Characterization of the ongoing electrophysiological activity of the planarian *Schmidtea mediterranea*

C|A|U
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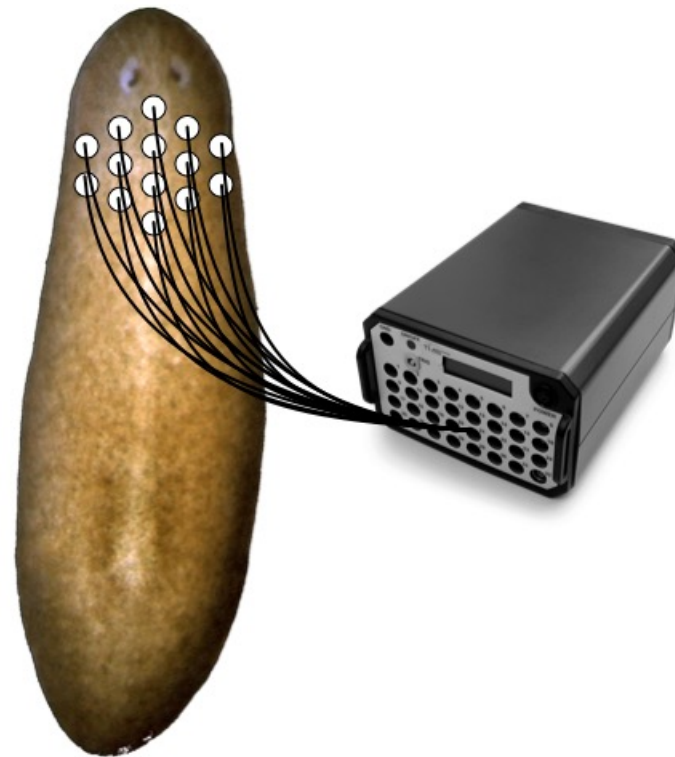
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https://github.com/juliankeil/Slides/blob/master/Talk_Teap_2022.pdf

Background

- Comparisons across species reveal structural similarities:

  - Community structure

  - Short communication paths

  - Hubs and functional clusters

- Do these similarities translate to similar functional neural mechanisms?

  - Spontaneous alpha and evoked gamma oscillations in honeybees

Van der Heuvel et al., 2016
Popov & Szyszka, 2020
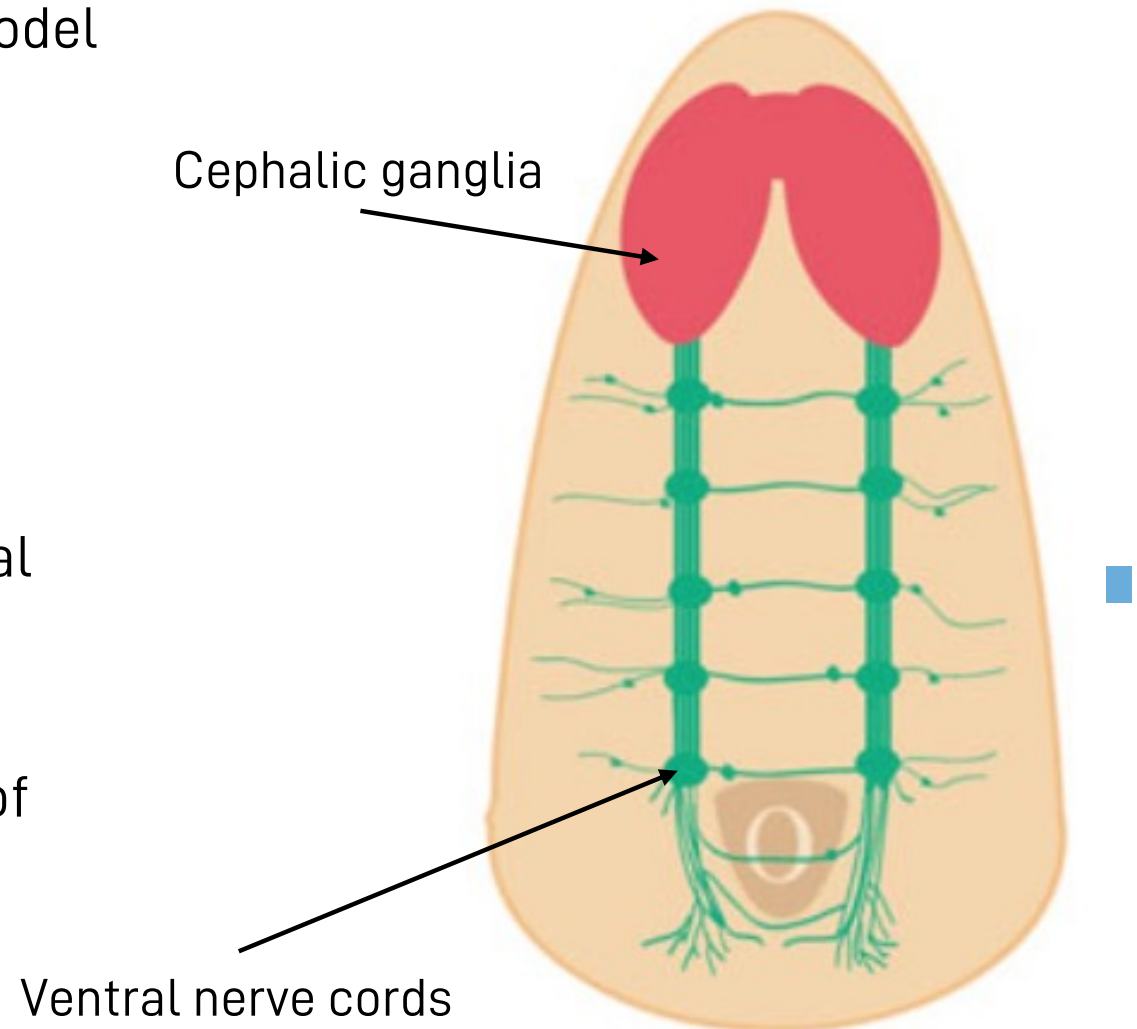
Keep it simple!

What is the simplest possible model system?

- Bilateral organization

- Visual processing

- Cognitive processes

Schmidtea mediterranea as an animal model, to study functional neural mechanisms in simple nervous systems
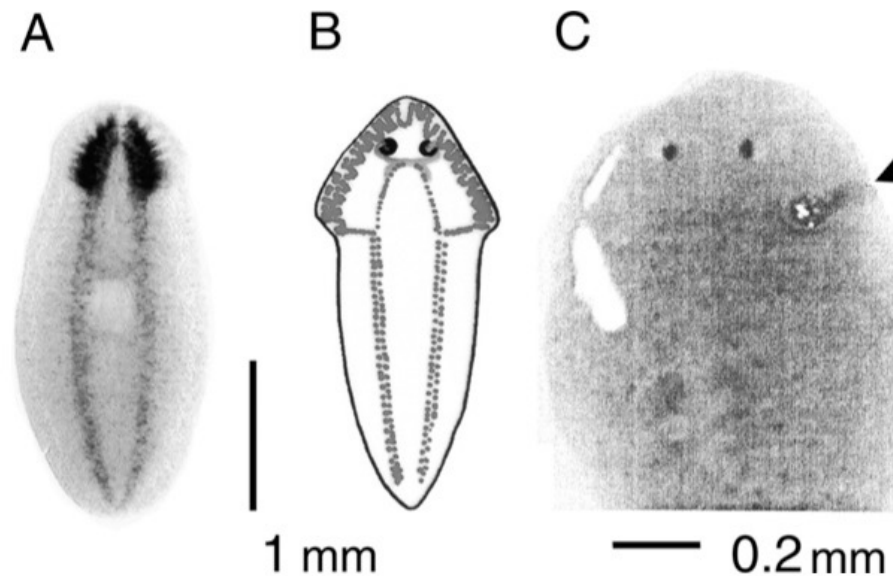
Close to the common ancestor of bees and humans

Cephalic ganglia

Ventral nerve cords

Fraguas et al., 2012

Previous work

Invasive recordings from the cephalic ganglia

- Animal cooled to 5-7° C

- Electrode inserted 0.2 – 0.3 mm

- Ongoing recordings for 20-30 minutes until the death of the animals

A   B   C

1 mm   0.2 mm

Aoki et al., 2009

Ongoing oscillations?

- 2 animals
  - Warmed to ~10° C
- No separation of ongoing activity and muscle potentials
- FFT analysis
  - 0.1 – 10 Hz
  - 1/f-characteristic above 0.5 Hz

Aoki et al., 2009
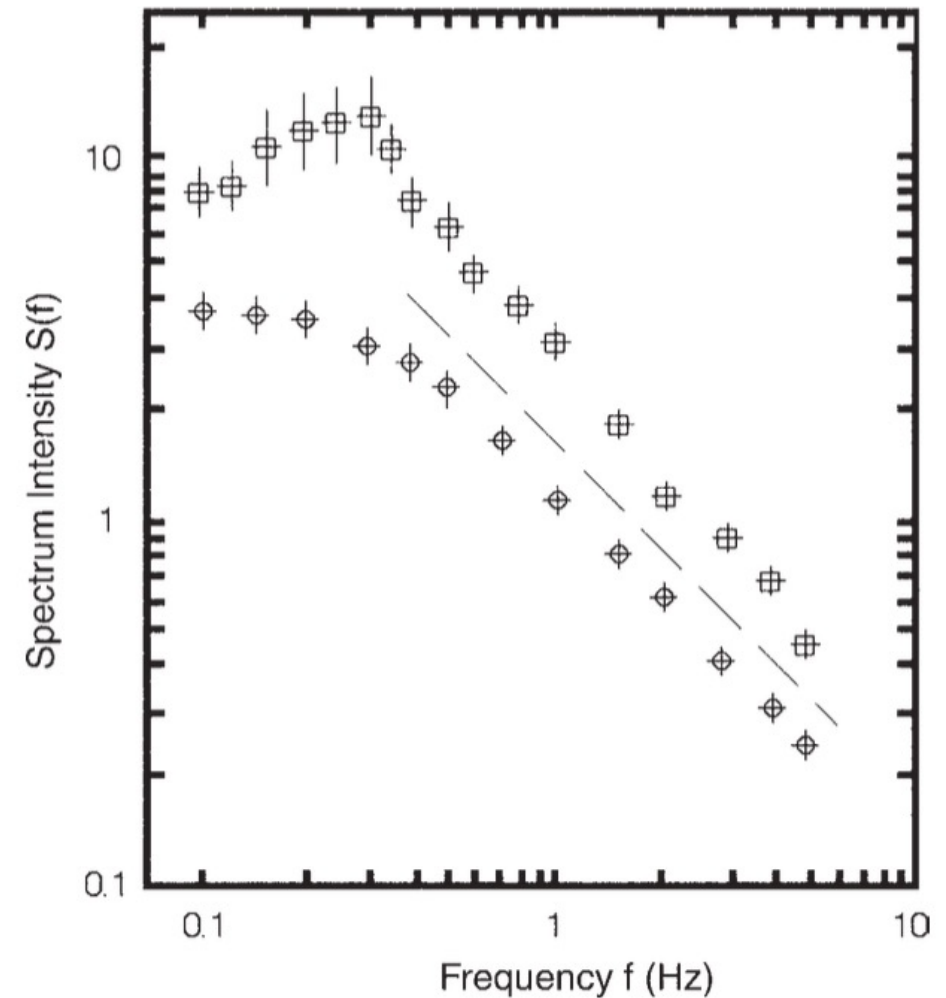
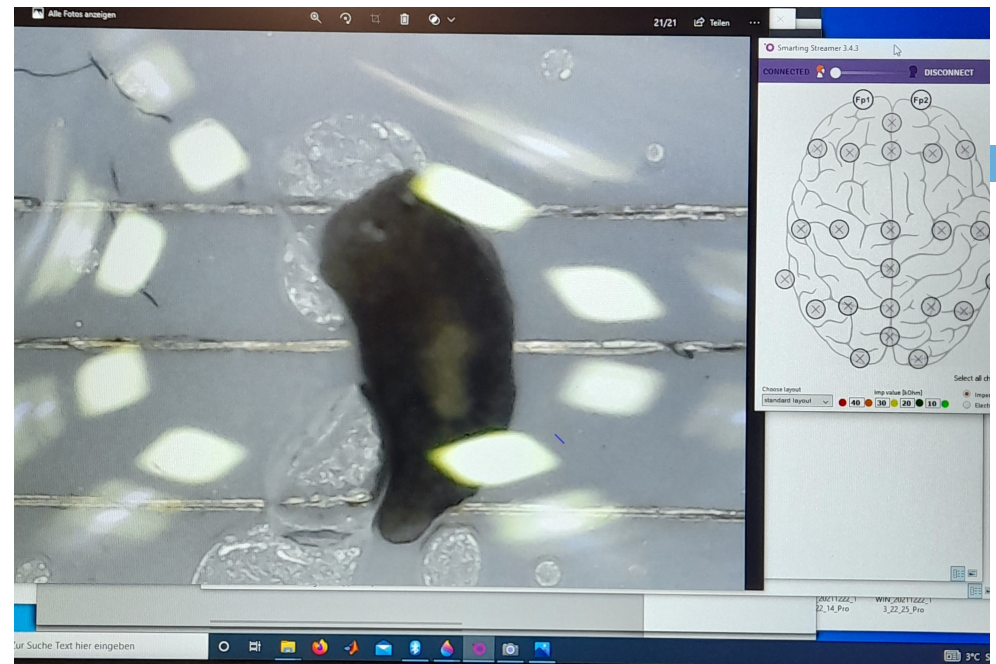# Optimize recordings

Goals:

- Less cooling

- No harming

- Simple setup

Approach

- Human EEG amplifier

- Electroretinography wire electrodes

- Fixate the animal in agarose gel

- State-dependent recordings

Optimize recordings - Setup

- Pipette animal on specimen slide

  - Slide is cooled on crushed ice

- Pipette agarose gel on animal

  - Gel max. 50° C warm

- Slide hardened gel with animal onto wire electrodes

- Ongoing recordings for 10 minutes

  - Darkness = 0 lux

  - Light = 40000 lux

- Slide animals into petri dish for observation and recovery
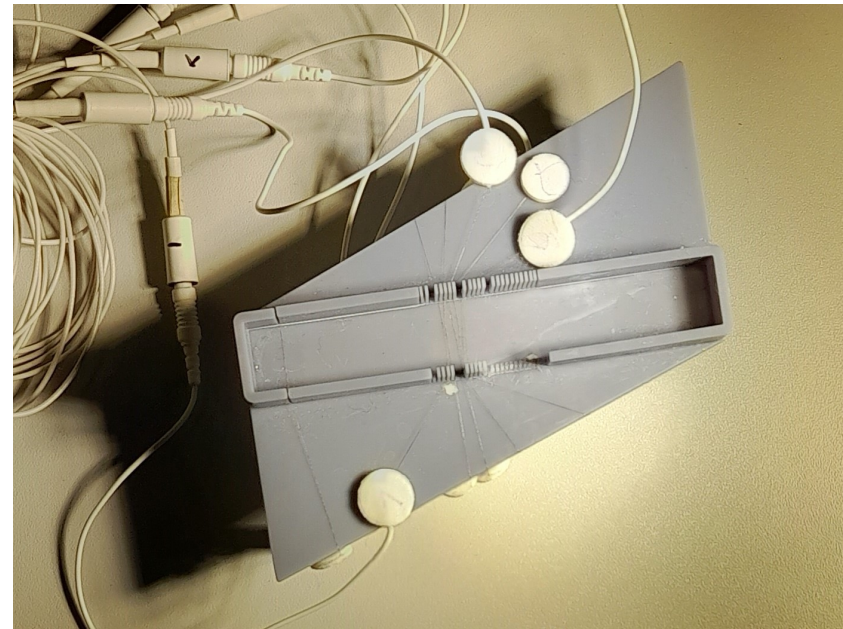
First results

- N = 17 darkness, N = 20 light

- 10 minutes ongoing recording

  - 0.1 – 20 Hz FIR filter

  - 10s segments, exclude muscle activity

  - 0.5 – 20 Hz FFT

- Between-animals independent-samples t-test with cluster correction for multiple comparisons

  - 1/f-characteristic during darkness

  - Broadband increase in power between 3 and 20 Hz during light stimulation

red = light, blue = dark, stars = sig. diff
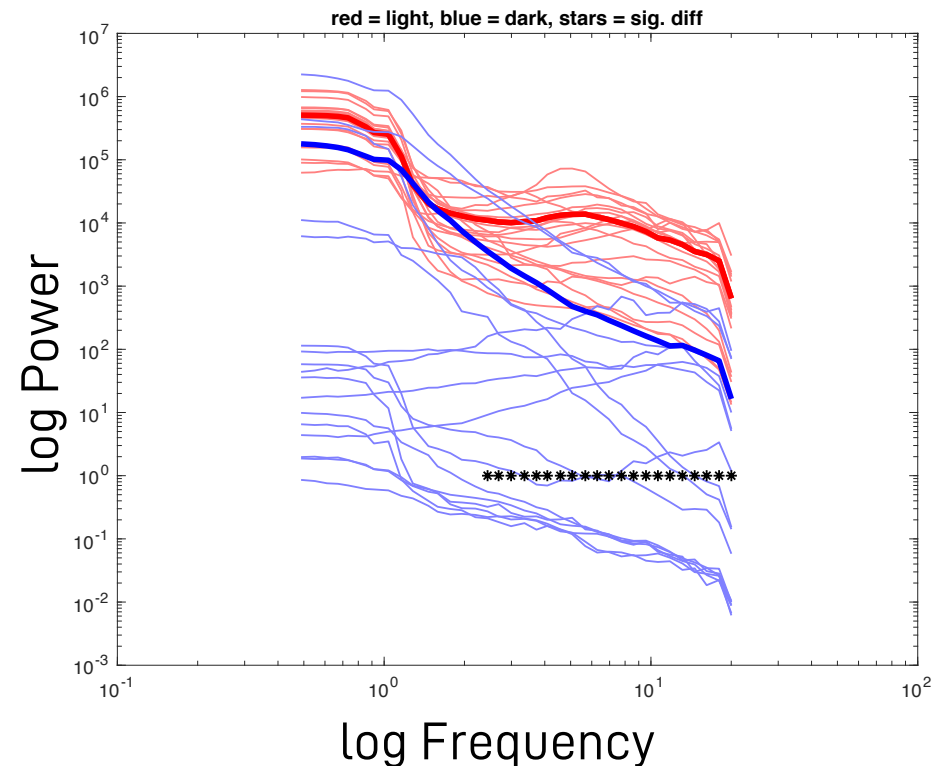
Mean light   **Mean darkness**
Individual light   Individual darkness

What's next?

Current state:

- Sucessful recording of ongoing neural activity without harming or killing the animal

- First evidence of functional changes of ongoing neural activity due to light stimulation

Next step:

- Optimize recording environment to exclude noise

- Introduce event-based experiments

Thank you!

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References

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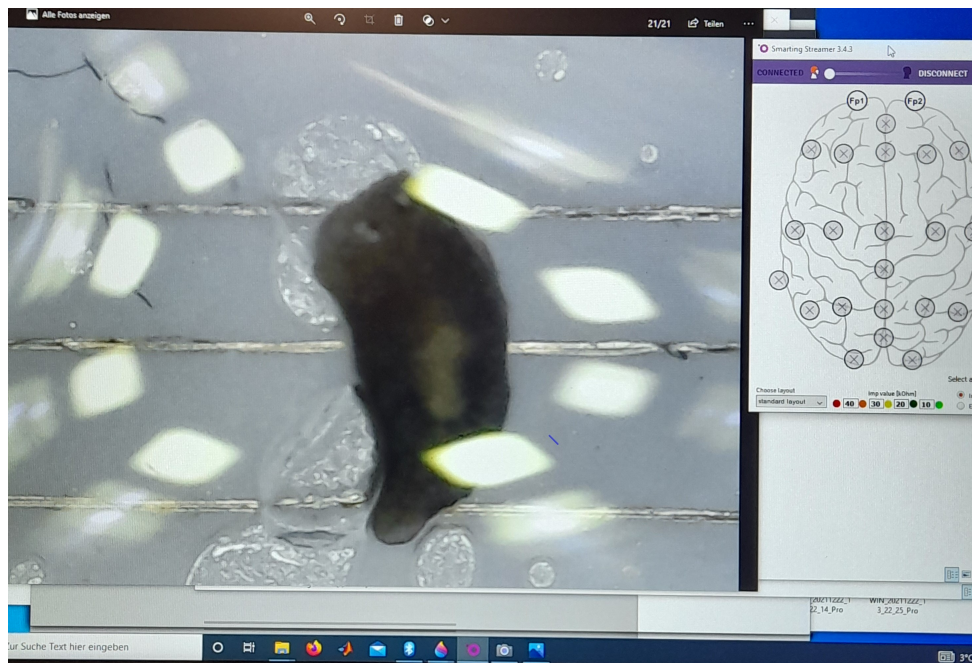
Optimize recordings -Setup

Human EEG amplifier
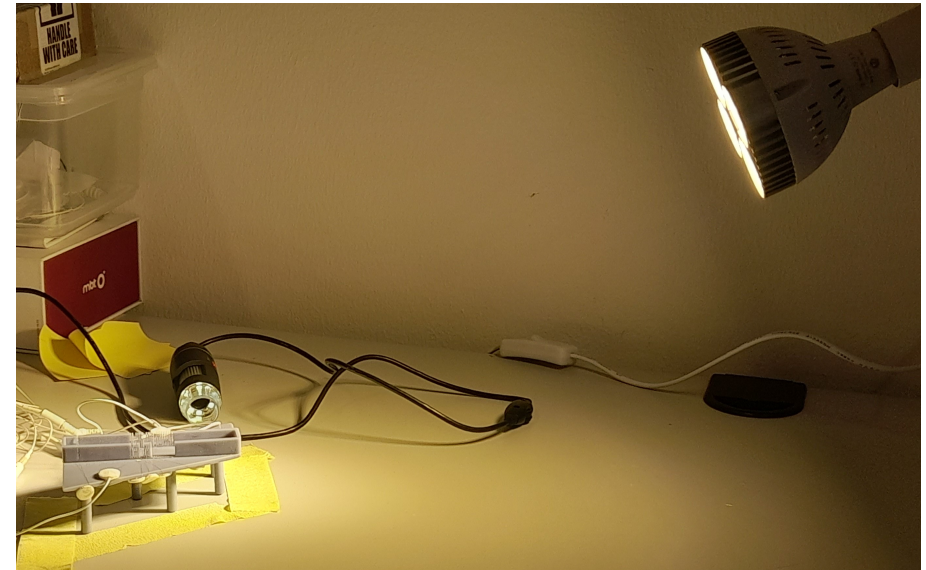
State-dependent recordings

Electroretinography wire electrodes