

Does lead affect the learning and memory of male and female zebrafish differently?

by Savon Morris & Deyaniris Reyes

Introduction

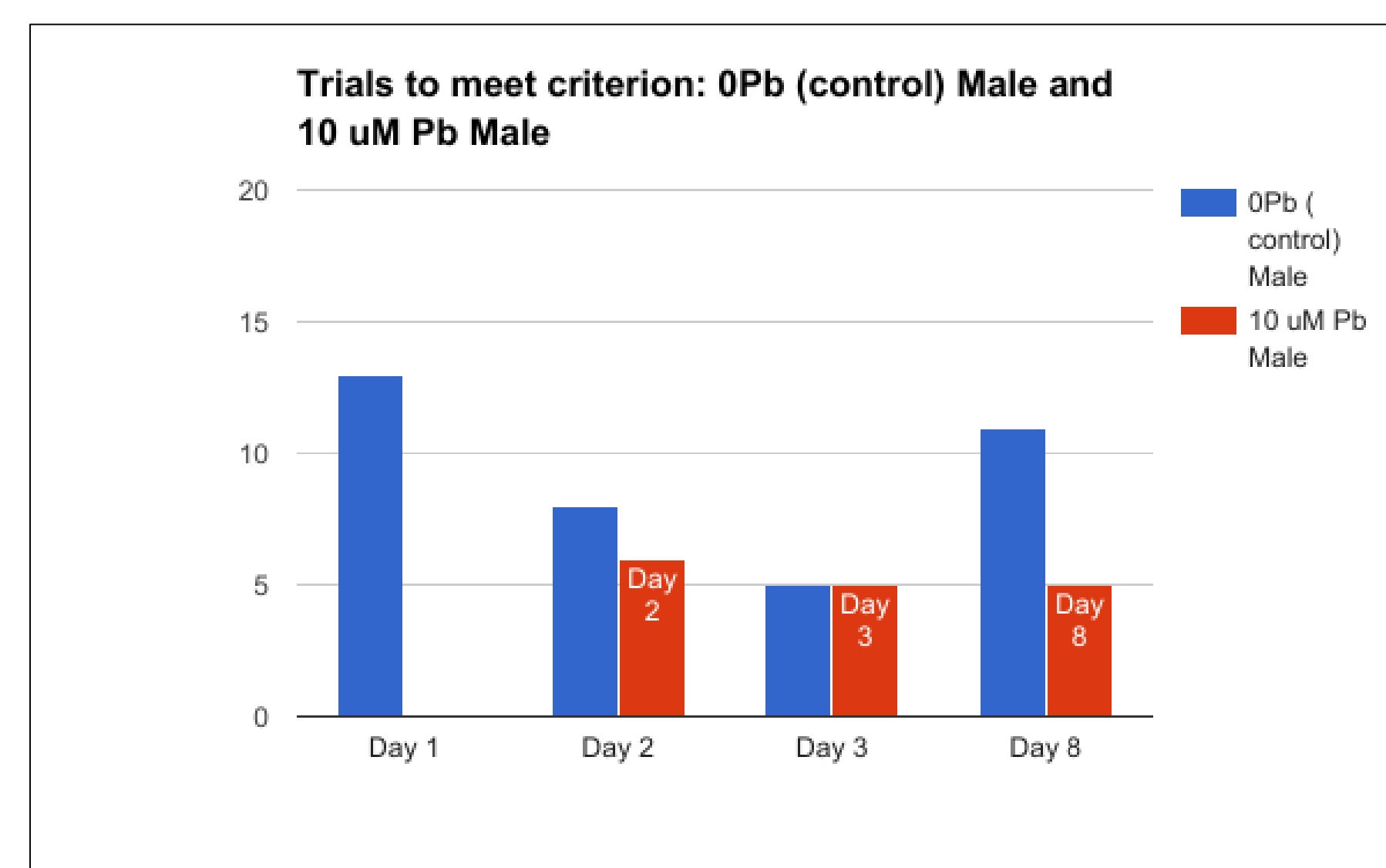
- This investigation's purpose is to determine if lead exposure of zebrafish embryos affects the learning of adult male and female fish differently.
- Recently animal studies have shown that early exposure to Pb results in Alzheimer's disease. Many genes of the zebrafish are related to human genes which are associated with neurodegenerative diseases such as Alzheimer's disease and Parkinson's disease. Zebrafish are being used in Pb neurotoxicity studies to help explore genetic mechanisms of toxicology and associated neurobehavioral alterations. (Lee, 2014)
- According to Chena (2012), lead effected embryonic toxicity, behavioral responses, and adult learning and memory. Behavior problems were demonstrated that showed exposure to lead changed behavioral responses in zebrafish larvae. Hyperactivity was exposed within the first minute during the light-to-dark transition in the fish that were exposed. The adult zebrafish who were exposed to lead, demonstrated to us learning and memory difficulty.
- Prior research has shown that zebrafish learning and memory is affect by exposure to Pb. Is this consistent between male and female fish?

Methods

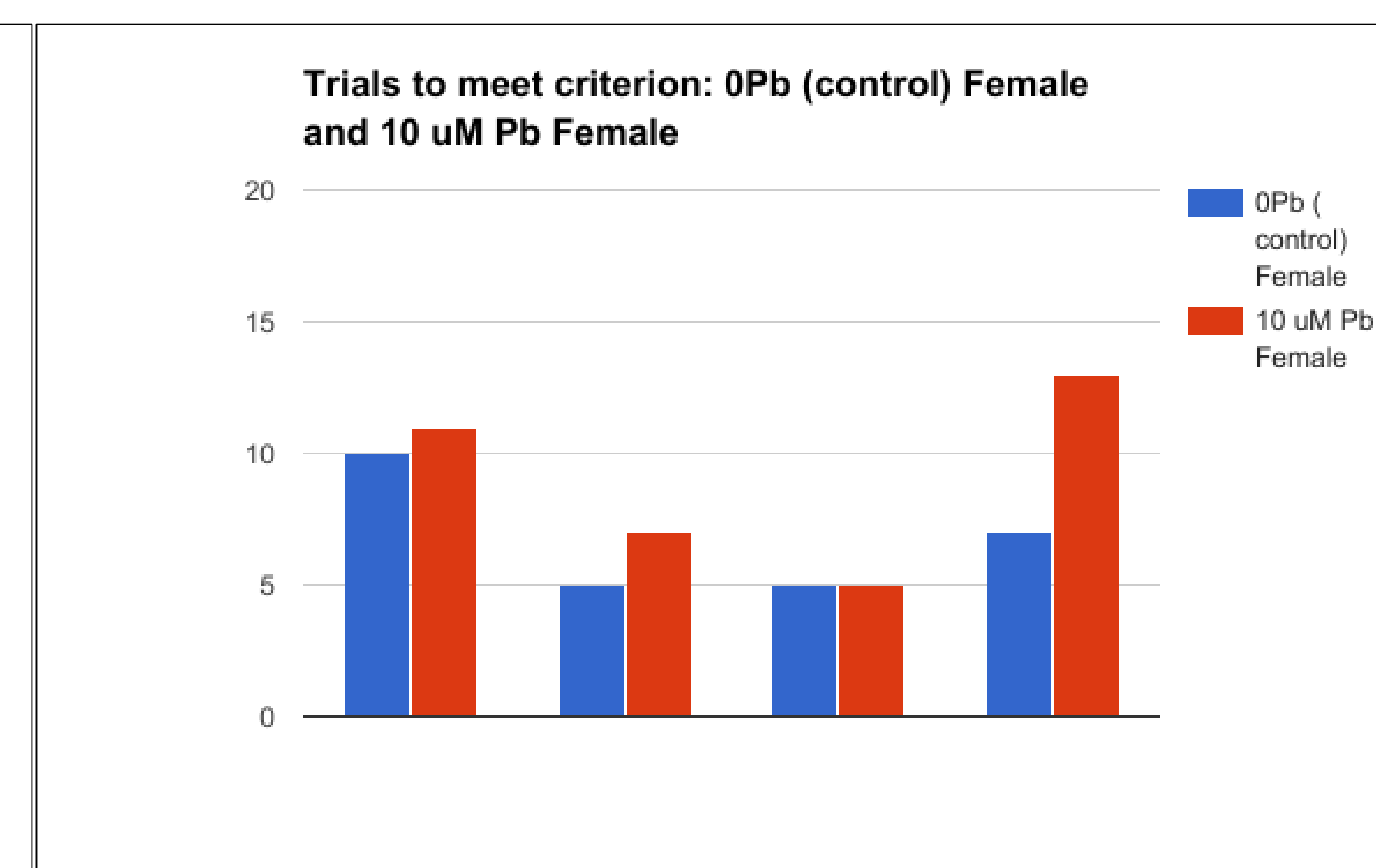
- Using the T-Maze (Image 1) the zebrafish was allowed to acclimate for 5 five minutes.
- The direction the zebrafish should turn was selected.
- The fish was placed in the starting location for 15 seconds.
- The fish was released and the fish chose a direction.
- If the fish went in the correct direction, it roams for 45 seconds and then goes back to start.
- If it goes the wrong way, it is netted and put back to the starting position.
- The fish must get 5 out of 6 attempts correct.
- As compared to last year, this year data was separated between male and female fish.



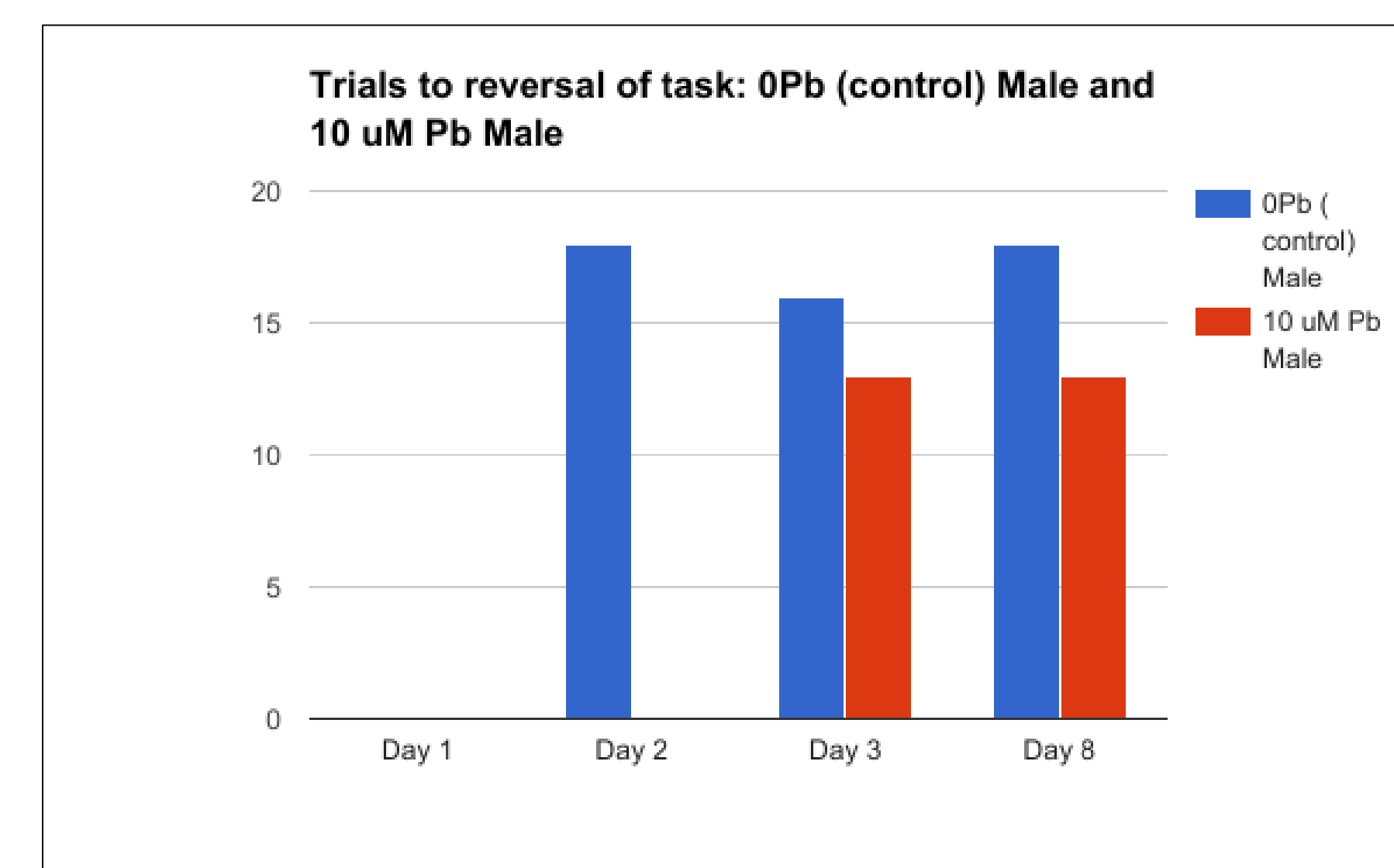
Image 1: T-maze



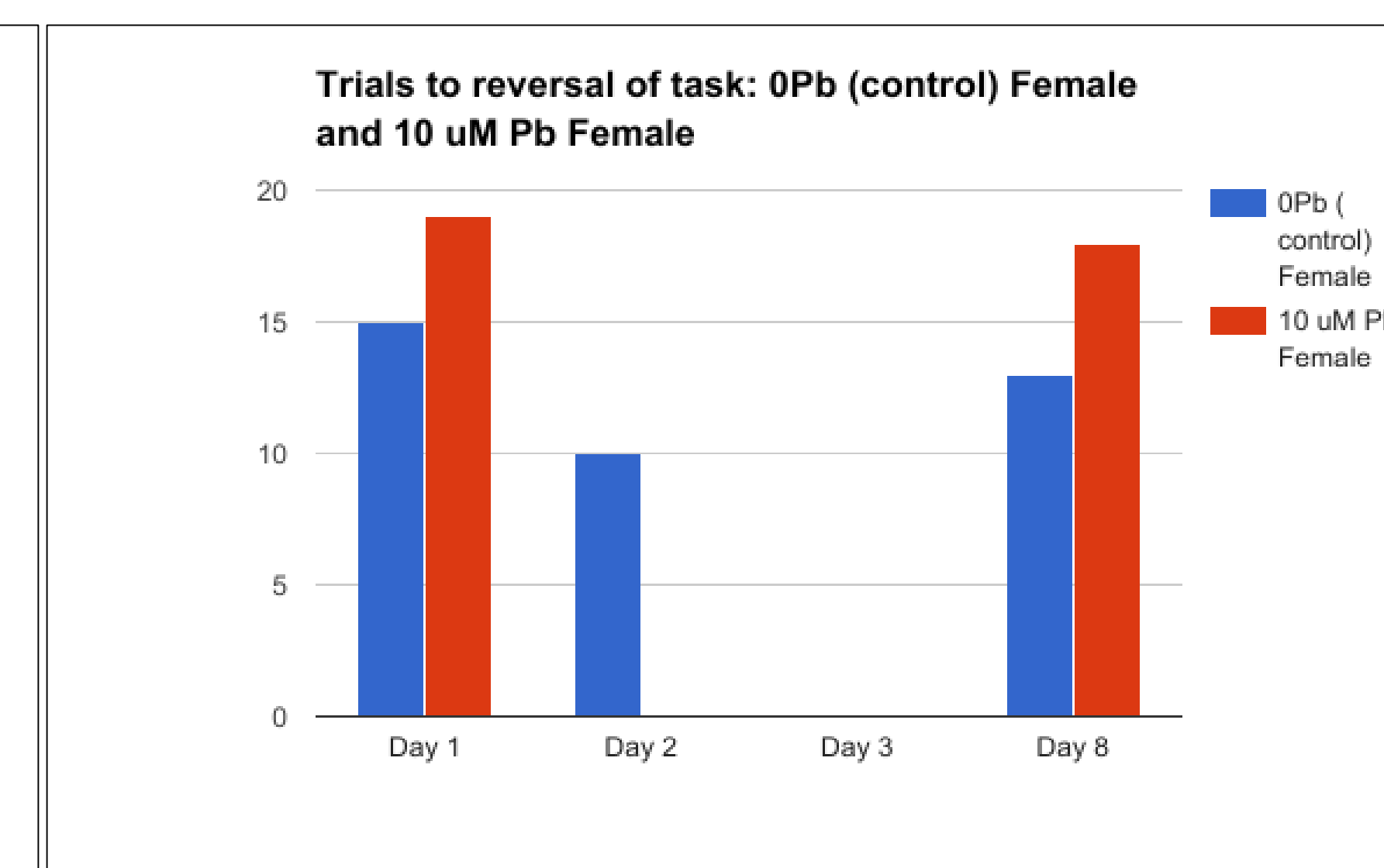
Graph 1: Trials to meet criterion (5/6) for Pb and Control males.



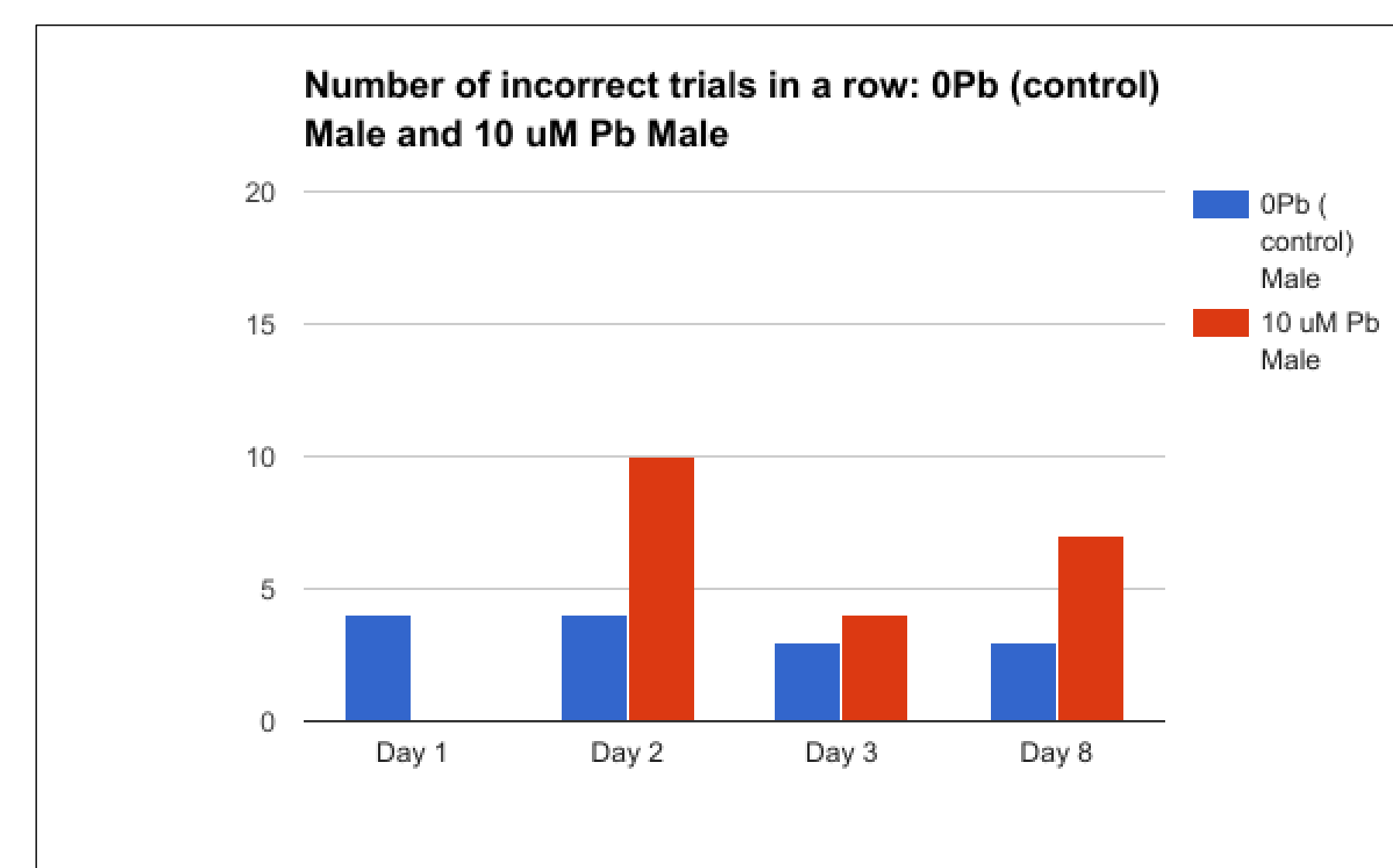
Graph 2: Trials to meet criterion (5/6) for Pb and Control females.



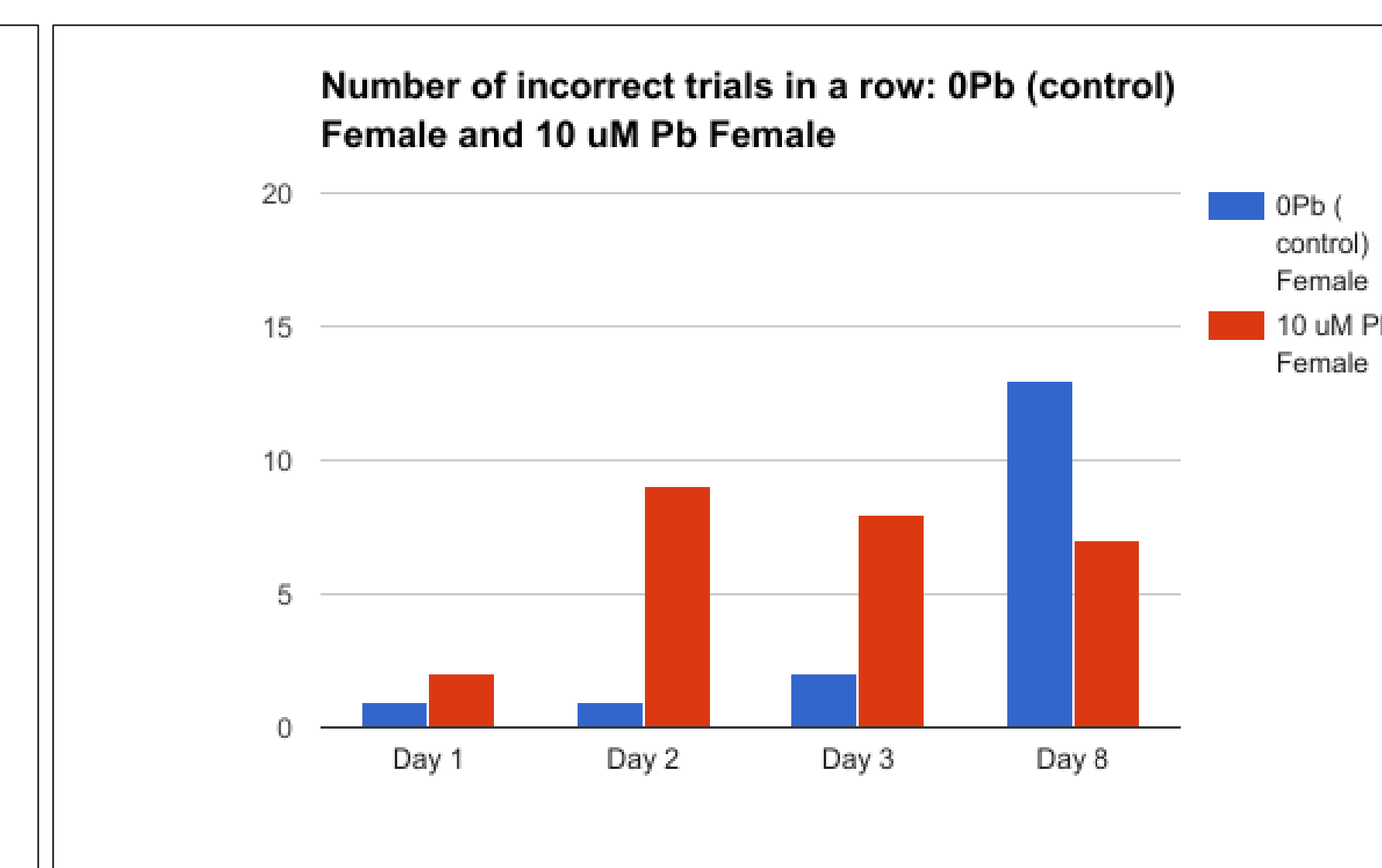
Graph 3: Trials needed to reverse the task (5/6) for Pb and Control males.



Graph 4: Trials needed to reverse the task (5/6) for Pb and Control females.



Graph 5: Number of incorrect trials in a row for Pb and Control males.



Graph 6: Number of incorrect trials in a row for Pb and Control females.

Results

- In graphs 1 and 2, the female Pb exposed fish seemed to be delayed at meeting criteria.
- In graphs 3 and 4 the female Pb exposed fish was delayed at repeating reversals or not able to complete reversals at all.
- In graphs 5 and 6, the male and female Pb exposed fish consistently made more mistakes in a row. The female control fish had the most mistakes in a row on her day 8 trial.

Discussion

- From our investigation we were able to detect that lead does affect learning and memory behavior in zebrafish.
- Lead exposure seems to affect female fish more than male fish.
- The female Pb exposed fish had the worst performance of all the fish: it took her longer to meet criteria, longer to reverse a task (if she did it at all), and she made many mistakes in a row indicating that she is not as cognitively flexible.
- A similar study tested conditioned fishes' ability to find food. They found that the fish had a significantly decreased accuracy and increased time when finding food. (Chen, 2012)
- Our study is consistent with others detecting a decreased ability to learn and remember when Pb exposure occurs.
- More fish need to be tested to be more confident in our finding.

References

- Chen J, Chen Y, Liu W, Bai C, Liu X, Liu K, Li R, Zhu J-H, Huang C (2012) Developmental lead acetate exposure induces embryonic toxicity and memory deficit in adult zebrafish. *Neurotoxicol Teratol* 34(6):581-586
- Jiangfei Chena, Yuanhong Chena, Wei Liua, Chenglian Baia, Xuexia Liua, Kai Liua, Rong Lia, Jian-Hong Zhub, Changjiang Huang (2012) Developmental lead acetate exposure induces embryonic toxicity and memory deficit in adult zebrafish. 34 (6): 581-586
- Jinyoung Lee, Jennifer L. Freeman (2014) Zebrafish as a model for investigating developmental lead (Pb) neurotoxicity as a risk factor in adult neurodegenerative disease: A mini-review. *NeuroToxicology* 43: 57-64