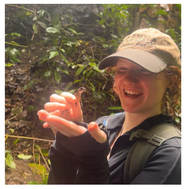

Visual acuity of a non-model semi-aquatic anole shows possible consistency between sexes

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Introduction

- Visual acuity is an organisms' ability to discern detail.
- Across species, males and females have evolved important behavioral and cognitive differences, including the way they perceive the world.
- These sex differences are crucial to understanding the reproductive investments and life history tradeoffs of males and females. For example, *Heliconius* butterfly males have greater visual acuity than females due to divergent environmental pressures[9]
- *A. aquaticus* have varying observed differences between sexes. These differences include; morphological differences such as body size (males being larger, males having larger more colorful dewlaps) [6], as well as behavioral differences such as higher boldness in males [8].In response to threats, *A. aquaticus* can dive water, and remain submerged for extended periods of times, however males tend to resurface faster than females [5]. All of these differences in behaviors and morphology could allow for potential differences in visual acuity between sexes.

Study Species

- The water anole (*Anolis aquaticus) (Figure 2)* is a semi-aquatic lizard found in Costa Rica and Panama that inhabits rock ledges along rivers and streams[6] (*Figure 1*), with a visually complex environment.

Figure 1. Habitat example, research site, Rio Java, San Vito, Costa Rica.

Figure 2. Anolis aquaticus

Research Objectives

1. Investigate potential differences in visual acuity between male and female *A. aquaticus.* We predicted that **females would have greater visual acuity than males due to different behavioral selection pressures, as female *A. aquaticus* choose mates based on a male's complex rapid head-bobbing motions.**
2. Compare *A. aquaticus* to other known anole visual acuity models to determine potential variance due to their unique semi-aquatic environment. *A. aquaticus,* unlike some other terrestrial anoles, is able to identify prey even when it is immobile [3].

Methods

Collection and Field Sites

A. aquaticus were captured across several field sites in southern Costa Rica. They were brought to lab for trials, measured for various body size metrics, and then released to their respective capture location.

Experimental Design

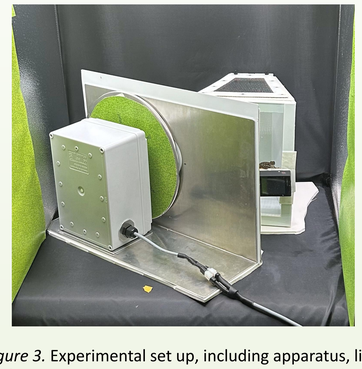

Figure 3. Experimental set up, including apparatus, lightbox, enclosure, and camera to monitor and record trials remotely.

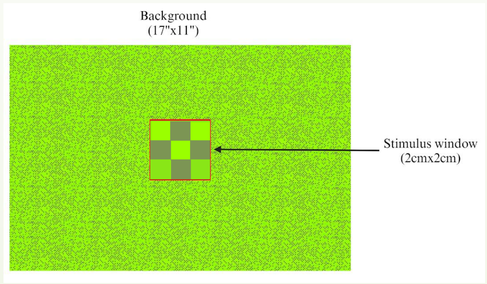

Figure 4. Stimulus window and background. Through the stimulus window, five sized checkerboard patterns were displayed to each lizard. (1mm, 2mm, 3.6mm, 7mm, 14mm)

Figure 5. Example of no response to stimulus, *A. aquaticus* remains in neutral position, eye does not move toward stimulus.

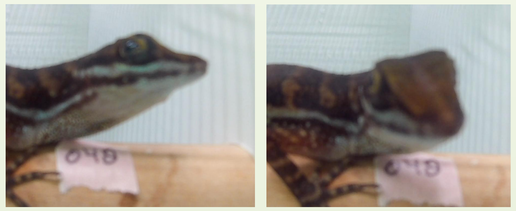

Figure 6 & 7. Example of visual grasp response to stimuli, *A. aquaticus* shifts gaze toward stimuli, or reposition towards stimulus.

Results

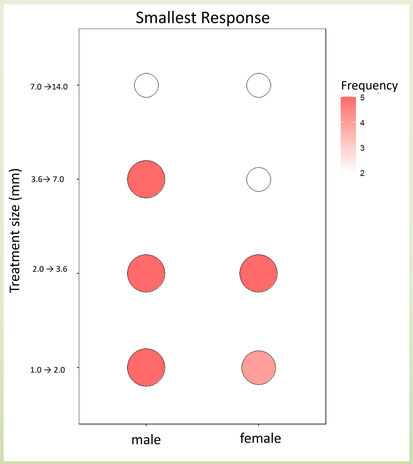

Figure 8. Shows the smallest stimuli size individual females and males responded to.

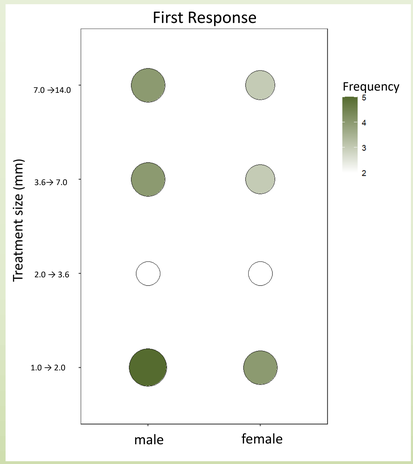

Figure 9. Shows the first stimuli size individual females and males responded to.

Comparison of Peripheral Visual Acuity in *Anolis* Species

Species	Visual Acuity (cpd)	Method
Anolis sagrei	1.21	Behavioral[2]
Anolis carolinensis	~1.25	Anatomical & Behavioral[1]
Anolis aquaticus	**0.916**	**Behavioral**

Table 1: Shows **observed behavioral visual acuity** in *Anolis aquaticus* in comparison to published visual acuity in other *Anolis* species. To calculate this measurement, we used the Visual angle-based acuity calculation where: visual angle of one cycle (θ) = 2*arctan(half cycle width/viewing distance)[4] then; Acuity (cpd)= (1/ θ). It is important to note viewing distance was adjusted to correlate to viewing distance used in other studies (21cm).

Discussion

- Overall, no significant differences were observed between the visual acuities of male and female *Anolis aquaticus (Figure 8, Figure 9*).
- This is the first time visual acuity has been documented in a non-model, semi-aquatic anole.
- Observed visual acuity appears to be *lower* in *A. aquaticus (Table 1)*, but it is important to note observed peripheral visual acuity does not represent actual visual acuity. In the comparative studies, lizards were purchased from a commercial supplier and were more accustomed to lab settings, potentially allowing for higher frequency response rates.
- Further research with smaller resolution size is needed to determine differences between *A. aquaticus* and other anole species, there is still potential for sex differences in visual acuity. Future research should investigate their foveal vision vs. peripheral , since this study focused on peripheral visual acuity.

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