

Time Place Learning in Fathead Minnows, *Pimephales promelas*

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Abstract: Previous studies have shown that some animals can exhibit time-place learning. Our study focused on the ability of time-place learning in fathead minnows. To test this we placed groups of 8 minnows into 11 tank replicates. To prevent room position bias, some tanks had food placed on the right side in the morning and on the left side at night. Remaining tanks had food placed vice versa. After one week of feeding, we recorded the total average positions of minnows in comparison to the correct side where they should have been in the morning and night. Our results showed no significant differences in the total average positioning of minnows within the tanks ($t=-1.247$, $df=10$, $P=0.241$). In our study we found that fathead minnows did not exhibit time-place learning. Future studies could replicate our experiment and change the length of observation time or number of minnows in a tank to further test for time-place learning.

Introduction: Time-place learning (TPL) is a behavior noted in many animals such as rodents, birds, insects, and fish that display the ability to associate places that have biological important events occur (like foraging) during different times of day (Barreto et al. 2006). Laboratory-based experiments have shown that fish are indeed capable of spatial learning, and can use information from multiple sources to maximize foraging efficiency (Braithwaite, 2003). In TPL, an animal must learn to associate different times of day with different locations (Reebs, 1996). It is thought that TPL would increase foraging efficiency in fish because the time and energy saved searching for new areas to forage can be used for something else such as exploring new patch areas (Barreto et al. 2006). In this experiment we are going to look at the fathead minnow (*Pimephales promelas*) and its ability as a species to exhibit time-place learning. We are going to replicate an experiment done by S.G. Reebs that reported time-place learning

when fish were fed in one of the two places at specific times of the day using the fathead minnow instead of the golden shiners (*Notemigonus crysoleucas*).

Methods: Twelve 75L tanks were set up with lake water and a filter system to hold eight fathead minnows each for our separate samples. Ninety-six minnows were collected from Deming Lake with an average length of 6.12cm and divided into the tanks. Styrofoam rims were cut from cups and attached to the front left and right corner of each tank to serve as floating feeding areas. These were attached with fishing line and duct tape. For the first couple of days the feeding areas were not used to get the minnows used to the fish food because they were not exposed to flake food prior to capture. When scheduled feeding started, we fed the fish in opposite corners for AM and PM feeding times as well as opposite side to the tank next to it to avoid the minnows being able to follow what the other tanks' reactions were. Minnows were fed on schedule for 6d then tested and observed on day 7. The observation was conducted by not feeding the minnows at the scheduled feeding time, but instead watching and recording their location in units away from the correct side in the tank for a time every 5min for a total time of 30min. This was done both at the AM feeding time and the PM feeding time. After this test the minnows were released and data analysis commenced. Prior to test day and collecting these data, one tank was omitted from the experiment due all eight minnows escaping. Our sample size was then eleven tanks and not twelve.

Results: These data show that there was no significant difference in the preference of side that the minnows were on ($t=-1.247$, $df=10$, $P=0.241$). The minnows show no indication of time-place learning over the course of a week. We expected to see a lower value for PM distance and a higher value for the AM showing that the fish were

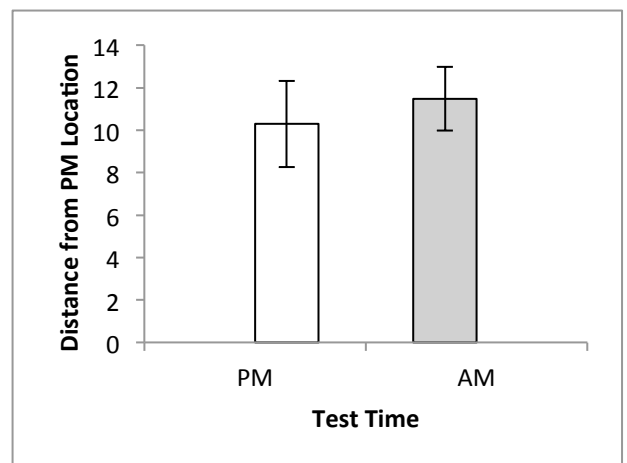


Figure 1: Total average distance (± 1 SE) from the PM feeding location. ($t=-1.247$, $df=10$, $P=0.241$)

no longer near the PM feeding side but as these data show, this was not the behavior that was exhibited (fig. 1).

Discussion: Although the data were found to be insignificant, there appeared to be other factors that could have hindered the results. The experiment done by S.G. Reeb's that we mimicked had gone on for over a month while we only had a week. These data collected in our experiment might also reflect on the species *Pimephales promelas*' inability to exhibit time place learning (Barreto et al., 2006).

Pimephales promelas are known for their shoaling behavior and because of this preexisting behavior, it might be noted that the shoaling leader was not able to learn which hindered the ability of other minnows within the group to learn a behavior (Reeb's, 2006). Further research can be done to test this theory as well as a more controlled version of our own experiment with the fathead minnows with a longer learning time used.

References:

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