Competitive Resource-Based Aggression in *Betta splendens*

Reed College
Biology 342

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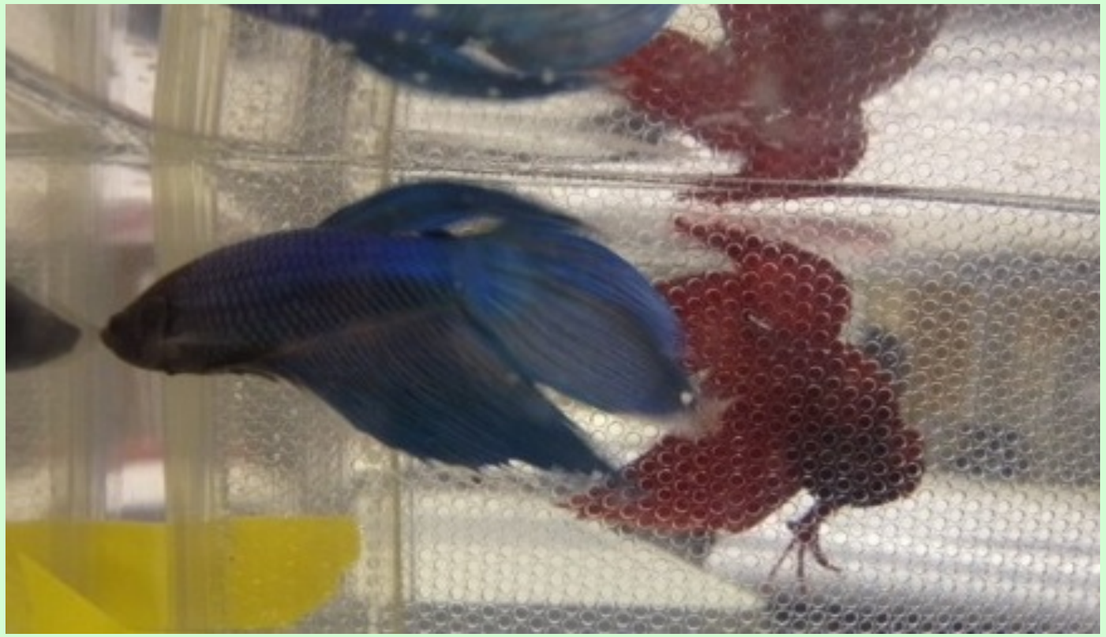
Betta Splendens, more commonly referred to as Siamese Fighting Fish or simply betta fish, are known for their colorful displays and aggression towards other members of their species. Males are commonly more aggressive, vigorously defending their territory, food sources, and potential mates. We explore this aggression when males are presented with various preferable resources.



Betta splendens:

- member of the gourami family
- a favorite among aquarium hobbyists
- primarily bred in captivity
- males display a variety of vibrant colors
- aggressive traits, vivid colors, and longer fins selected for

THE BIG QUESTIONS:

Why do Betta fish display aggressive behaviors?

Do Betta fish prioritize some resources over others as evidenced by aggression?

Are some displays more common in response to a specific type of resource competition?

Experimental Design:

Hypothesis: Betta fish will display more aggressive behaviors when more valuable resources are threatened by competing male fish.

Hypothesized hierarchy of resources as shown by aggressive displays:

- female (in response to presence of female)
- food (in response to food competition)
- territory (in response to intruder)

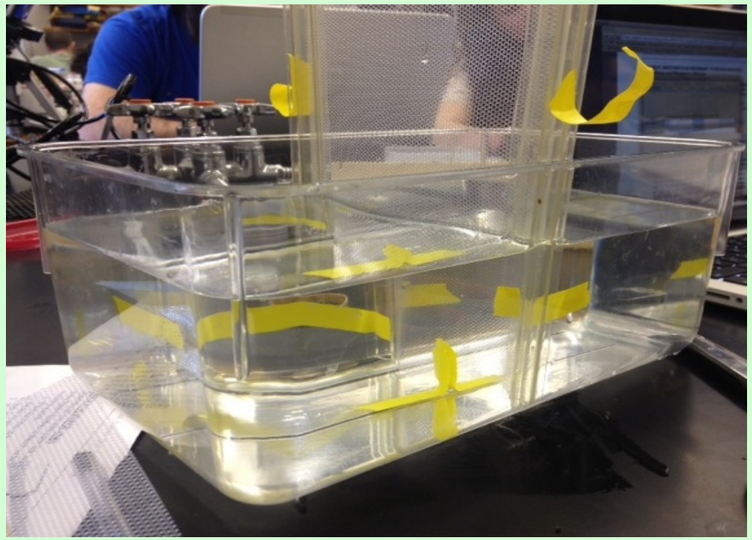


Figure 1. Setup of tank to separate two male bettas. Clear mesh barrier used to allow males to see and smell each other but not come into physical contact for ethical reasons

Table 1. ethogram of Betta fish aggressive behaviors formulated from one hour of observation time after fish had acclimated for one week. Ethogram was recorded and used in J-Watcher.

Behavior	Description
charge	swims into barrier rapidly and repeatedly
mouth open	opens mouth and locks jaw for non-eating purpose
gill flare	operculum flare (under-gill extension)
fin flare	raises dorsal fin upwards
shimmer	displays side within one inch of opponent; color change
jerk	rapid twitching movement resulting in direction change
approach	swims in direction of opponent
pacing	stereotypic circular swimming around edge of tank
retreat	swims in opposite direction of opponent

Test Execution:

- Territory: fish acclimated for one week in their respective tanks before intruder (from its own tank) was presented
- Female: female was presented in a separate section of the tank and allowed to swim freely between the sides containing the males
- Food: fish were starved for 24 hours before a tea bag food was placed on the side of the opponent fish

Results:

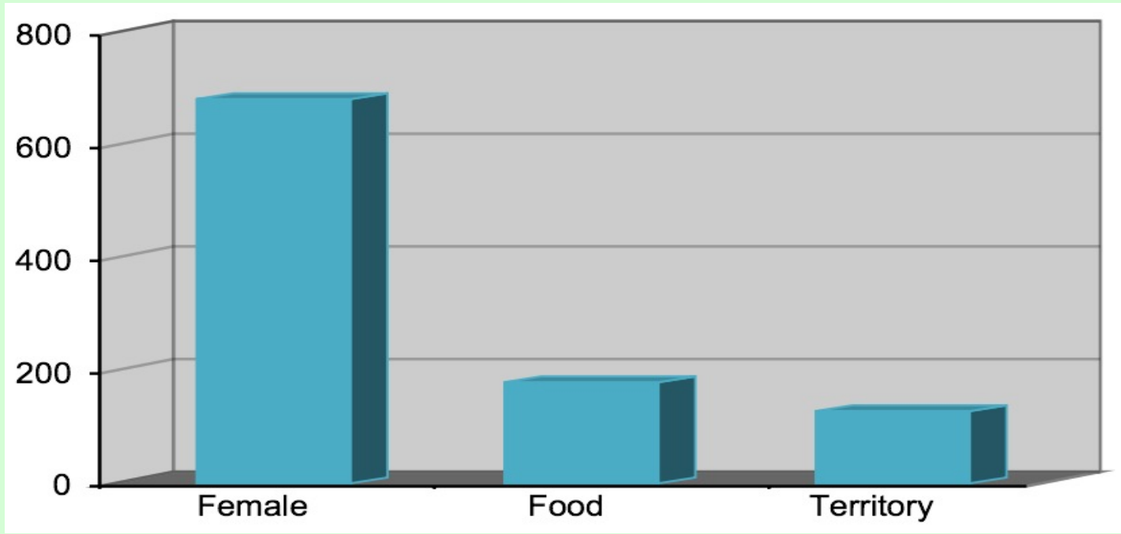


Figure 2. Average aggressive behavior display score by reseource-type test. Totsl points for all behaviors scores divided by three for three trials performed for each test. Data analyzed in JMP (p=0.0326)

Hypothesis proven significant (p=0.03260)

- Female courtship test ranked highest for aggressive displays (average = 680)
- Food competition test (average = 177)
- Territory defense test ranked lowest for aggressive displays (average = 127)

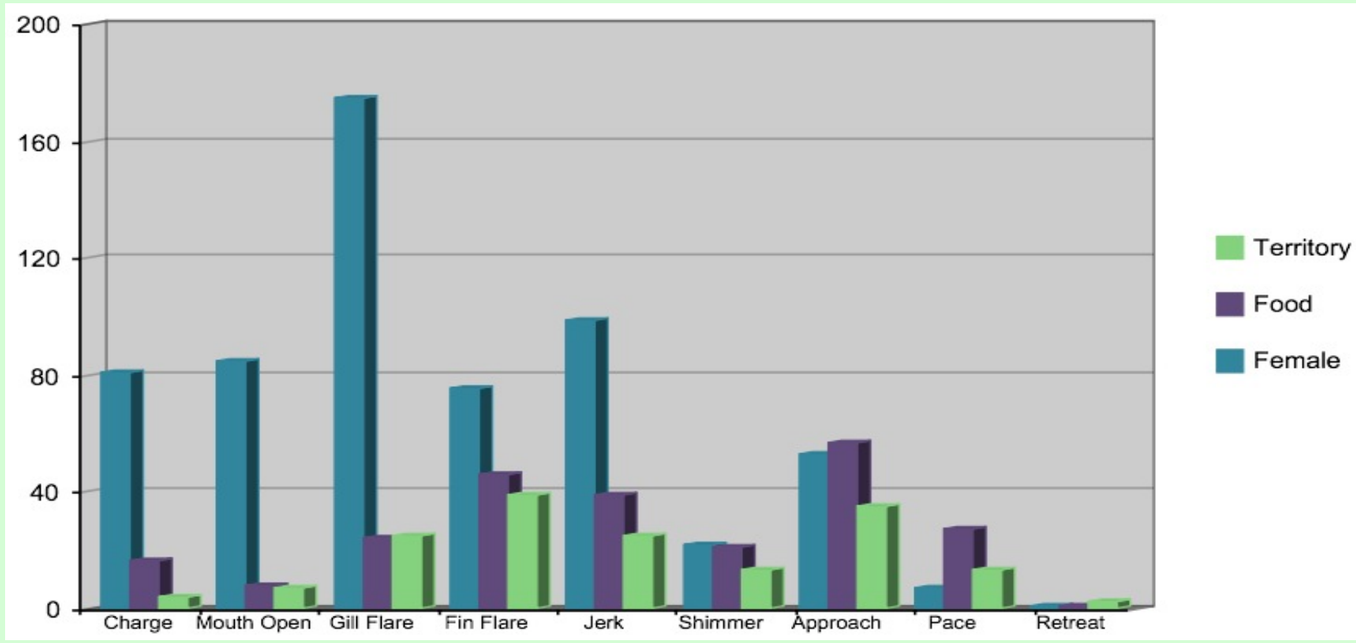


Figure 3. Aggressive behavior display type and count as categorized by resource-test type. Total number of displays per behavior for three trials each test-type. Not analyzed for significance.

Behavior	Aggression Score
charge	+5 points
mouth open	+5 points
gill flare	+4 points
fin flare	+3 points
shimmer	+2 points
jerk	+2 points
approach	+2 points
pacing	0 points
retreat	-1 points

Table 2. Point values (aggression score) assigned to behavioral displays ranging from +5 to -1. Values assigned in accordance with assumed aggression from prior literature and observed reaction by opponent fish

Data was analyzed in JWatcher, JMP (1-way ANOVA, and Microsoft Excel

Discussion:

Future Directions:

- exploration of cost/benefit model by presenting fish with more adverse consequences to aggression
- explore intra-species territory competition
- analyzing types of displays presented in response to competition of specific resources

Conclusions:

We can conclude from this study that betta fish will display more aggressive behaviors when presented with more valuable resources, suggesting an aggression hierarchy. This may correlate with a cost/benefit model for aggressive behavior in this species, suggesting the theory that the fish to choose to display aggression when appropriate and avoid aggression when the cost is too high. Competition proves to be a causation factor of conspecific aggression in these animals.

References:

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