A learning task of classical music discrimination in rats

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Background

- Associations between auditory stimuli and behavior responses (freezing, lever presses, nose pokes, ...)
- Often used auditory stimuli: pure tones (sinusoids), up- or downward sweeps

**Purpose:** Create an experimental auditory learning paradigm with complex stimuli

→ **Classical music**

- Rich in dynamics
- Huge pool of stimuli with different characteristics

**Research question:** Are rats able to discriminate different pieces of classical music?
Auditory stimuli

- Shift to higher frequency range by up-sampling of factor 3 \( \rightarrow \) more appropriate to rats hearing range
Behavior responses

Operant chamber

Major training steps in lever pressing
1. 1 press → reward
2. 16 presses → reward
3. Variable interval 30 ±5 sec

- Reward: Sucrose chocolate pellet

Cumulative Record plot

Training up to 2000 – 3000 presses in a 60 min session
Auditory discrimination task

Rewarded stimuli
- S1+ Chopin Mazurka
- S2+ Vivaldi Winter

Unrewarded stimuli
- S3- Bach Orgel
- S4- Smetana Moldau

Trial
- Continuous repetition of 8 sec segments until trial end
- Trial duration 60 ± 5 sec

Session
- Session includes 60 trials; 15 trials per stimulus in pseudo-randomized order / ~1h
Results discrimination performance

Performance = \frac{\text{Correct responses}}{\text{Correct+false responses}} \times 100

**Correct responses**: lever presses during S1+ & S2+ trials

**False responses**: lever presses during S3- & S4- trials
Results generalization performance

- **Generalization test:** selection of new 8 second segments of the same 4 classical music pieces
Conclusions

- New auditory learning paradigm
  - Complex stimuli
  - Stable increasing learning performance over days

- Rats are able to **discriminate** and to **generalize** classical music pieces
Electrophysiology recordings

Recording sites

Spike detection
High-pass filtered (300-8000Hz)

Primary auditory cortex (A1)

Medial geniculate nucleus

Onset response
Offset response
Future perspectives

Electrophysiological recordings

- Local field potentials
- Spikes
- Electrical stimulation

Comparison analyses of auditory responses

- Learned vs. New stimuli
- Rewarded vs. Unrewarded stimuli
- ...
Thank you ☺ !