Goldfish School: Conditioning and Shaping in an Undergraduate Psychology of Learning Classroom

Riley Craig, Ray Santiago, Lindsay R. Mehrkam
Monmouth University, West Long Branch, NJ

Human-Animal Wellness Collaboratory

Monmouth University | Psychology

Introduction

- Extensive research has demonstrated the effectiveness of learning principles such as classical and operant conditioning for teaching new behaviors in a wide range of species. Recent research has begun to examine how operant conditioning can be applied to nontraditional species beyond humans, such as companion animals.
- Goldfish (*Carassius auratus*) possess long-term memory comparable to other vertebrates and can identify contingencies between behavior and outcomes. Goldfish are able to recognize patterns and be able to differentiate behaviors that result in reinforcement. Goldfish have been shown to have the ability to acquire new behaviors through reinforcement-based learning and demonstrate a memory that is comparable to other vertebrates (Kogan, Frankland, & Silva, 2000). Goldfish have an ability to identify contingencies between behavior and outcomes (Portavella, Torres, & Salas, 2004).
- Positive reinforcement is generally more effective than punishment for reliably increasing desired behaviors and teaching new behaviors (Kobza et al., 2012). This study evaluates the success of using shaping and positive reinforcement to teach novel behaviors to naïve goldfish in an undergraduate classroom and laboratory setting. The present study evaluates the success of a Monmouth University learning course to teach novel behaviors to four naïve goldfish using a step-by-step shaping plan, in which students reinforced small approximations that moved them toward the target behavior.
- A secondary aim of the present study was to evaluate the use of student-conducted preference assessments with the goldfish prior to training target behaviors to ensure the reinforcers used were highly preferred.

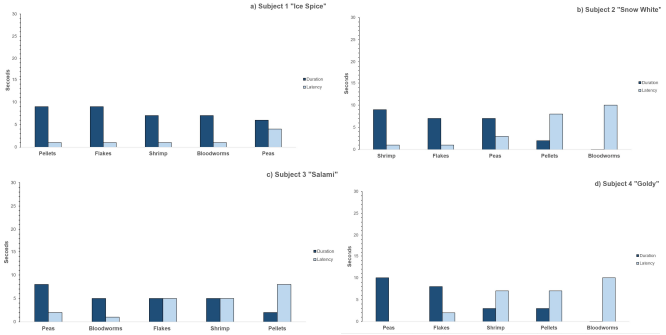
Methods

Methodology

- **Subjects & Setting:** Four naïve healthy goldfish, purchased from a local aquarium supplier, each assigned to a different team consisting of 3-4 students enrolled in a 300-level undergraduate psychology of learning class.
- **Design:** A step-by-step shaping plan was developed for each team, consisting of 10–15 approximations per target behavior, chosen by each team and approved by the instructor/third author.
- **Materials:** A variety of five goldfish-specific food items, stainless steel tea strainers, and shaping materials were used from the R2 Fish School purchased on Amazon.com.
- **Procedures:**
  - Reinforcers were selected based on the results obtained during single-stimulus preference assessments.
  - All four goldfish-student carried out of operant conditioning (shaping plans) for teaching new behaviors across three topographies through a shaping plan (see Table 1 and Figure 2a-c). Each student-goldfish team developed a 10-15 approximation for each shaping plan and reinforced each successive approximation in order to achieve their final approximation or final target behavior. Four goldfish – each assigned to a different team of students – were reinforced on an FR-1 reinforcement schedule for every successive approximation until the criteria was met to move onto the next approximation. In addition, the previous approximation was put on extinction until the final approximation was achieved.
  - Delivered on a Fixed-Ratio 1 (FR-1) schedule (continuous reinforcement) for every successful approximation.
  - Previous approximations were put on extinction as the fish moved toward the final target behavior
  - Once the behavior was mastered (at a criterion of three consecutive trials across two sessions), intermittent reinforcement strategies were used to promote the maintenance of the behavior in the goldfish's repertoires in the long-term and to promote generalization across student trainers.

Part 1 Results: Assessing Primary (Food) Preferences in Naïve Goldfish

Figure 1a-d. Results of single-stimulus preference assessments across five distinct food stimuli for four goldfish. For each stimulus, the latency to approach each food station (light blue bars) and the duration of interaction at each food station (dark blue bars) across 30 second trials is shown. Higher preference is indicated by shorter latencies and longer interaction durations, whereas lower preference is indicated by longer latencies and shorter interaction directions. Bars are arranged with from the most-preferred stimulus to the least-preferred stimulus for each individual to highlight the preference hierarchy.



Part 2 Results: Shaping New Target Behaviors in Naïve Goldfish

Table 1. **Topographies and Definitions of Target Behaviors Shaped**

Target Behavior	Number of Goldfish Trained	Operational Definition
Tunnel	*N* = 1	Swimming through a tunnel submerged underwater.
Playing Basketball	*N* = 1	Pushing a small basketball into a hoop at the surface of the water.
Playing Football	*N* = 2	Pushing a small football across a field and through a goal post.



Figure 2a-c. Images of three student-selected target behavior topographies taught to goldfish included a) "playing football", b) "playing basketball", and c) "tunnel".

- All four goldfish-student teams were able to demonstrate the effectiveness of operant conditioning for teaching new behaviors across three topographies through a shaping plan described above. All four goldfish-student teams mastered new behaviors within 60 trials across three days (individual data can be provided upon request).

Results & Discussion

- The results showed that all four goldfish-student teams were able to master new behaviors within 60 trials across three separate days.
- Students were also observed and reflected on how positive reinforcement was used throughout in order to maintain motivation and keep the goldfish engaged, as well as how the effectiveness of the positive reinforcement and the shaping plan is dependent on the timing, placement, and strength of the reinforcer. Students were able to directly learn and conduct procedures related to the efficacy of reinforcement-based procedures.
- When a person or an animal performs a behavior there is always some form of feedback that they interpret to determine whether the behavior was positive or negative. Research has shown that reinforcement is more effective than punishment, and that positive strategies are generally more successful than negative ones; therefore, the best method for reliably eliciting a desired behavior is to use positive reinforcement (Kobza et al., 2012).
- This knowledge and application of operant conditioning to goldfish can allow us to help others who want to be able to develop effective tools for teaching new behaviors in a wide range of species. This knowledge can be used to

Conclusions & Future Directions

- This study shows that learning principles are not species-specific and can teach new skills - even to goldfish!
- In a Monmouth University learning course, four naïve goldfish were trained through step-by-step shaping, reinforcing small behaviors that moved them toward the target action.
- Students were able to conduct successful preference assessments and deliver effective, individualized reinforcers an FR-1 schedule.
- The successful completion of the preference assessment and shaping plans within a combined 4 weeks supports operant conditioning using positive reinforcement as an effective, humane method for animal care settings.
- Future directions for this work should include evaluation of student learning outcomes, long-term maintenance, additional topographies of behavior, and incorporating social learning.

References

Kobza, S., Ferrea, S., Schnitzler, A., Pollok, B., Südmeyer, M., and Bellebaum, C. (2012). Dissociation between active and observational learning from positive and negative feedback in parkinsonism. PLoS One 7:e50250. https://doi.org/10.1371/journal.pone.0050250

Kogan, J. H., Frankland, P. W., & Silva, A. J. (2000). Long-term memory in goldfish. *Behavioral Neuroscience, 114(5),* 1096–1105. https://doi.org/10.1037/0735-7044.114.5.1096

Lattal, K. A., & Fernandez, E. J. (2022). Grounding applied animal behavior practices in the experimental analysis of behavior. Journal of the *Experimental Analysis of Behavior, 118(2)*, 186–207. https://doi.org/10.1002/jeab.789

Portavella, M., Torres, B., & Salas, C. (2004). Avoidance response learning and emotional memory in goldfish are dependent on different telencephalic pallial systems. *Journal of Neuroscience, 24(49),* 10322–10328. https://doi.org/10.1523/JNEUROSCI.2510-04.2004

Presented at the 2026 Annual Convention of the Eastern Psychological Association in Boston, MA on Thursday, February 26 – Saturday, February 28, 2026

Please direct all feedback to: Dr. Lindsay R. Mehrkam, Monmouth University at lmehrkam@monmouth.edu.