



Effect of Caffeine on Memory and Learning in Adult Zebrafish



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Abstract:

This experiment studied the effects of caffeine on memory and learning in *Danio rerio* (Zebrafish). Caffeine is a widely used substance among many middle school and high school adolescents, which has led to concerns about focus and learning during school. According to one study, caffeine positively affected memory and learning. The question being investigated is, does caffeine have a positive affect memory and learning?

The results of this research are part of a two-year project which includes one control group, one group exposed to 6mM caffeine solution, and another group exposed to 0.6mM caffeine solution. The first set of fish were exposed to 6 mM of caffeine for 14 days. After the fourteen days, a T-maze was used to test their learning and memory compared to the control. The preliminary results of this initial trial indicate that caffeine does have a positive effect on memory and learning.

Introduction:

Caffeine is a stimulant drug that increases humans' brain and nervous system activity. Caffeine is in almost everything you drink, from coffee to energy drinks to soda. Scientists state that lower amounts of caffeine can help people concentrate and feel more focused. Consequently, this can result in less sleep, more energy, and increased physical activity.

I decided to investigate the effect of caffeine on memory and learning on Zebrafish. Zebrafish is a model organism used all the time for human-related experiments. Around 70% of their genes are similar to humans. The hypothesis being tested is: If Zebrafish are exposed to caffeine, it will improve their memory and learning.

Materials and Methods:

- Cut off Saw
- Drill Press
- 3/32, 5/32, 5/16 drill-bits
- 7/8 Hole-saw and arbor
- Countersink bit
- Screw-gun or Phillips screwdriver
- 3-5" Clamps
- 2" Brush for polyurethane Caulking-gun
- Belt Sander or utility knife
- A funnel
- 1-18 x 24 x 1" End-glued pine board
- Four non-exposed Zebrafish, 2 males and 2 females
- Four caffeine exposed Zebrafish, 2 males and 2 females



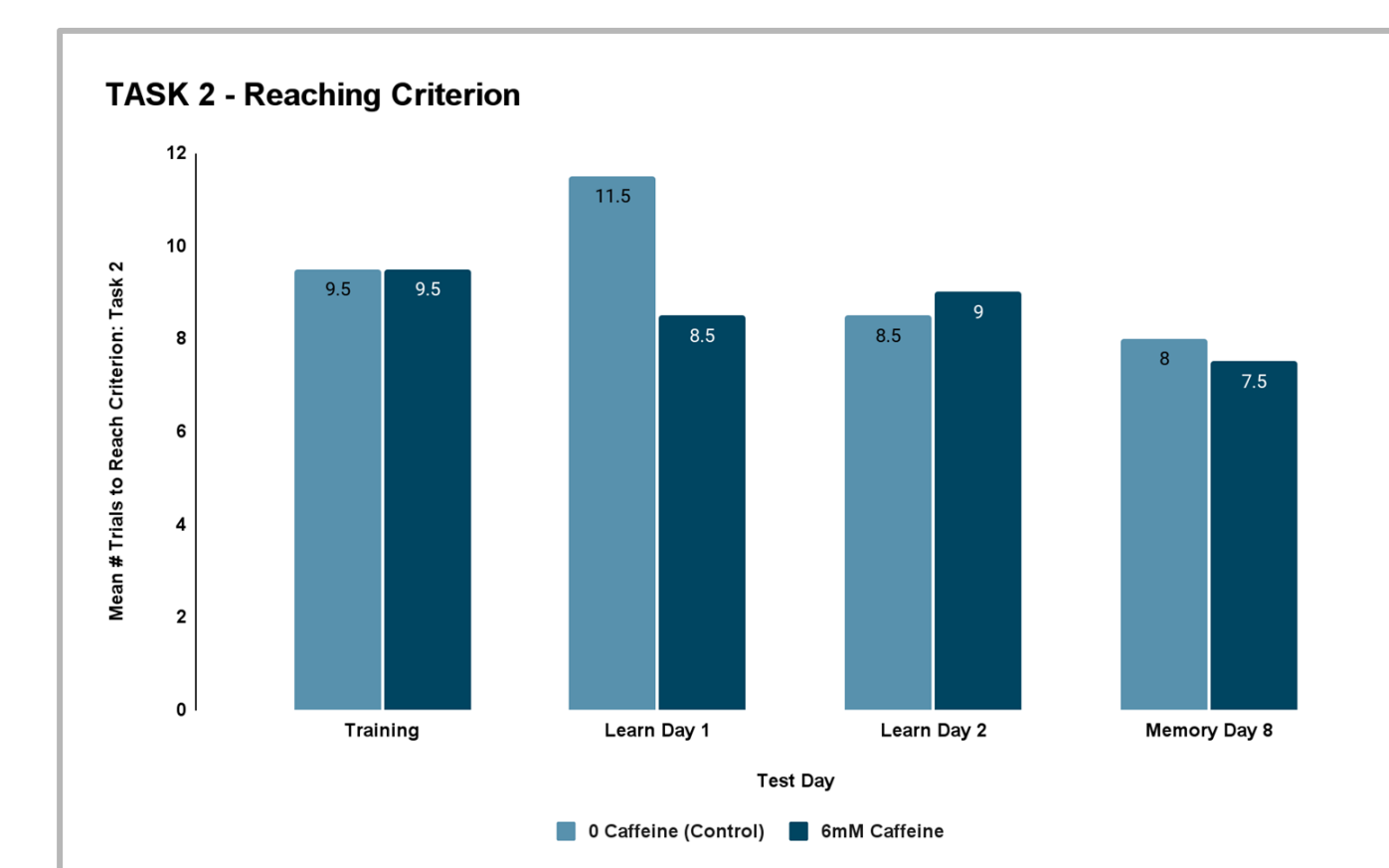
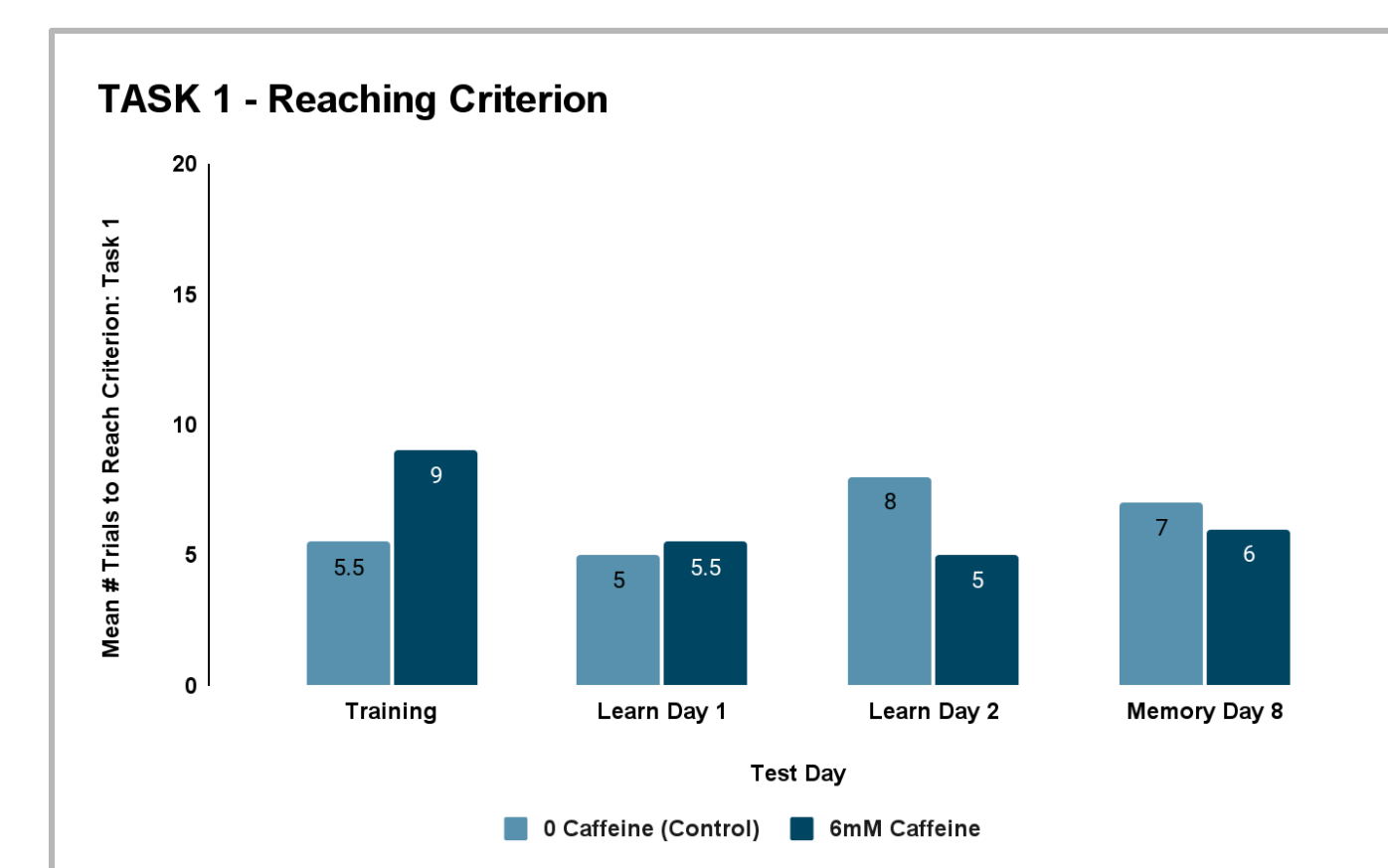
- 1-36 4 x 4" Post
- 2-36 x 5/16" diameter dowel rod
- 1-72 x 1 x 4" pine board
- 1-#4 Rubber Stopper
- 1/16-1/8"- Thick, clear acrylic sheet
- Wood Glue
- 1-qt. SPAR urethane wood finish (Marine Grade)
- 50-#8 x 1-1/4" flathead screws
- Aquarium safe, silicone caulk
- Mineral spirits
- 4 L dechlorinated water
- 4 (3-gallon) aquariums
- 2 (10-gallon) aquariums
- 6 mM caffeine stock solution
- 0.6 mM caffeine stock solution

The same T-maze and memory and learning tests were used on all Zebrafish. One group was the control, and the second group was exposed to 6mM of caffeine. Both groups had two females and two males, and the same protocol was implemented. Day one was the training day. Day two was the first testing day or learning day. Day three was the second testing (learning) day, and day eight was memory day.

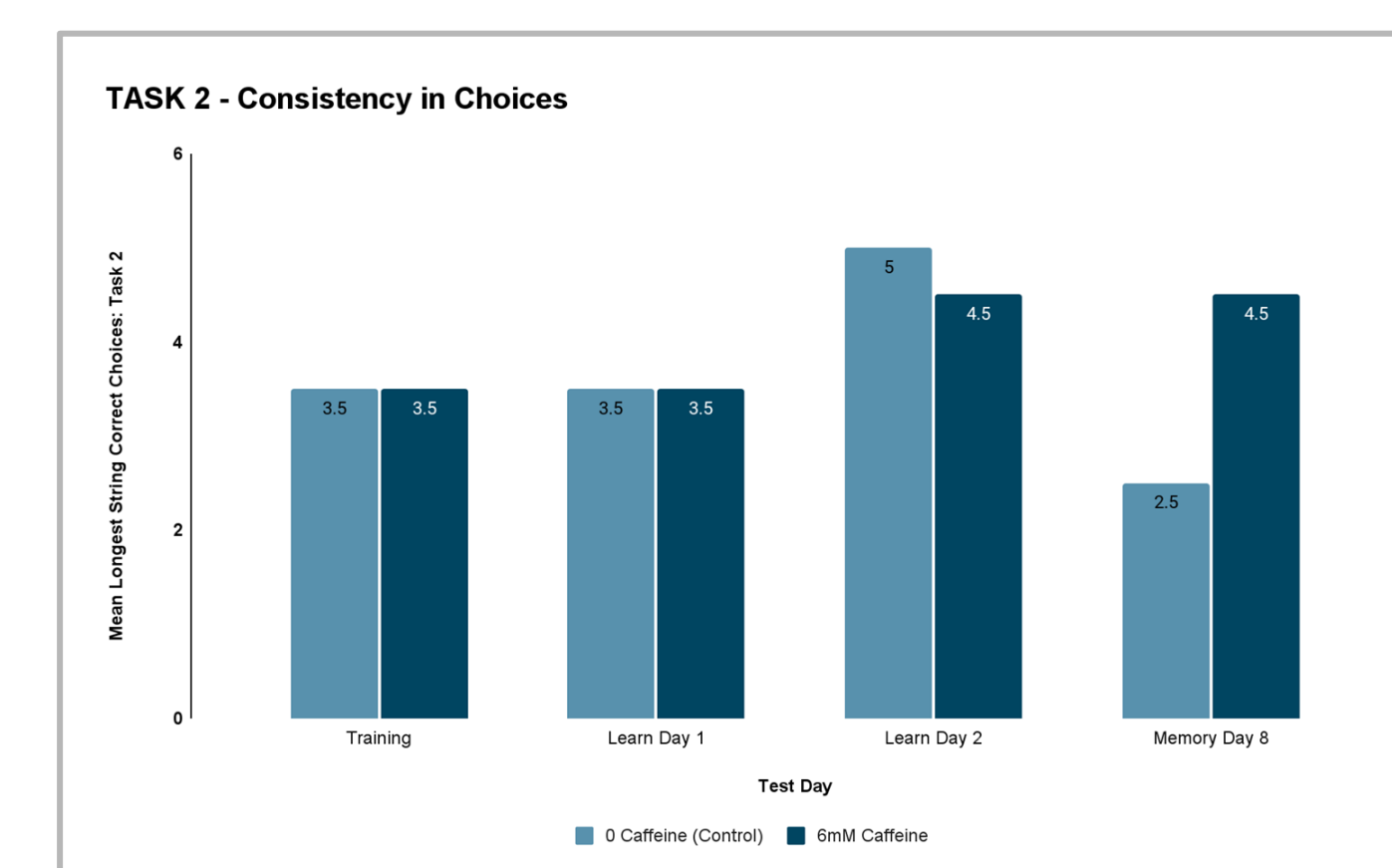
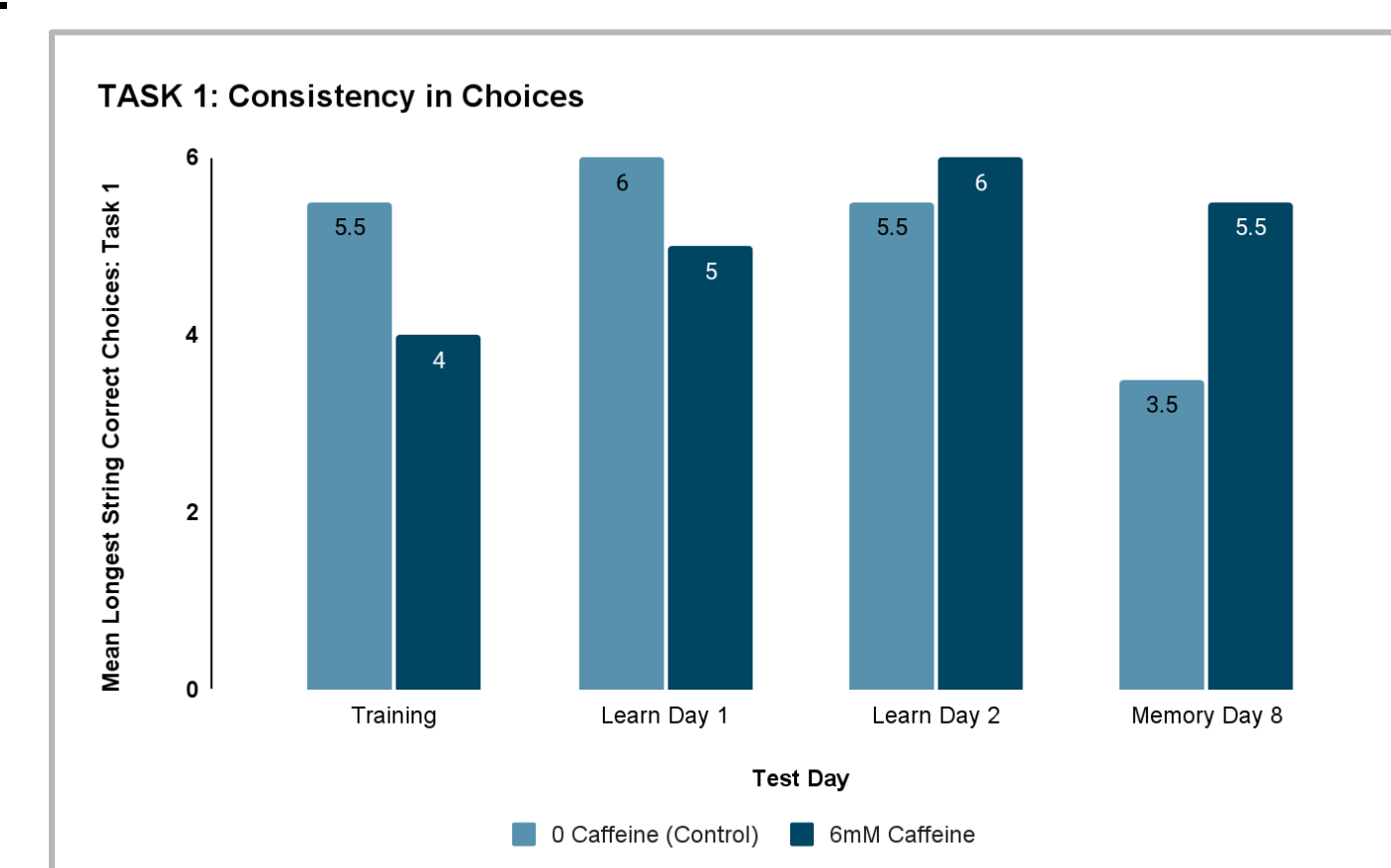
The caffeine-exposed Zebrafish were exposed using a staggered system. In a separate individualized exposure tank, all the fish were exposed to 6mM of caffeine for 14 consecutive days for three minutes each day. After 14 days, they were tested using the T-maze and following the same protocol as the control group.

The reversal task shows how fast the fish can learn. To do this, the fish must go to the preselected side, right or left of the T-maze, 5 out of 6 times to meet the criteria for success. Once the first task was completed, the fish would then do the reversal task and swim in the opposite direction of the T-maze.

Data (Preliminary Results)



The graphs above show how long it took the two groups to meet criteria for task one and the reversal task, task 2. The two graphs below show how many in a row they got correct. Both sets of graphs demonstrate how well the Zebrafish can adapt and learn to the T-maze.



Discussion

The preliminary results for **task 1** indicate a slight positive effect on memory and learning with the caffeine-exposed fish. For **task 2**, the reversal task, the results do not indicate a difference among either group. Lastly, on **Day 8 Memory Day**, the caffeine exposed fish did better with "Consistency in Choices" compared to the controls.

After gathering preliminary results, the hypothesis could prove to be correct. For now, it seems that the caffeine exposed fish seem to be doing better. This experiment could have some possible human error. The experimental results are inconclusive as all the data has yet to be completed and analyzed using more reliable statistical methods such as the Student's T-Test. More experimentation will be done next school year using a 0.6mM caffeine solution.

Works Cited

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