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Isometric forelimb task behavioral training

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Protocol status: Working

We use this protocol and it's working



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Abstract

This is the standard protocol for behavioral training of the Isometric Two Action task developed and used for Rodrigues-Vaz and Athalye et al, 2025.

This task is a self-paced task in which mice are reinforced for using their forelimb to apply force to an immobile joystick exceeding a threshold of duration and force. In this task mice receive a 10% sucrose drop when they perform correct action. This task has a trial structure as follows:

1. There is an inter-trial-interval (ITI) that lasts for 1 second during which no reinforcement will be delivered. At the end of ITI if the force is below 3g threshold, the trial initiates. If force is above threshold, a new ITI is initiated.
2. Once a trial is initiated, mice execute task actions – actions that cross task defined force threshold (4g or 6 g) for task defined duration (20 or 50 ms). If a task action occurs, mice receive a delayed reinforcement. If force crosses the force threshold for less time than the task duration, the task re-enters ITI phase (1).
3. After reinforcement, the task re-enters ITI (1) or ends – according to task duration and number of task actions executed.

This task was developed and trained to study minimal motor actions and their encoding in striatum. There are 3 blocks to this task, performed in sequence: block Both, block A and block B – in which both actions or one action is reinforced (more details below). Action A is defined as the action that the animal performs less during the last session in Block Both. Action B is defined as the action the animal performs more during the last session of Block Both.

Materials

- Behavior setups
- 70% ethanol
- 10% ethanol
- 10% sucrose
- Food pellets
- Scale

Safety warnings

- ! -Wear appropriate PPE as required by your institution.

Ethics statement

This protocol was approved by Columbia University IACUC. Please do not perform any of these procedures unless there is prior approval from the institution's animal ethics committee.

Before start

- Mice were implanted with head plate.
- Habituate mice to head-fixation:
 1. Animal is removed from home cage and held in researcher's hand.
 2. Mouse is head fixed for 5 minutes on running wheel – no anesthesia is required for this.
 - a. The duration of head fixation increases across 4 days up to 15 minutes.
 - b. Animals are then head fixed in the cup for the first time in task.
- Mice are food deprived 20 hours before first behavioral session – each mouse is moved into new cage without any traces of food.
- Baseline force measurements from the joystick load cells are recorded between each mouse – without the mouse in the setup. No weights are applied to the joystick for this baseline recording.
- Solenoids are calibrated before each session to deliver 5-6 ml of sucrose and tested before each mouse.
- Sucrose dispenser is filled as necessary.

General task steps

- 1 Mouse is weighed every day before behavioral session
- 2 Mouse is placed in the cup and head fixed and spout is moved to mouse's reach.
- 3 Task starts and mouse performs push and pull isometric actions onto joystick.
- 4 For task actions, mouse receives a delayed drop of 5-6 ml 10% sucrose.
- 5 Task ends at 30 minutes or once mouse achieves desired number of reinforcers.
- 6 This is repeated every day until mouse reaches desired behavior.

STEP CASE

Block Both 3 steps

- Mouse is reinforced for both actions.
- Individual sessions are run as described in steps 1-5.
- Each session is shaped according to Table I.
- Each session ends at 30 minutes or if mouse produces 100 reinforced total actions (50 pull + 50 push).
- Block Both concluded when the animal performed more than 50 task actions in each of 2 consecutive sessions in "Parameters label: 3".

	A	B	C	D
	Parameters	Task action threshold (g)	Task action duration (ms)	Reinforcement delay (ms)
1	1	4	10	100
2	2	4	20	200



	A	B	C	D
	3	6	20	300

Table I – Task parameters for Block Both

End of session

- 7 Remove mouse from head fixation and place them in home cage.
- 8 Clean setup with 10% ethanol.
- 9 Give the mouse supplementary food at least 30 minutes after training ends.