Section V: Conclusion

The primary objective of this study was to investigate the effects of PTZ exposure on spatial learning in UNC-49 worms across multiple generations and to determine whether these effects persist or accumulate over time. Using standardized spatial learning assays with sample sizes of 30 worms per group, we systematically compared control worms with those exposed to PTZ in various generational combinations. Statistical analyses, including two-proportion Z-tests, were employed to rigorously assess differences in training and learning performance, with significance thresholds clearly defined.

The results demonstrate that PTZ exposure significantly impairs spatial learning in both directly exposed worms and their descendants. Generation 1 worms exhibited clear deficits in training and learning phases, while subsequent generations showed varying patterns depending on exposure history. Notably, worms exposed multiple times across generations sometimes exhibited partial adaptation, whereas those with ancestral exposure alone still displayed persistent learning impairments. Cross-generational comparisons revealed that the effects of a single PTZ exposure can carry forward but may also attenuate in more distant generations.

Analysis of these data supports the hypothesis that environmental stressors such as PTZ can induce transgenerational cognitive deficits, likely mediated through molecular and epigenetic mechanisms. While limitations such as behavioral variability and lack of mechanistic assays exist, the findings align with prior studies on transgenerational inheritance in C. elegans and extend our understanding by highlighting the interplay between exposure frequency, generational timing, and adaptive responses.

In summary, this study provides compelling evidence that environmental exposures can have lasting and heritable effects on cognitive function. These results underscore the importance of investigating not only immediate behavioral outcomes but also the long-term implications for progeny.

By linking environmental stressors to transgenerational learning deficits, this research advances our understanding of inherited neural vulnerability and sets the stage for future mechanistic and interventional studies aimed at protecting cognitive health across generations.