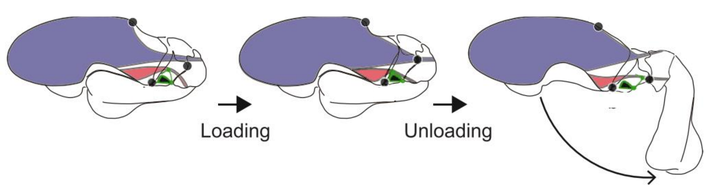
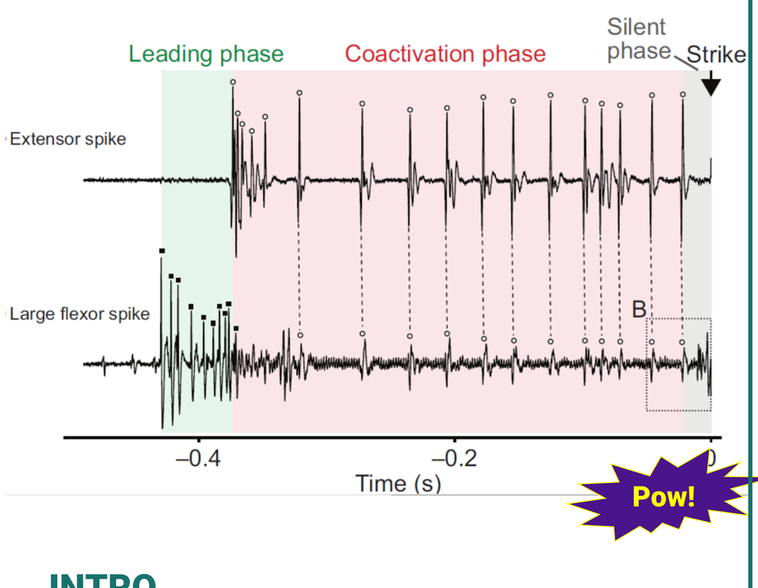
Pow! Mantis shrimp strikes can add citizen science to a rigorous neuroscience curriculum.

An Electrophysiological Investigation of Power-Amplification in the Ballistic Mantis Shrimp Punch

Daniel J. Pollak, Kathryn D. Feller, Étienne Serbe, Stanislav Mircic, and Gregory J. Gage J Undergrad Neurosci Educ (JUNE) 17(1), T11-T18





INTRO

Mantis shrimp make excellent organisms of study for the classroom.

Nearly unstudied power-amplification mechanisms [1] with EMG (below).

500+ species, ~1% striking parameters studied

Putting EMG technology into the hands of ordinary people could facilitate discovery and learning in the classroom.

METHODS

New species-agnostic technique for arthropod EMGs enables recordings across multiple days in a laboratory exercise takes students through the scientific process from start to end.

RESULTS/DISCUSSION

Distinctions in power-amplification burst parameters within both arthropod taxa and mantis shrimp species.

WORKS CITED

[1] Kagaya, K., & Patek, S. N. (2016). Feed-forward motor control of ultrafast, ballistic movements. J Exp Bio, 219(3), 319–333. https://doi.org/10.1242/jeb.130518

ACKNOWLEDGEMENTS

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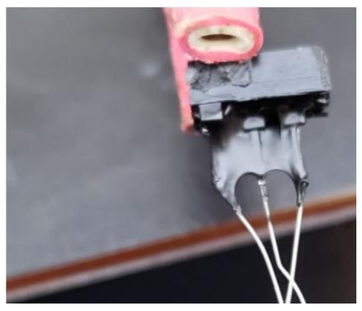
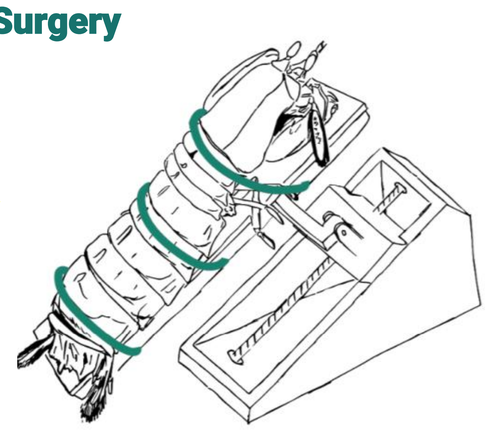
Fabrication



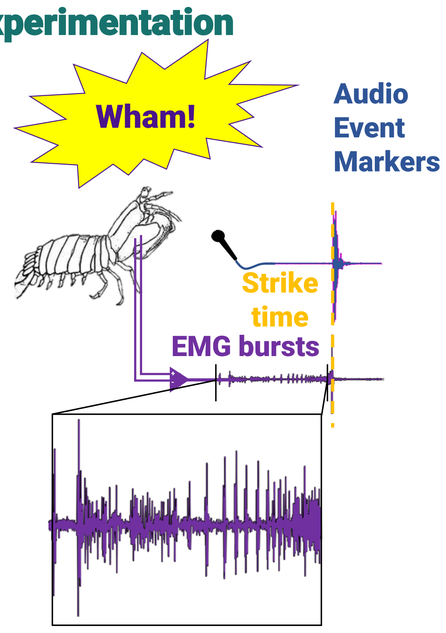
To understand power amplification, you need to understand the electronics used to measure it.

Surgery



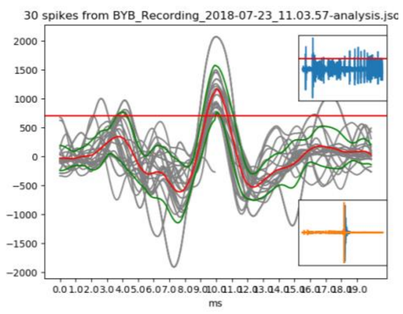
Don't worry, this process is resilient to small mistakes. And each mistake is a learning opportunity about anatomy!

Experimentation

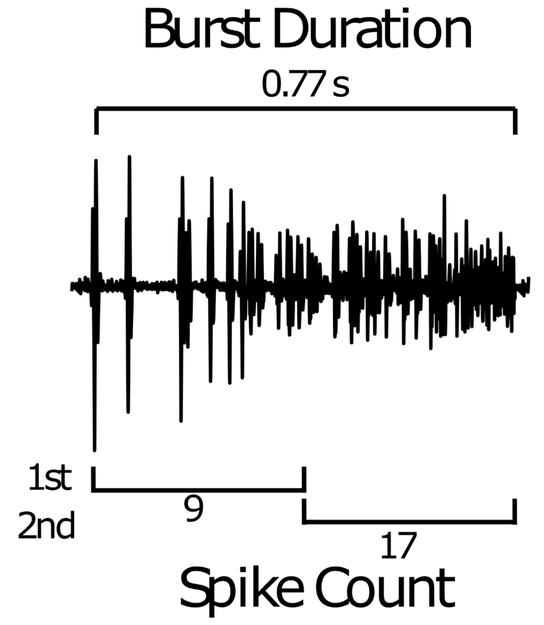


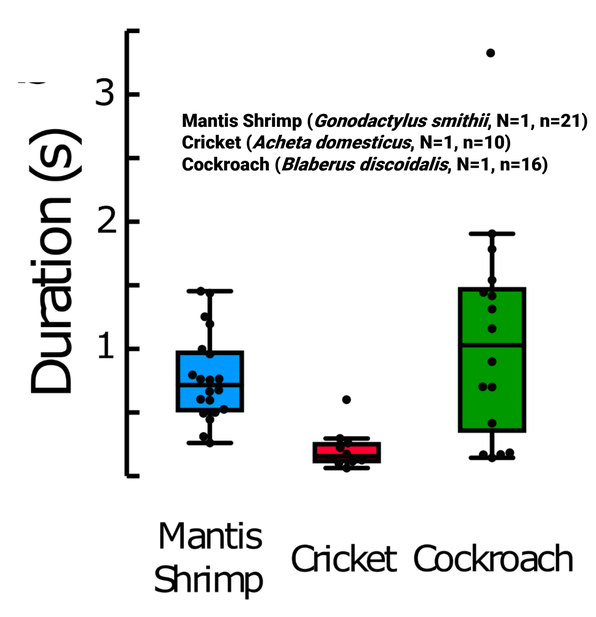
Students set up and use a rig for recording EMGs while eliciting behavior.

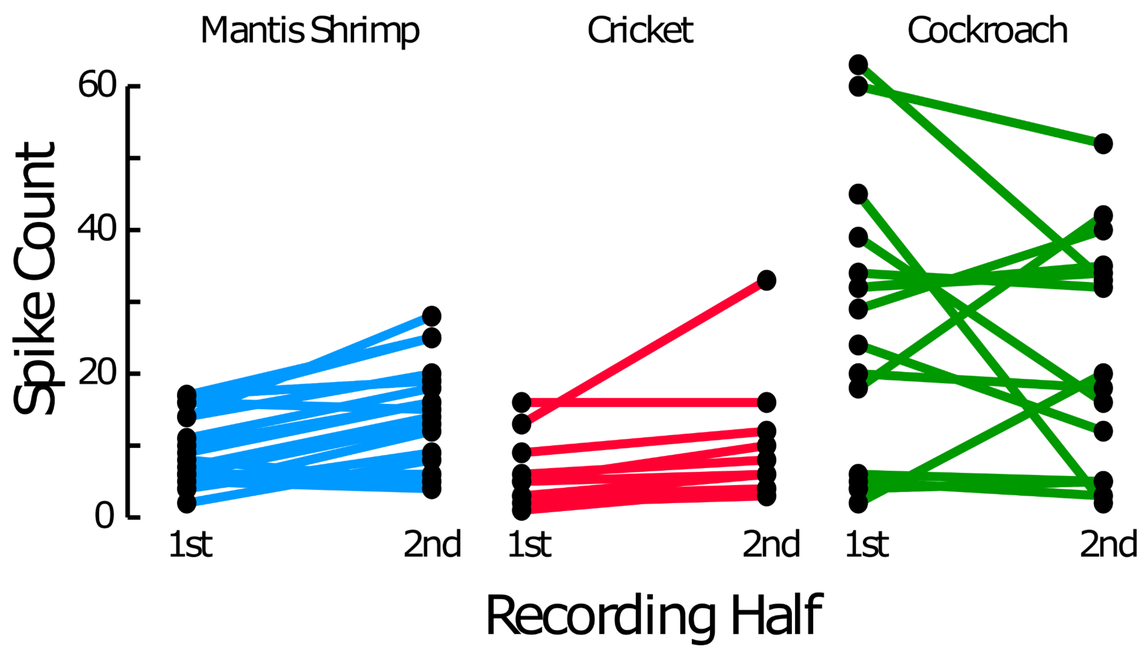
Analysis



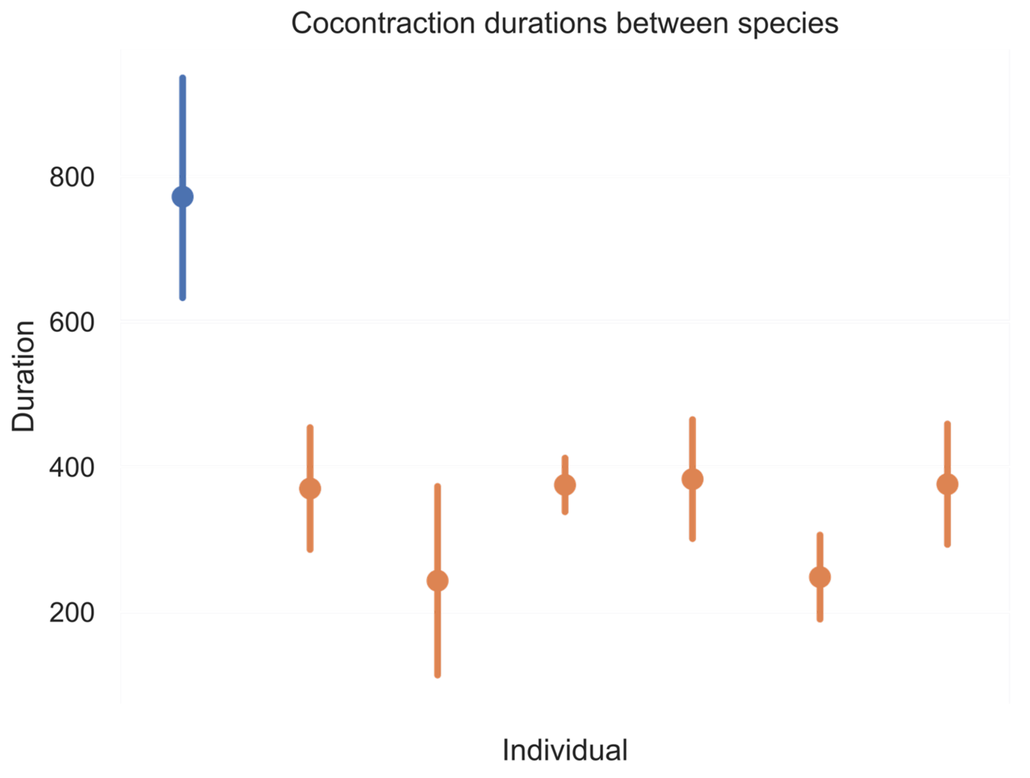
Students explore their data in Python to learn how to ask questions… some of which have never been asked!







From comparing arthropod taxa (top) to mantis shrimp species (bottom), this technique can open up the world of arthropods.

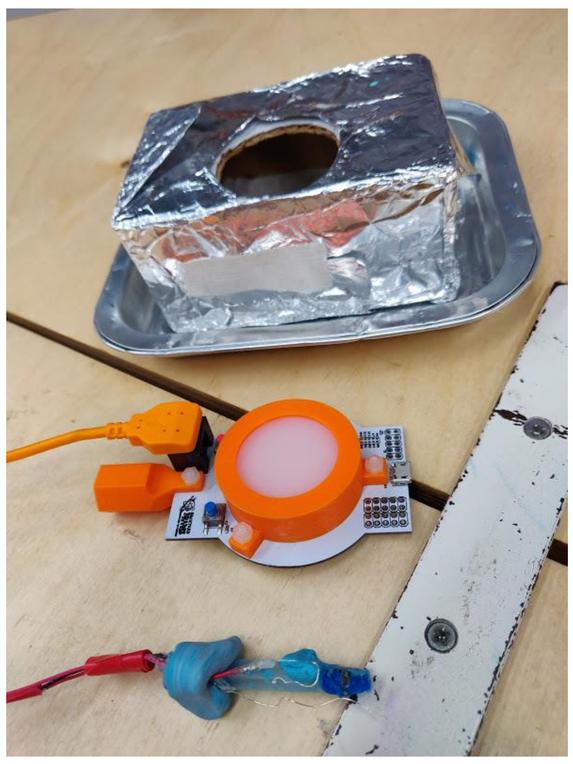


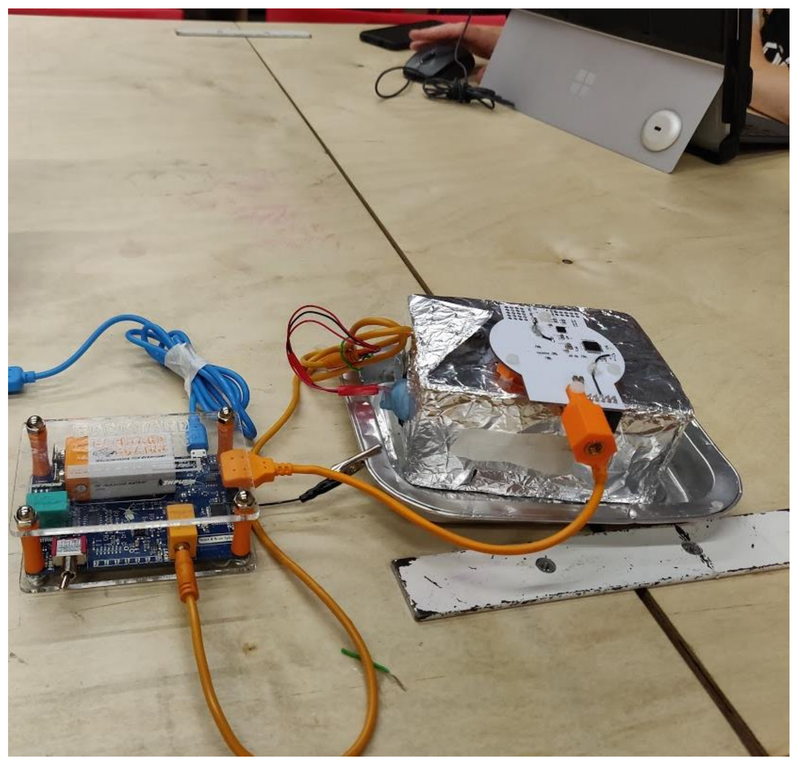
Affordable electrophysiology turns the citizen into a scientist

Crowd-sourcing insect biodiversity with DIY electroretinograms.

Daniel J. Pollak, Mattias Meier, Aljoscha Leonhardt, Gregory J. Gage, and Étienne Serbe

INTRO Though insects are the most diverse group of animals [1], they are underrepresented in the biological sciences. Electroretinograms (ERGs) shed light on ecology and evolution [2].
We designed an affordable ERG rig for citizen science.
METHODS ERGs were taken from honeybees with a ground electrode in the thorax and a signal electrode on the eye. The insect is restrained with Blu Tack and wax.

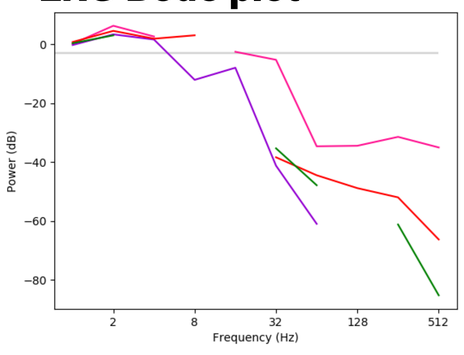




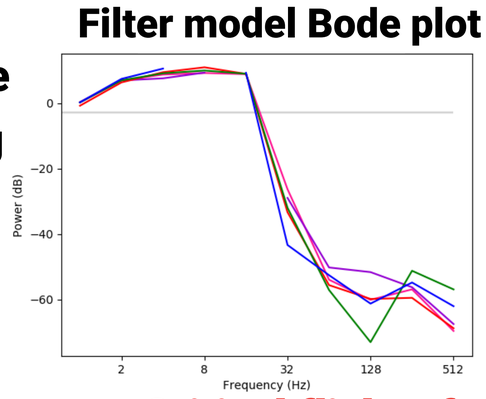
WHY INSECT ERGs?

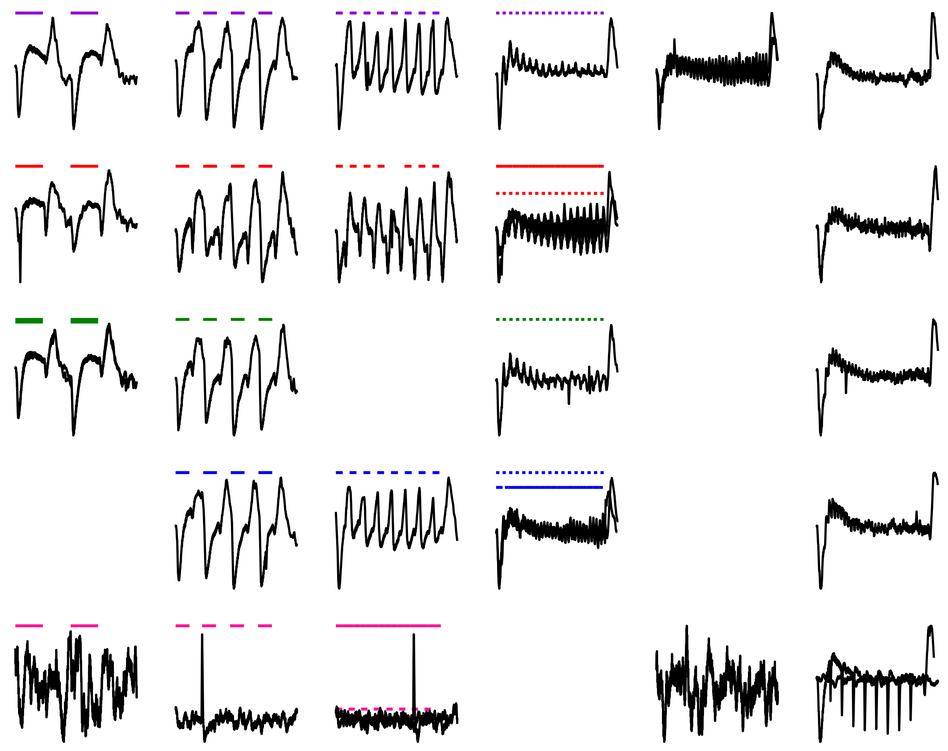
Climate change denial, indifference to waning biodiversity, and innocent and not-so-innocent ignorance threaten our world.
We can help fix this by bringing people into the club; making them feel like they have a stake in science and the world around them. To bring them in, we must *not* just make them feel informed but make them *actually involved.*

ERG Bode plot

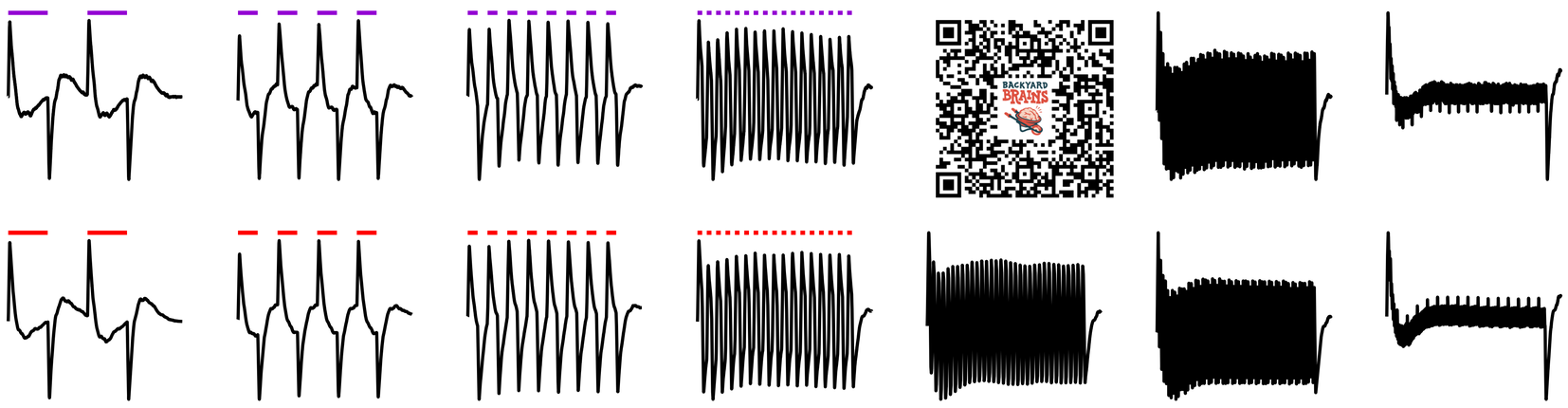


Filter model Bode plot





Critical flicker fusion assays (above) are modeled by hardware filters (below)



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[1] Giribet, G., & Edgecombe, G. D. (2019). The Phylogeny and Evolutionary History of Arthropods. *Current Biology*, *29*(12), R592–R602. https://doi.org/10.1016/j.cub.2019.04.057
[2]Vilinsky, I., & Johnson, K. G. (2012). Electroretinograms in Drosophila: A Robust and Genetically Accessible Electrophysiological System for the Undergraduate Laboratory. *The Journal of Undergraduate Neuroscience Education*, *11*(1), 149–157. Retrieved from http://fly.bio.indiana.edu/

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