

Mechanisms of Sexual Selection in the Common Guppy

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Cumana, Venezuela, home to the endler lineage of the common guppy. Unlike other guppy lineages, the endler is found exclusively in this region. Originally the endler was classified as a distinct species but now is considered highly differentiated morphotype of *P. reticulata*

- ❖ Previous research has shown partial prezygotic isolation between two lineages of *Poecilia reticulata*: the common guppy and the endlers livebearer. Female mate choice is thought to drive this isolation.
- ❖ This isolation has resulted in morphological and behavioral divergence, and may signal incipient speciation. The endler morphotype is marked by distinct coloration patterns and an elongated body ⁽¹⁾.
- ❖ Our experiments investigated the roles of visual and behavioral signals in determining female preference for their ancestral lineage.
- ❖ Female preference for males of her ancestral lineage could allow females to select for genes well suited for the environment, or be a result of run-away sexual selection since females do inherit trait preferences ⁽²⁾ and no genetic incompatibility between the populations has been observed.

Which would you choose?

What mechanisms do females use to select a male of their ancestral lineage?



Although endlers and guppies are technically the same species, populations in Cumana differ up to 2.56% in mitochondrial DNA⁽¹⁾.

The guppy is an ideal organism for studying sexual selection. Males vary in secondary sexual traits and female mate choice plays a crucial role in determining the success of heritable male characteristics.

Size

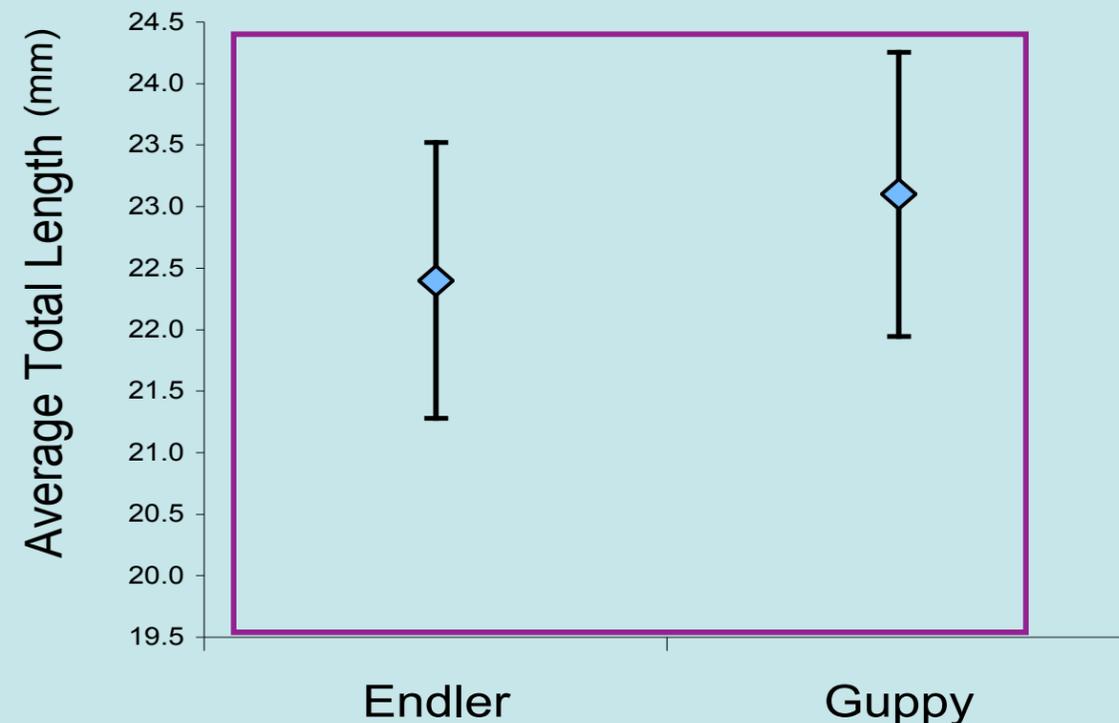


Figure 1. There was no statistically significant difference between the total lengths of the endler and guppy males. It was important to use similarly sized males because previous research has shown that male size influences mate choice⁽³⁾.

Color

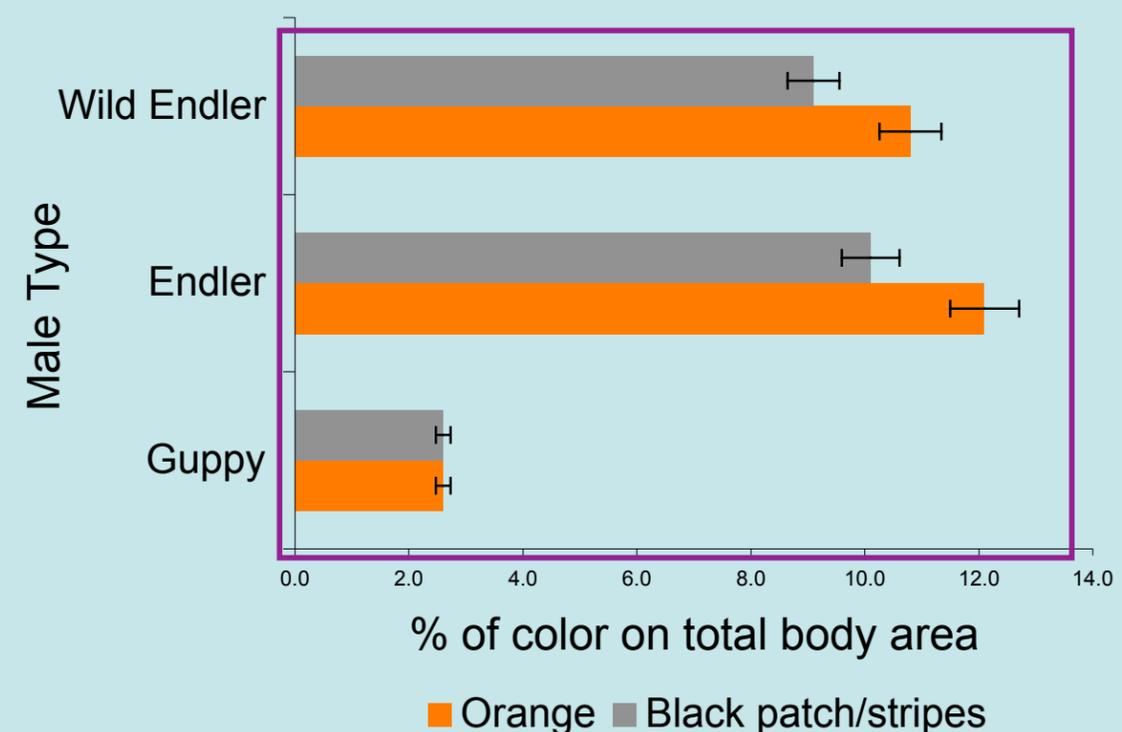


Figure 2. Male endlers had a significantly more orange and black patches and/or stripes than male guppies. The aquarium endlers we used did not have significantly different color patterns from the wild endlers, thus our findings may be generalized to wild endler populations.

Experimental Design and Control

Fish Tank Set-up

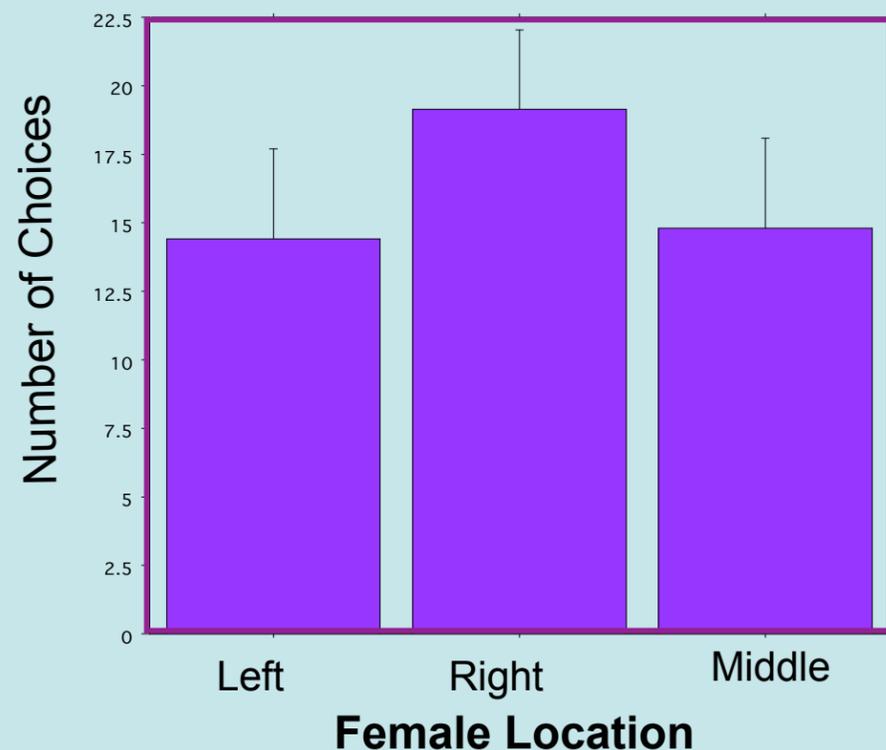


Figure 3. In the absence of visual or behavioral stimuli females significantly preferred the middle 55mm of the tank in 34 trials, where a plant provided cover ($P < 0.05$). Since females preferred the middle third of the tank in the absence of males, the change in female position in our experimental trials reflects female preference.

Control Trials:

- Females were placed in the tank in the absence of males to control for side preference. We found that females preferred to stay in the middle of the tank, under the cover of a plastic plant.

Two Choice tests were used in the Experimental Trials:

- The first confined the male movement by placing them in test tubes to prevent display behaviors, and prompting females to respond solely to visual stimuli.
- The second allowed males to move freely prompting females to respond to both visual and behavioral stimuli.

Behavioral Stimulus:

Males exhibit excited behavior in the presence of a female and curve their body sigmoidally in a mating display.



RESULTS: The best looking don't always win?

Females prefer dull guppies to flashy endlers based on visual stimuli

Female preference for endler or guppy males in response to visual stimuli

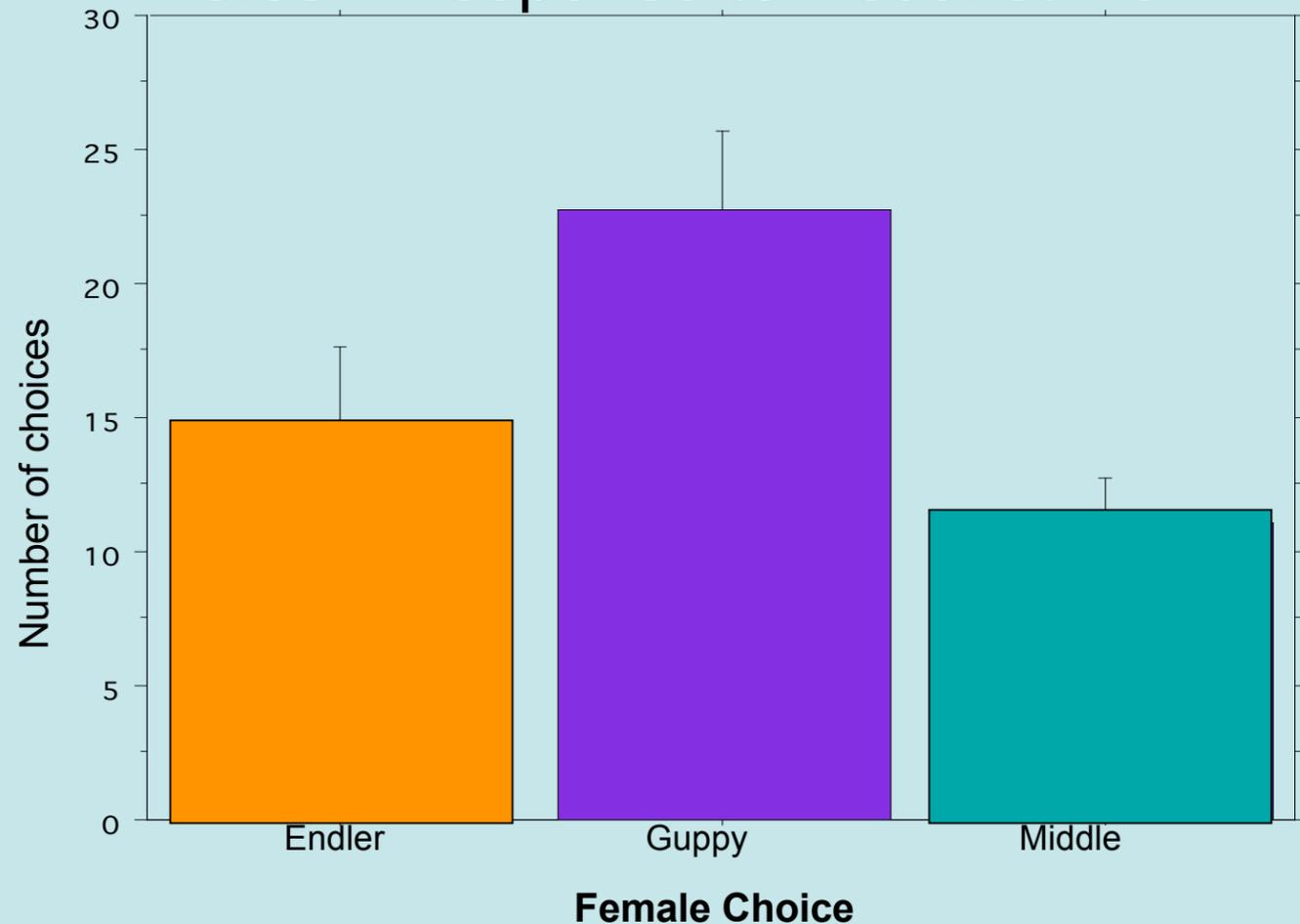


Figure 4. In 35 trials, females significantly preferred male guppies based on visual stimuli ($P < 0.001$)

Female preference for guppies or endlers in response to visual and behavioral stimuli

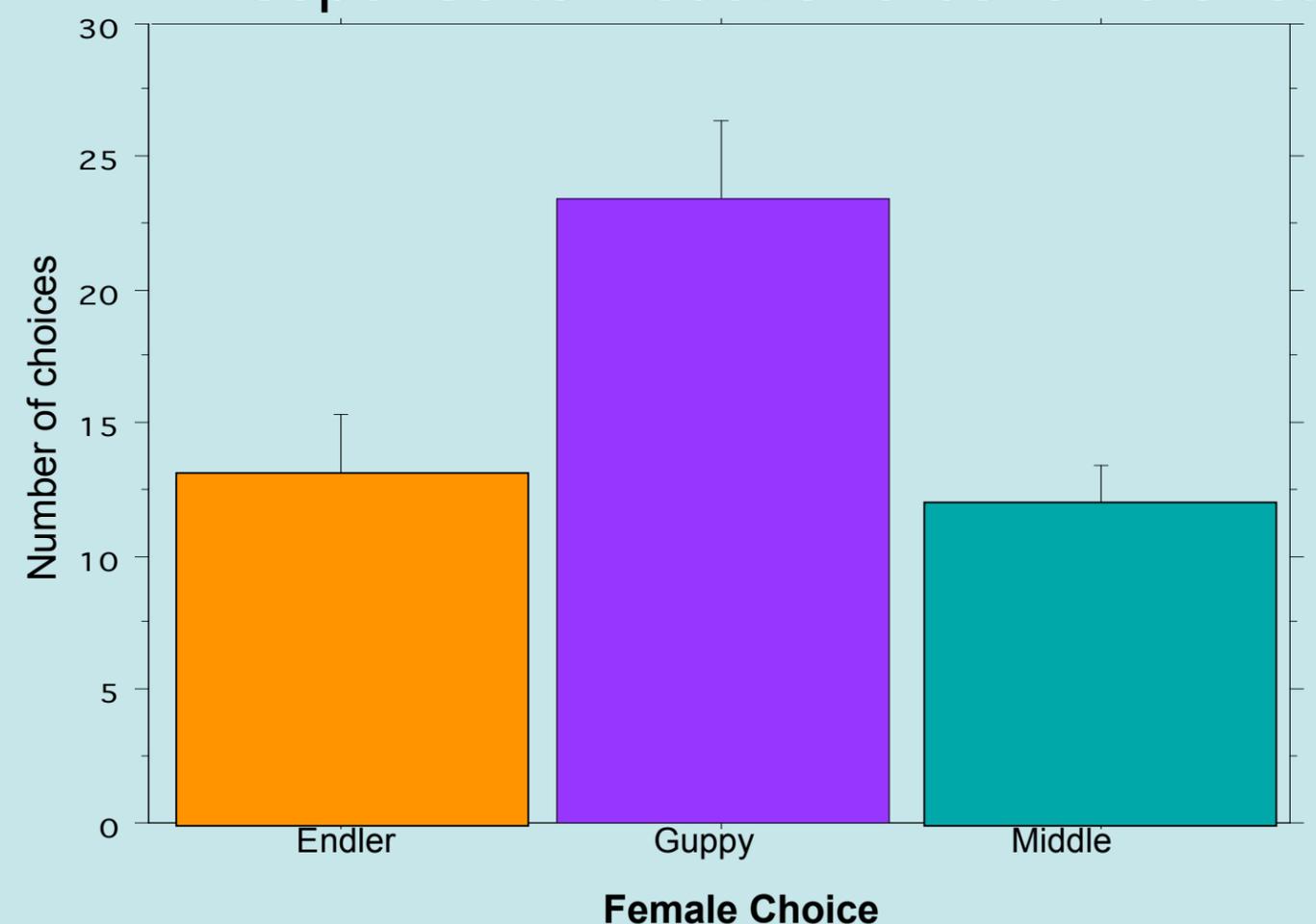


Figure 5. In 40 trials, females significantly preferred male guppies based on both visual and behavioral stimuli ($P < 0.001$)

In both experiments females preferred male guppies over brighter endlers; this conflicts with previous research on guppy mate choice, which suggests that females prefer bright orange males to other mates⁽⁴⁾. We found no significant difference between female preference for guppies in the visual and behavioral choice tests. However, all endlers and some male guppies failed to exhibit typical display behavior; this likely influenced female responses. These results indicate that females primarily use visual cues to differentiate between “foreign” males and males of their ancestral lineage, causing sexual selection that may eventually lead to reproductive isolation.

Judging a book by its cover:

Visual cues allow females to select ancestral lineage males.

Our results support the hypothesis that a female guppy's preference for males of her ancestral lineage is visually, and possibly behaviorally, based. Our results strongly support the hypothesis that female preference is driving reproductive isolation between these two populations. Previous research has shown that females inherit a preference for certain male secondary sexual characteristics, such as coloration⁽²⁾; this could explain females' preferential breeding with morphologically similar subpopulations.

Females have been shown to prefer orange guppies, but in our experiment they visually distinguished between the orange endlers and dull guppies. Based on our results, we hypothesize that females use the distinctive black spots and lines unique to the male endlers to differentiate between their ancestral lineage and the endlers. Against a bright orange background, these lines and spots provide a visually rich cue to females about the ancestry of the male.



Further Research

Future studies should investigate whether females are using coloration patterns (rather than body conformation) as the visual cue for mate choice. Dye could be injected subcutaneously in male guppies to mimic the spot patterns of endlers, and female mate preference subsequently observed. The role of divergent mating displays in the two populations should also be considered more rigorously. We did not observe any male endlers displaying during the behavioral trial, but researchers have reported that endler displays substantially differ from guppy displays⁽¹⁾. Females may use lineage specific mating behaviors as an additional cue in choosing a mate.



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Selected references:

1) Alexander, H. J. & Breden, F. (2004). *Sexual isolation and extreme morphological divergence in the Cumaná guppy: a possible case of incipient speciation*. *Journal of Evolutionary Biology*, 17: 1238-1254.

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3) & 4) Godin, Jean-Guy J. & Lee Alan Dugatkin. (1998). *How females choose their mates*. *Scientific American*, 278: 56-61.