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Anolis carolinensis exhibits background-dependent, spectrally refined camouflage: chromatic shift dynamic principles and biomimetic potential

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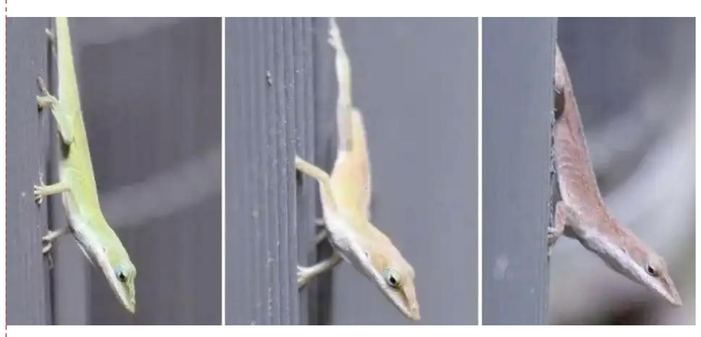
INTRODUCTION

Many animals can achieve the purpose of camouflage by changing their body color. Previous studies on camouflage behavior mainly focused on analyzing the static color characteristics of animals. However, systematic studies on the regulatory mechanisms of environment-induced chromoplasticity are still scarce.

The combined effect of various pigment cells in the skin of the *Anolis carolinensis* enables it to rapidly change its body color in response to the environmental background. The color change range of its back skin is generally from **green** to **brown**.



METHOD

Achromatic Contrast

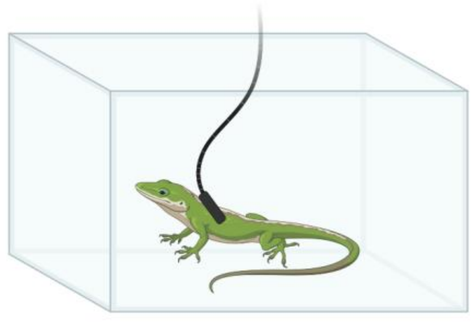
Chromatic Contrast

Overlap

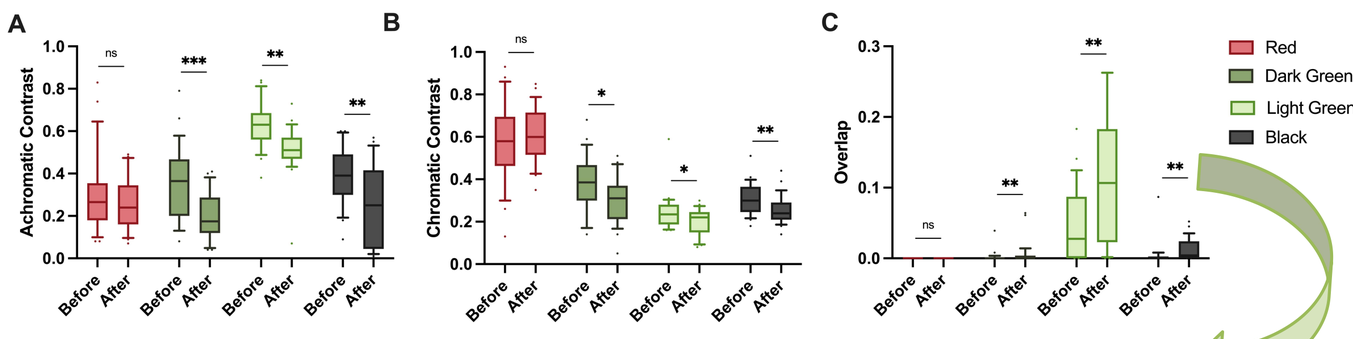
Time

Individuals of the *A. carolinensis* are exposed to four uniform colored substrates, which are designed to span ecologically related and unrelated background colors. The temporal dynamics of achromatic, chromatic contrast, overlap, reflectance and color change were quantified.

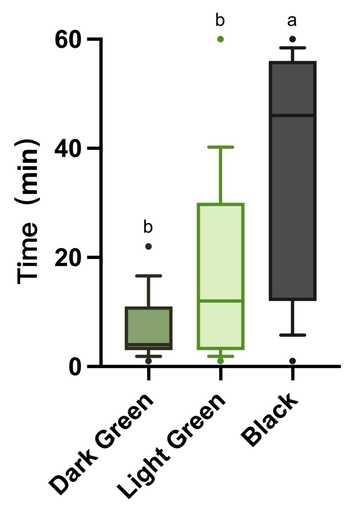
Reflectance (360-760 nm)



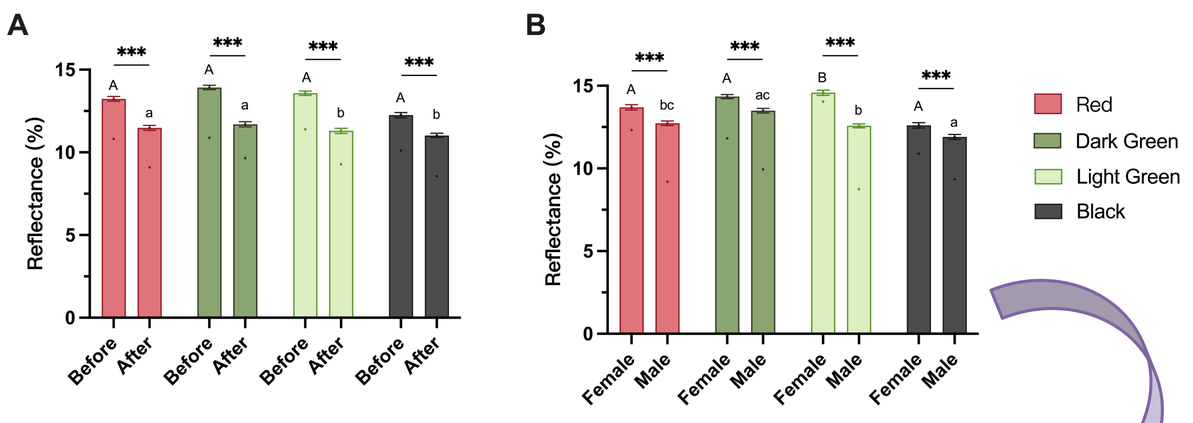
RESULTS



Against backgrounds resembling the species' native habitats, the achromatic and chromatic contrast between the lizard's skin and the background are significantly reduced, while increasing overlap. Conversely, against the ecologically alien red background, no statistically significant chromatic adjustment occurred, and background-matching indices remained unchanged.



The time required for color change was likewise background-dependent, with the fastest shifts observed against dark-green and the slowest against black.



Within the 360–760 nm waveband, the stabilized dorsal reflectance decreased significantly by 12–28 % relative to baseline; nevertheless, stabilized reflectance values remained markedly higher against red and dark-green backgrounds than light-green and black ones, with males consistently exhibiting lower mean reflectance than females.

CONCLUSION

These findings demonstrate that *A. carolinensis* employs a dynamic, spectrally fine-tuned background-contingent strategy for maximizing fitness through optimized concealment. The systematic investigation of how the body color of *A. carolinensis* responds to backgrounds not only paves the way for elucidating the underlying physiological control mechanisms, but also provides a biological prototype for the design and fabrication of actively color-changing biomimetic camouflage materials.

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