

# Hey Tough Fish, What Are You Lookin' At?

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Can concave and convex mirrors be used to simulate another individual of a disproportionate size to induce different aggression responses from cichlids (*Astatotilapia burtoni*)?



Is the divergence in aggressiveness between convex and concave groups represented in secreted testosterone?

- **Male Aggressiveness and Size:**
  - **Cichlid males are territorial and often fight other males to protect their territory**
  - **Male size is linked to dominance (honest signal of fighting ability)**
  - **winning a fight(even with a mirror) shown induces an increase in circulating androgens like testosterone**



# Experimental Design

## Recording Behavior Using J-Watcher



- Each tank was split in half with a black divider with one male and two females in each section
- Concave or convex mirror was introduced to each tank
- Observed for 10 minutes for aggressive behavior using J-Watcher:
  - Dorsal fin flaring
  - Attacking mirror

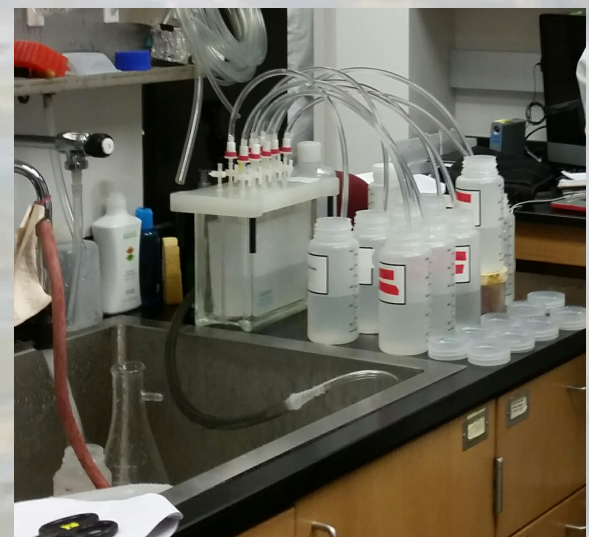
## Secreted Testosterone Measured Using ELISA



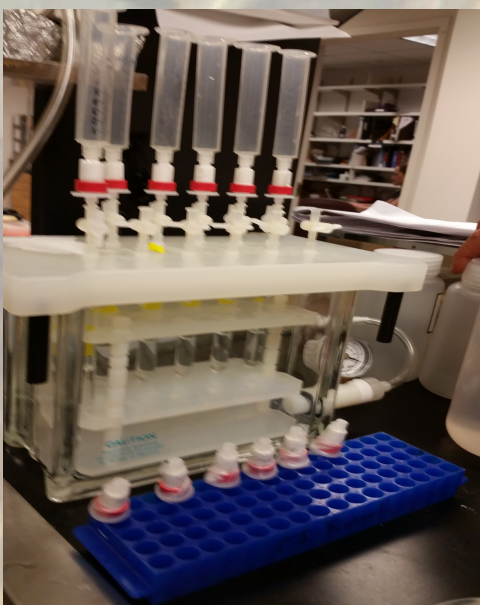
Secreted testosterone collection



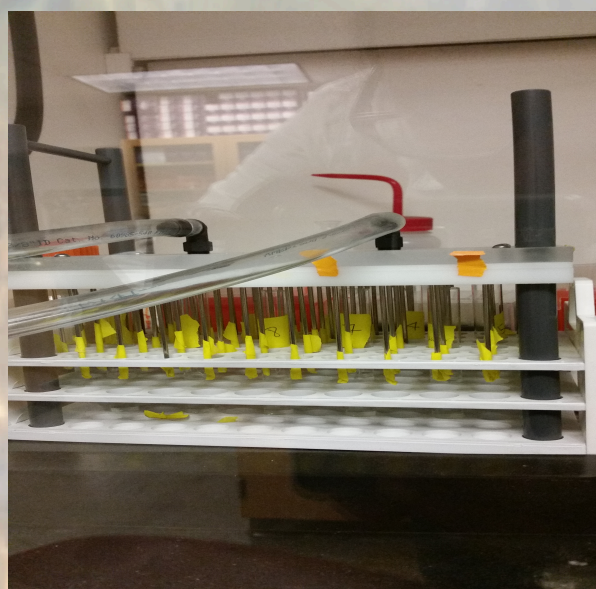
Filtered large particles in fish water



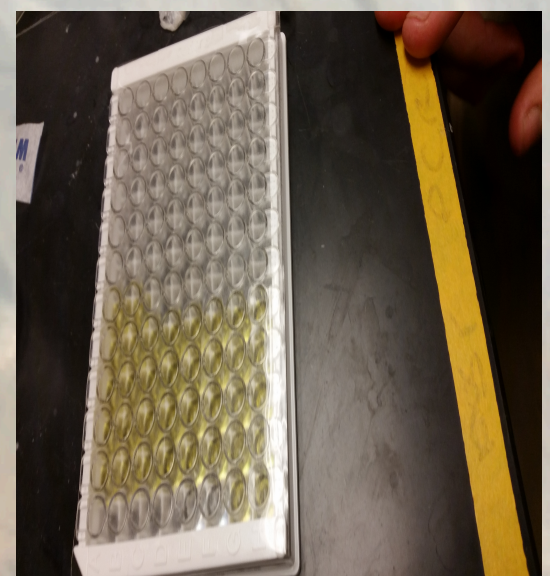
Extracted secreted testosterone from fish water



Eluted samples with ethanol



N<sub>2</sub> used to dry ethanol



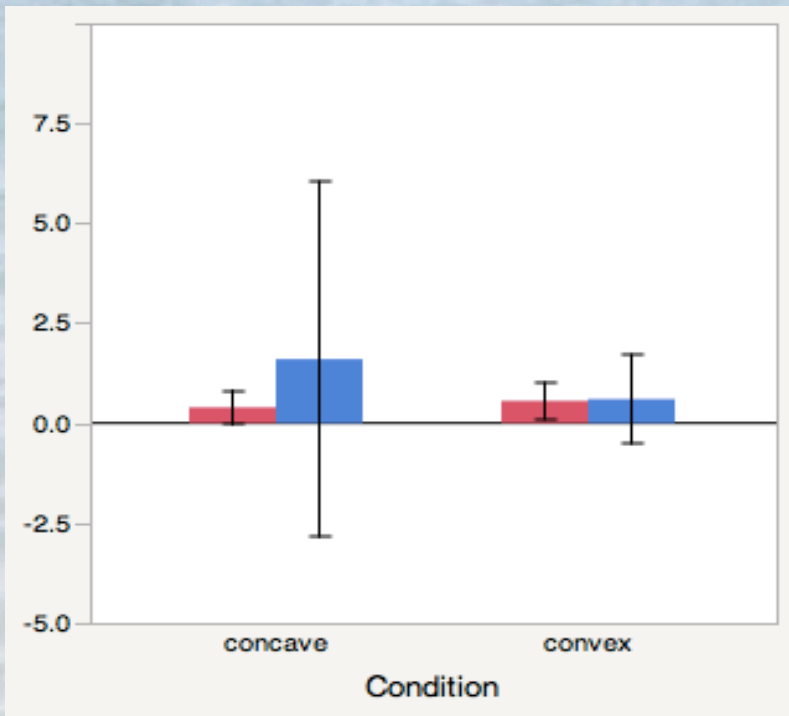
ELISA analyzed using microplate reader



# Results

**NO RELATIONSHIP** between aggressive displays and mirror group (concave or convex)

Proportion of time spent flaring and number of attacks

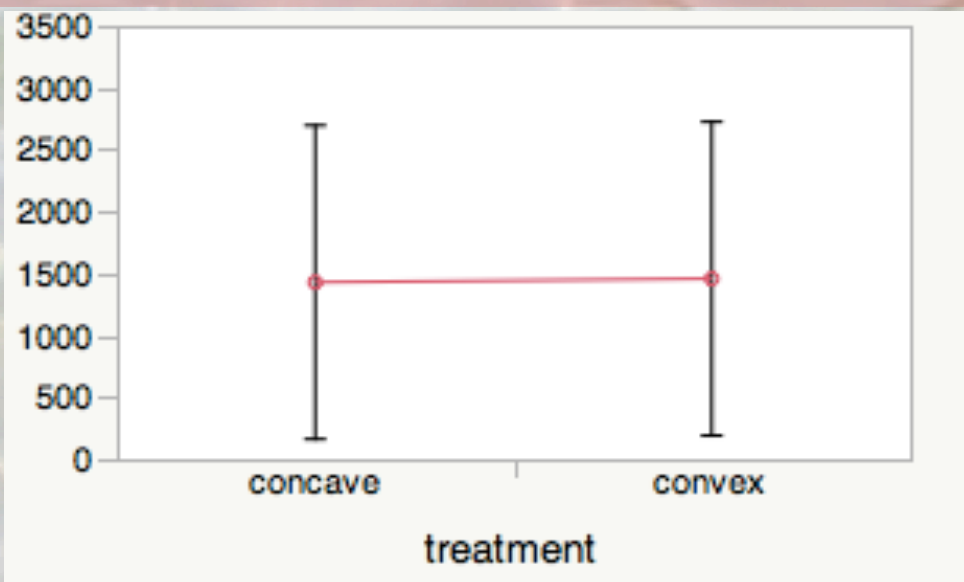


Mean Proportion of Time Spent Flaring

Mean Number of Attacks

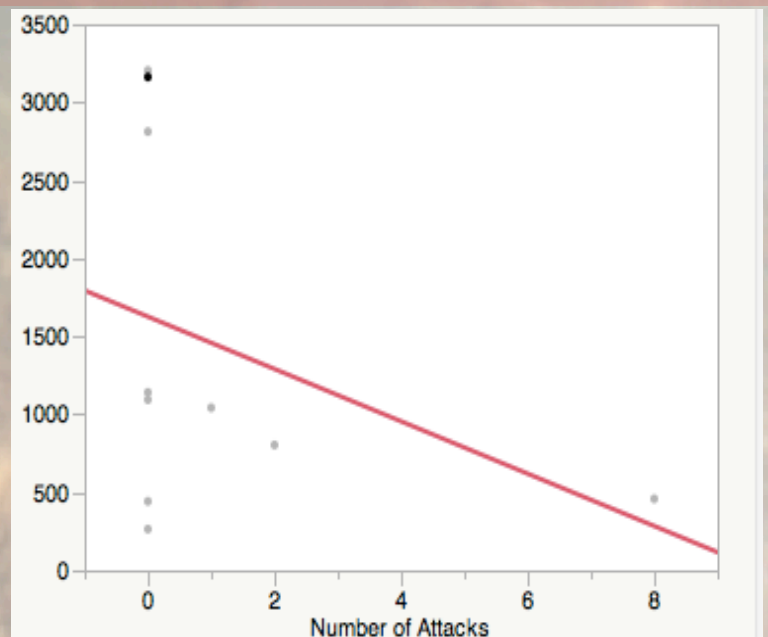
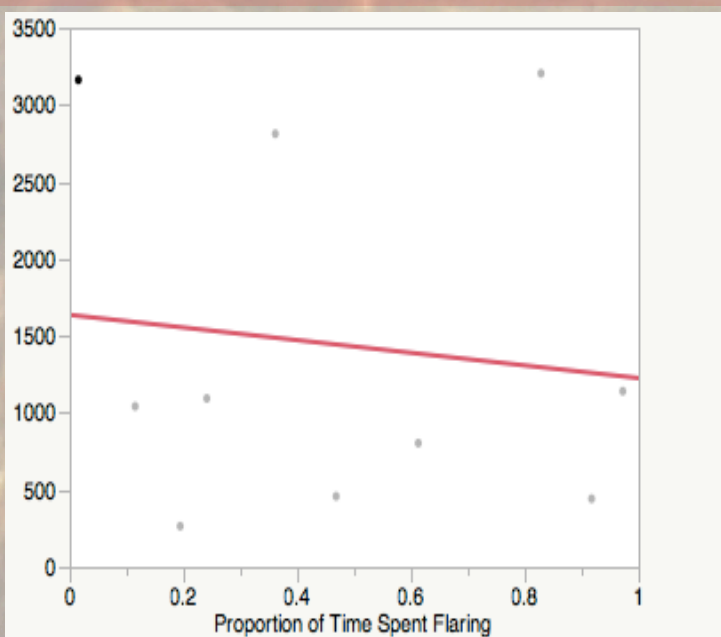
**NO RELATIONSHIP** between secreted testosterone (pg/ml/hr) ÷ cichlid mass(g) and mirror group (concave or convex)

Testosterone secreted (pg/ml/hr) ÷ cichlid mass(g)



**NO RELATIONSHIP** between secreted testosterone (pg/ml/hr) ÷ cichlid mass(g) and aggressive behaviors

Testosterone secreted (pg/ml/hr) ÷ cichlid mass(g)





# Conclusions

Concave and convex mirrors are ineffective at simulating another cichlid fish of disproportionate size.

## Future Directions

Experimental design could be redefined to yield significant results →

- Increase sample size.
- Redefine ethogram to capture more subtle aggressive behavior (Ex. Account for male female interaction)
- Account for environmental variance more rigorously (Ex. Perform behavioral and hormonal measurements at set time)
- Collect more data for comparative analysis (Ex. Test effects of convex/cave mirrors against those of real fish) (Ex. Test effects of flat mirror in addition to convex/cave)

## References

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**J.K. Desjardins, R.D. Fernald.** (2010) *What do fish make of mirror images?* *Biol Lett*, 6, pp. 744–747

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(1) [http://www.huffingtonpost.com/2013/08/29/vincent-connare\\_n\\_3837441.html](http://www.huffingtonpost.com/2013/08/29/vincent-connare_n_3837441.html)

(2) <http://www.nature.com/news/fish-fail-to-see-reflections-as-rivals-1.16099>

## Acknowledgements

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