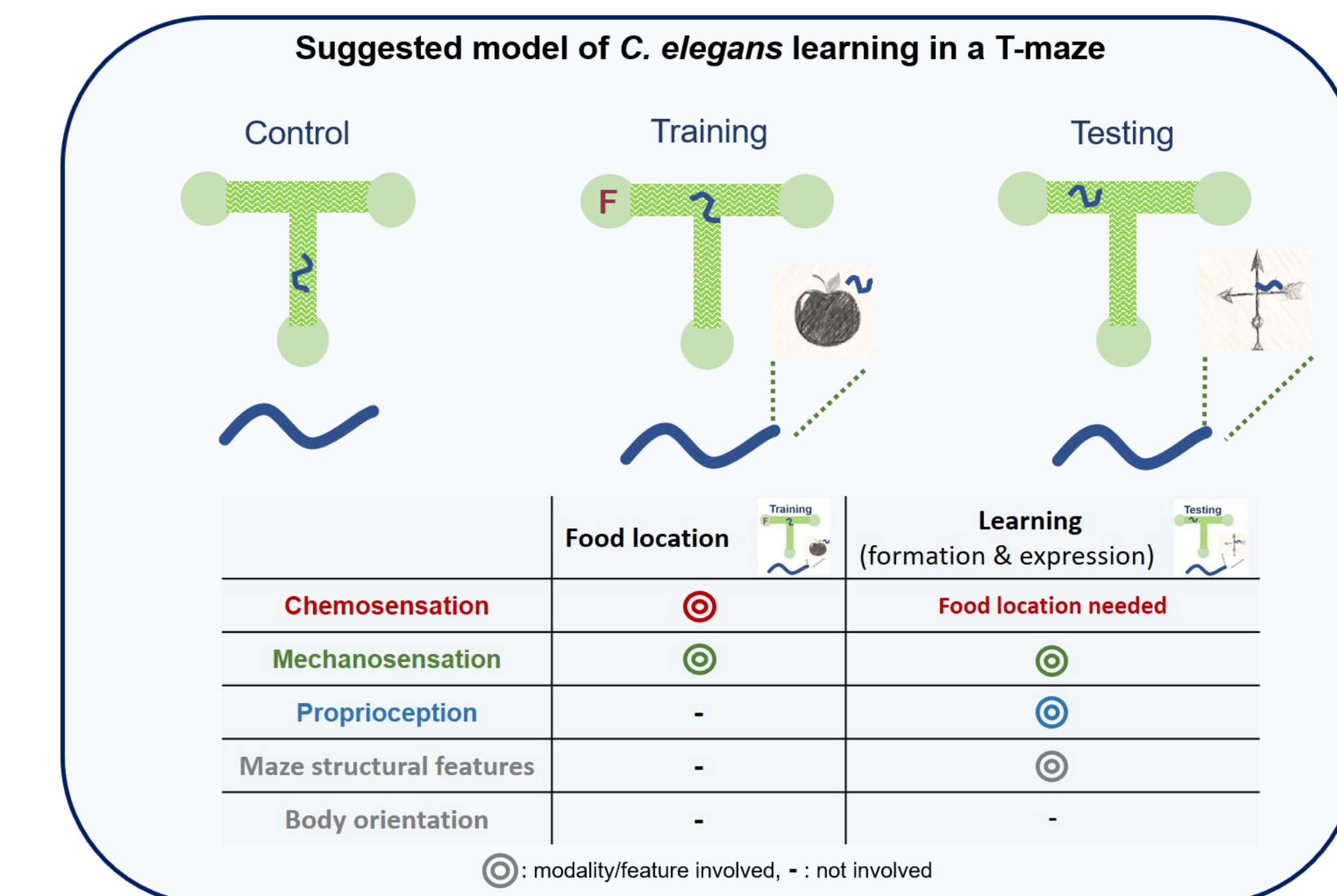
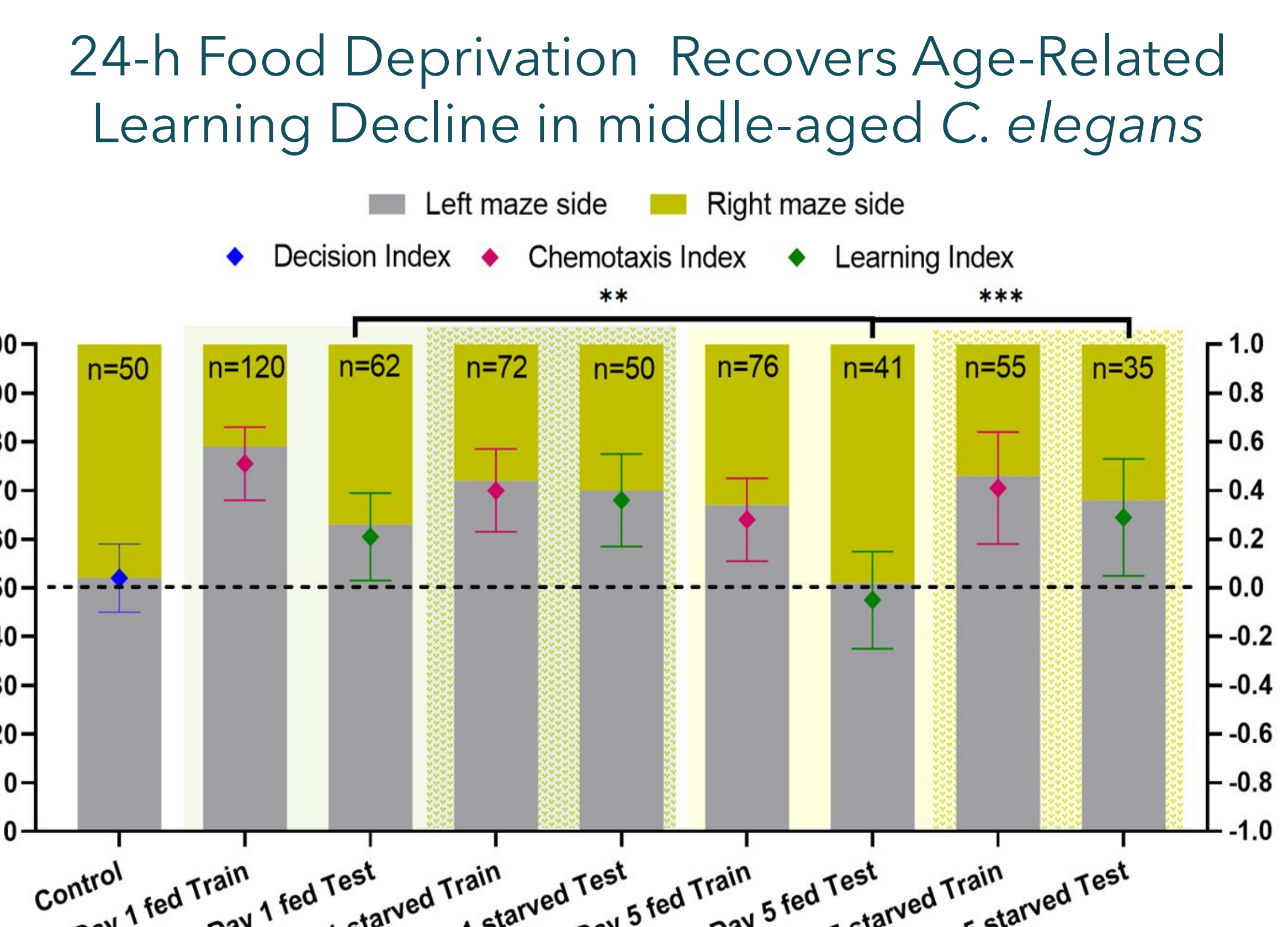
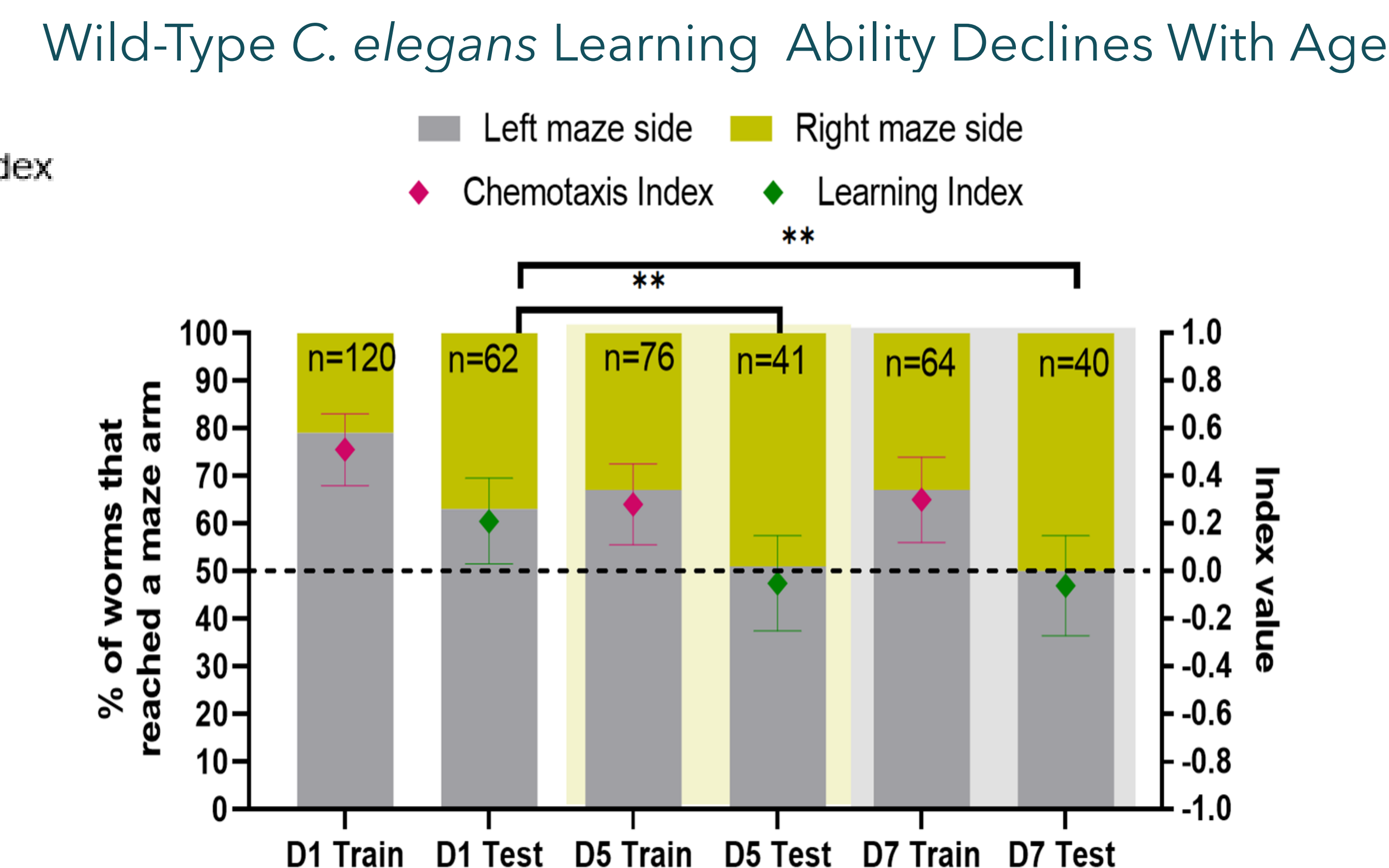
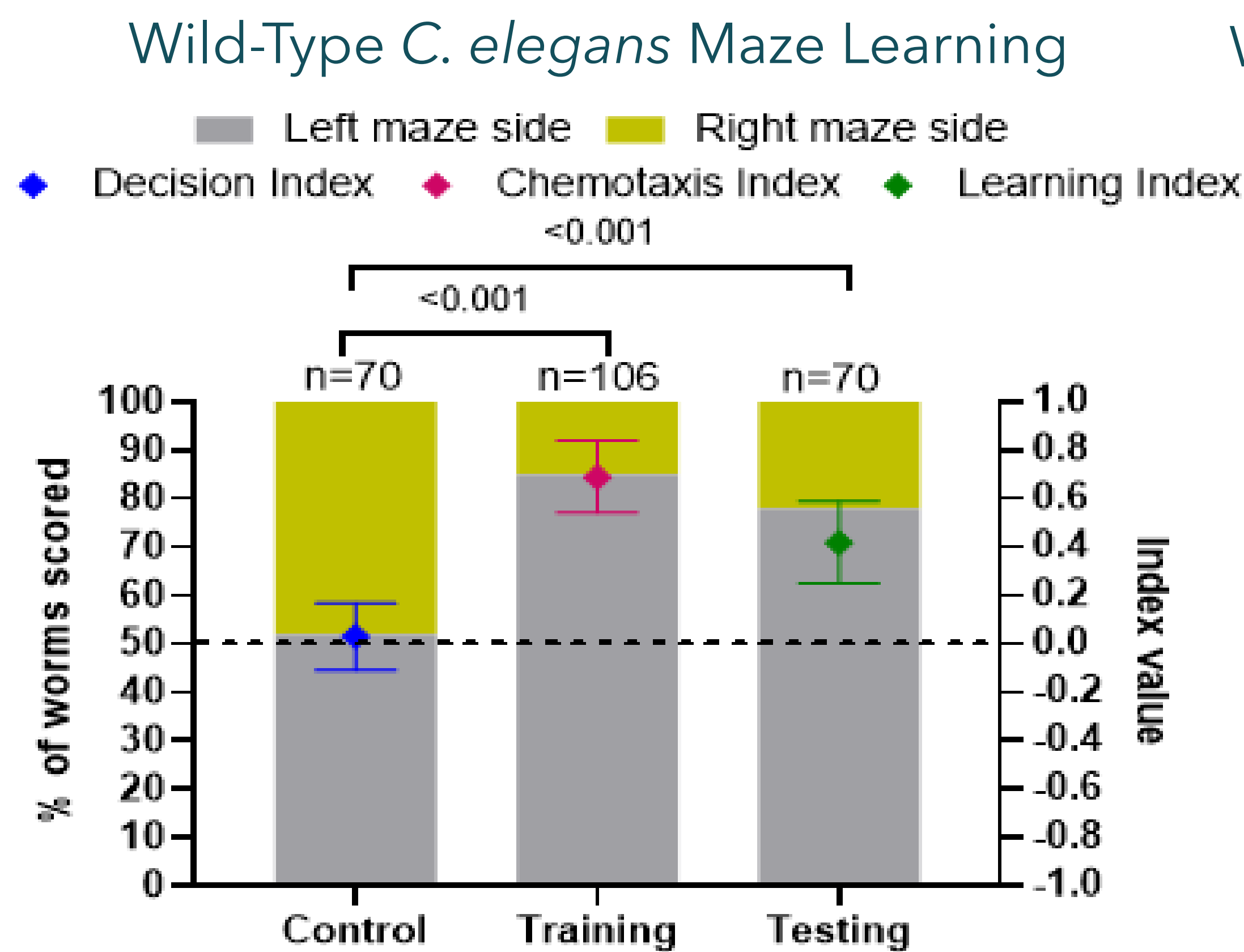
Step 4



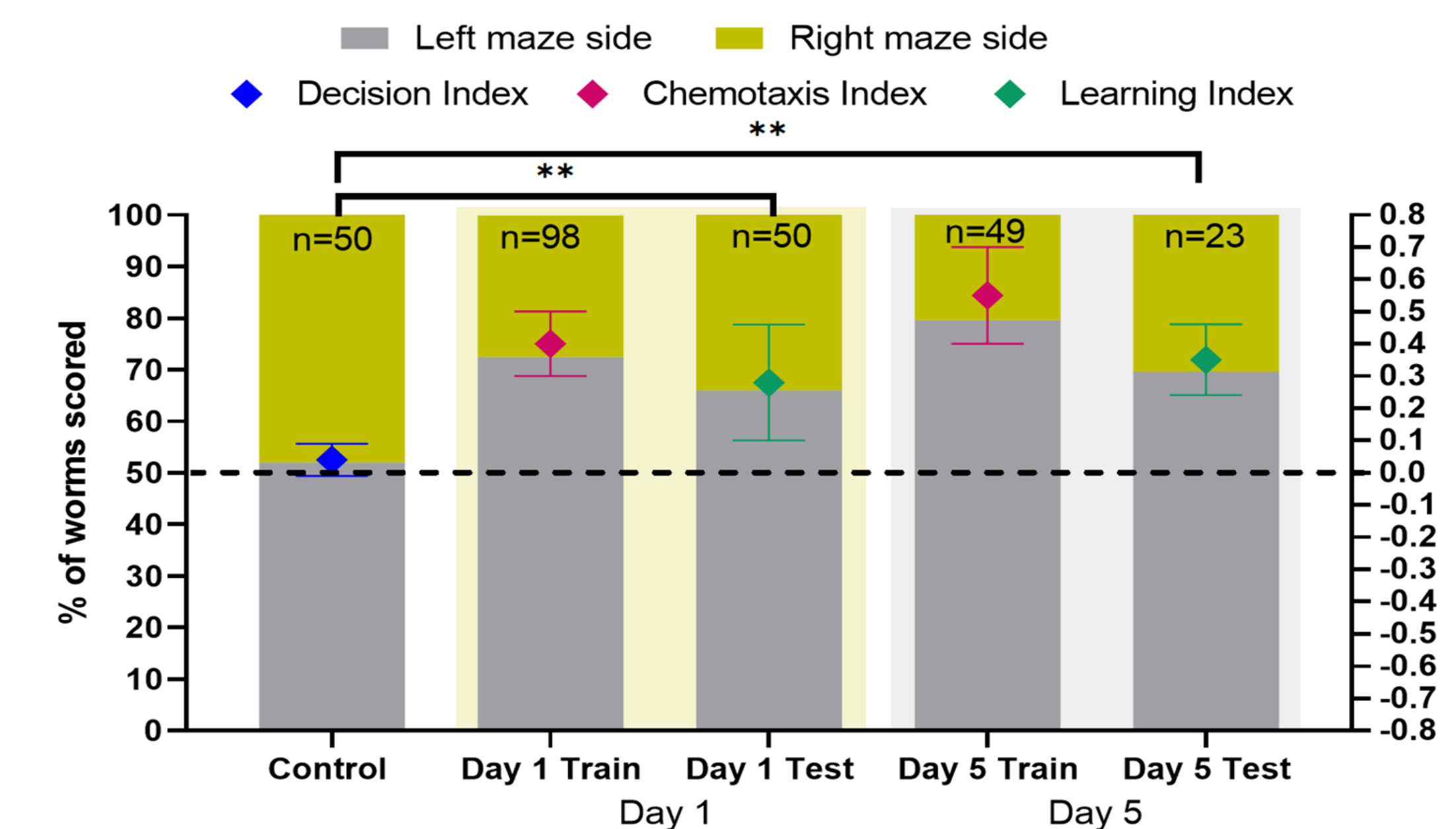
**Analyze Data**  
Statistical analysis  
Index calculation

## 3. Results

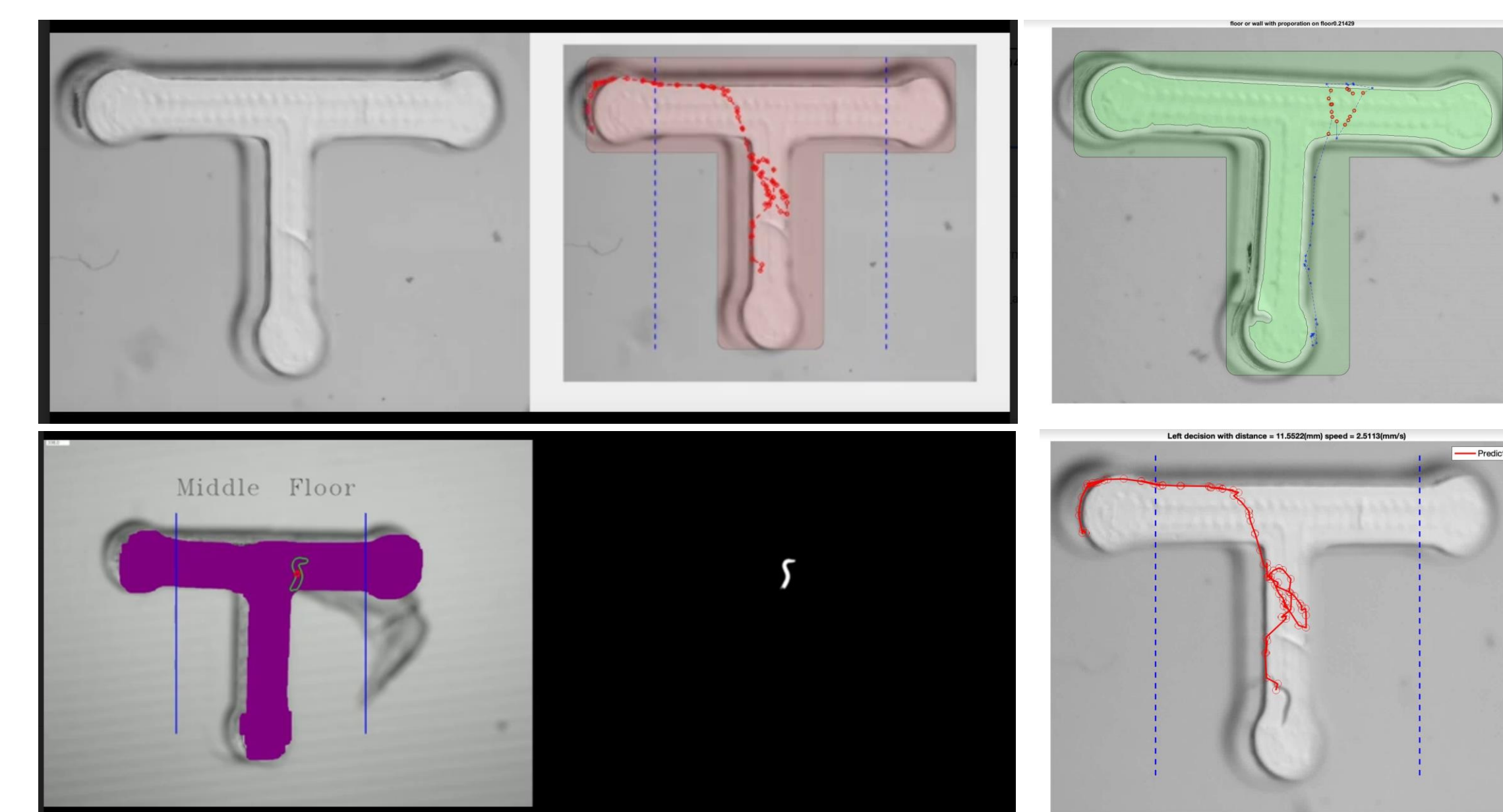
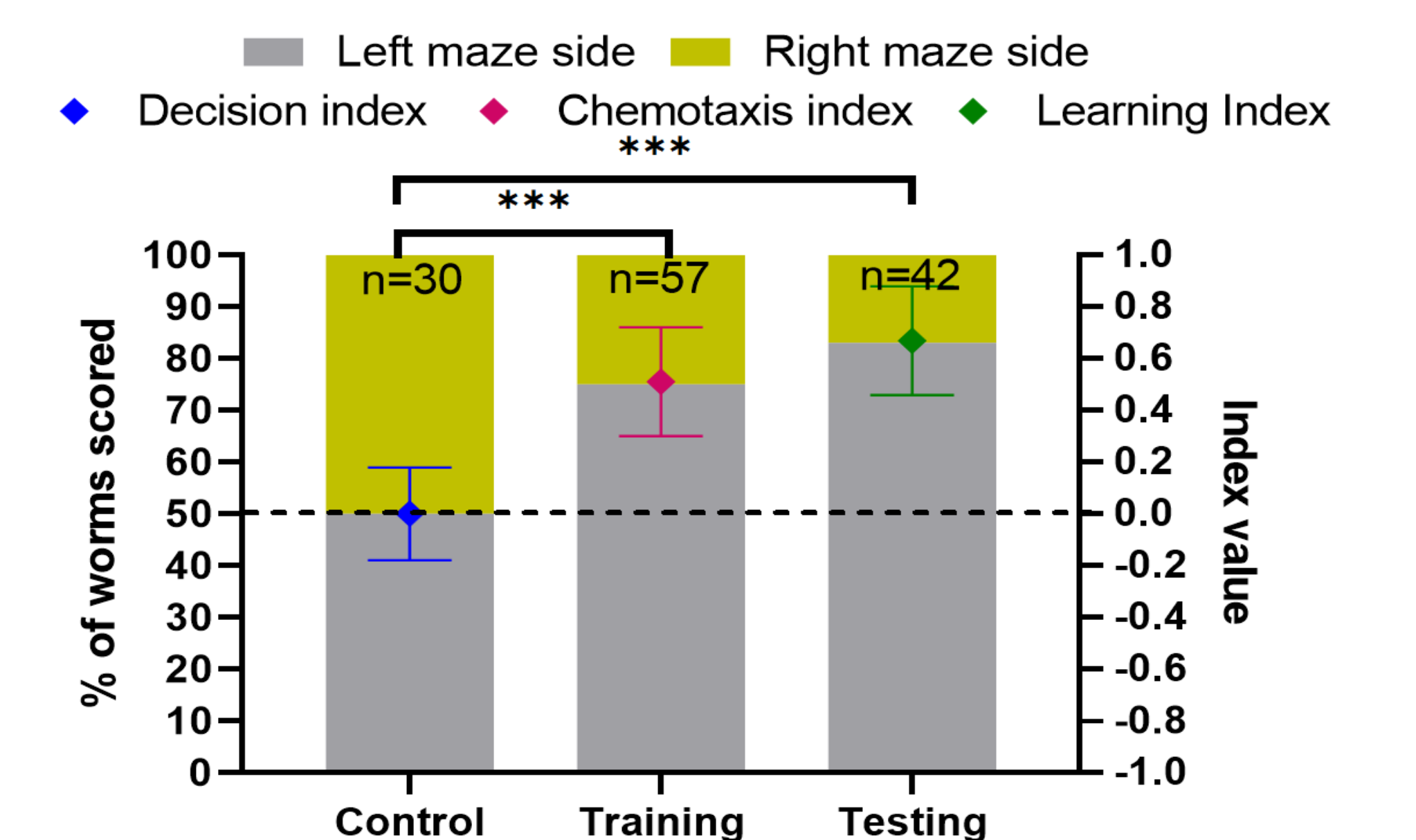
Binomial probability test,  $p > 0.05$ : not significant, \*:  $p < 0.05$ , \*\*:  $p < 0.01$ , \*\*\*:  $p < 0.001$ , \*\*\*\*:  $p < 0.0001$ .



*daf-2* mutants do not experience the age-related decline in learning ability seen in wild-type animals



*eat-2* mutants display enhanced learning ability; experiments with older animals in progress.



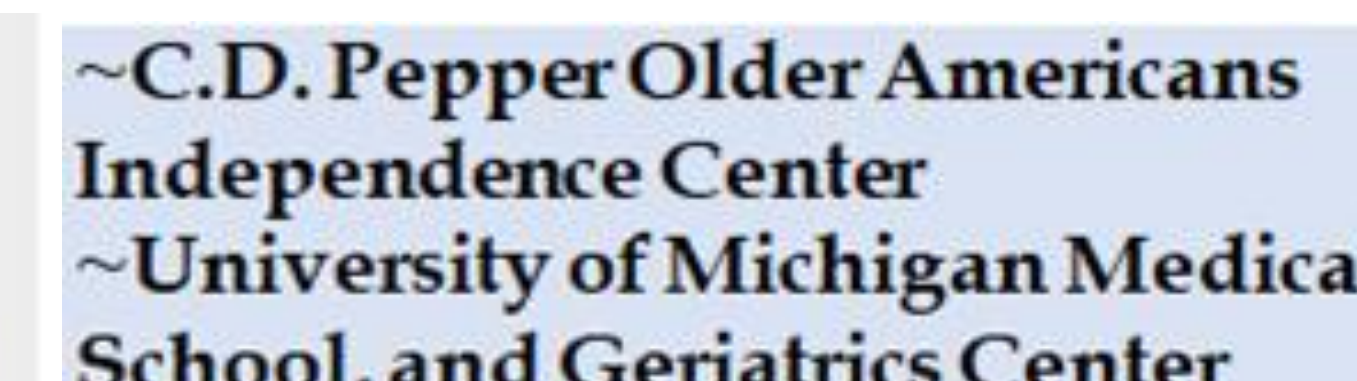
Custom tracking algorithm:  
Chan-Vese active contour method → T-shape polygon fit → singular value decomposition (SVD) → diff tracking operation (MatLab) → KNN noise cleaning

## 4. Conclusions

- ✓ *C. elegans* are capable of learning in the maze environment.
- ✓ Aged wild-type animals present impaired maze learning ability.
- ✓ 24h food deprivation restores age-related learning decline in middle-aged animals.
- ✓ *daf-2* mutants do not experience age-related learning decline like WT animals.
- ✓ *eat-2* mutants are able to learn and will be explored, among other long-lived mutant strains, to explore further the impact of aging on maze learning.

## 5. Acknowledgements

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## 6. References

~Gourgou E\*, Adiga K., Goettemoeller A., Chen C., Hsu A-L\*: " *Caenorhabditis elegans* learning in a structured maze is a multisensory behavior", \*: co-corresponding authors. *iScience*, 24 (4) 102284, doi: <https://doi.org/10.1016/j.isci.2021.102284>, 2021  
~Gourgou E. #, Hsu A.-L. #: "A maze platform for the assessment of *Caenorhabditis elegans* behavior and learning", \*technical contact, #: co-corresponding authors, *under review*.

