Role of Primary Motor Cortex in Learned Dexterous Reach

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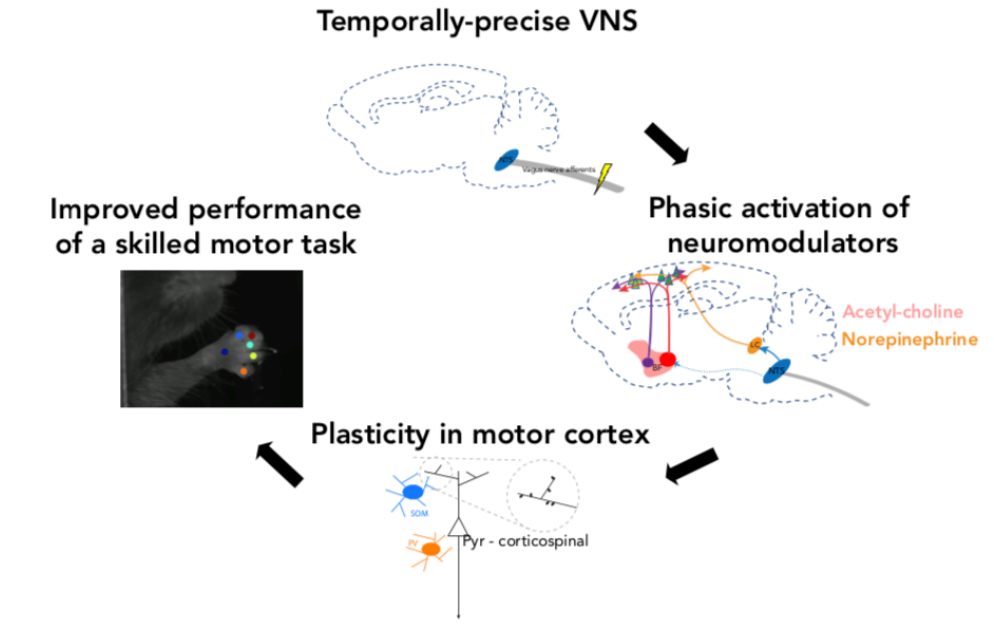
Lab's Goal

- VNS (Vagus Nerve Stimulation)
  - Axons to Brain Stem to Basal Forebrain
- Basal Forebrain
  - Neural Modulatory Center
- Motor Cortex
  - Basal Forebrain Axons activated
- Movement

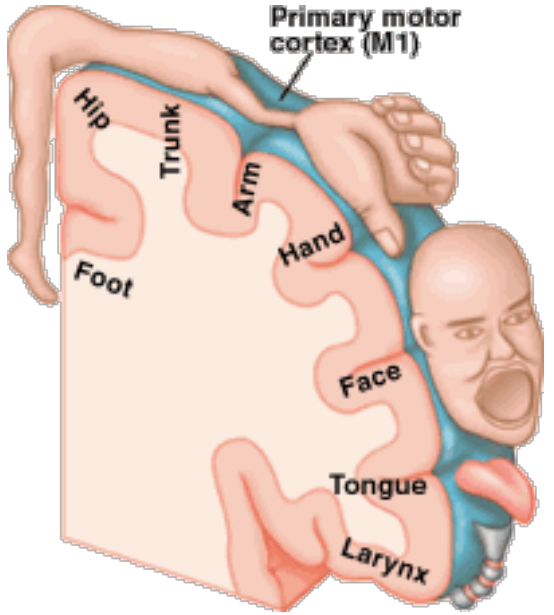


This Experiment in the Scope of Lab's Goal

- Confirms this area of the motor cortex is the relevant and essential in the scope of reach movements
- Connects with Vagus Nerve, Basal Forebrain, and Motor Cortex
  - Further experiments involving learned dexterous reach are based off of motor cortex and how different regions of the brain may impact this motor cortex

Primary Motor Cortex

- Associated with planning and programming of motor acts
  - Direction of movement, location of object, decision-making (premotor)
- Steps Breakdown for Learned Dexterous Reach:
  - Visual Processing
  - Trajectory and Position
  - Trajectory converted into muscle contractions



Purpose of Experiment

- Difference from other experiments
  - Specific region of the motor cortex
  - Different learned activity
- Is motor cortex activity in forelimb region necessary for a successful execution of a pre-learned dexterous reach?

Experimental Design/Procedure

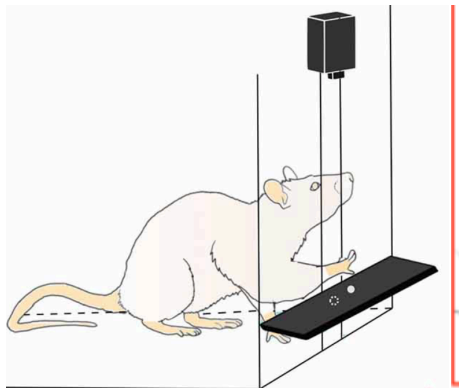
Training (10-15 days)

Surgery

Purpose: Craniotomy and Pipet necessary for specific region

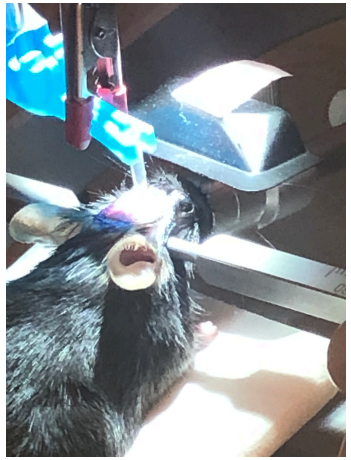
30 minutes later

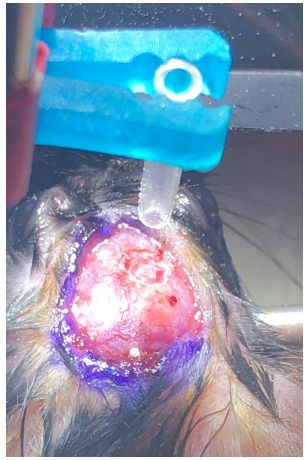
Injection of Saline then Muscimol



Nica Aerts 2018 Automated Assessment of Endpoint and Kinematic Features of Skilled Reaching in Rats

Sauerbrei Hantman 2018 The cortical dynamics orchestrating skilled prehension

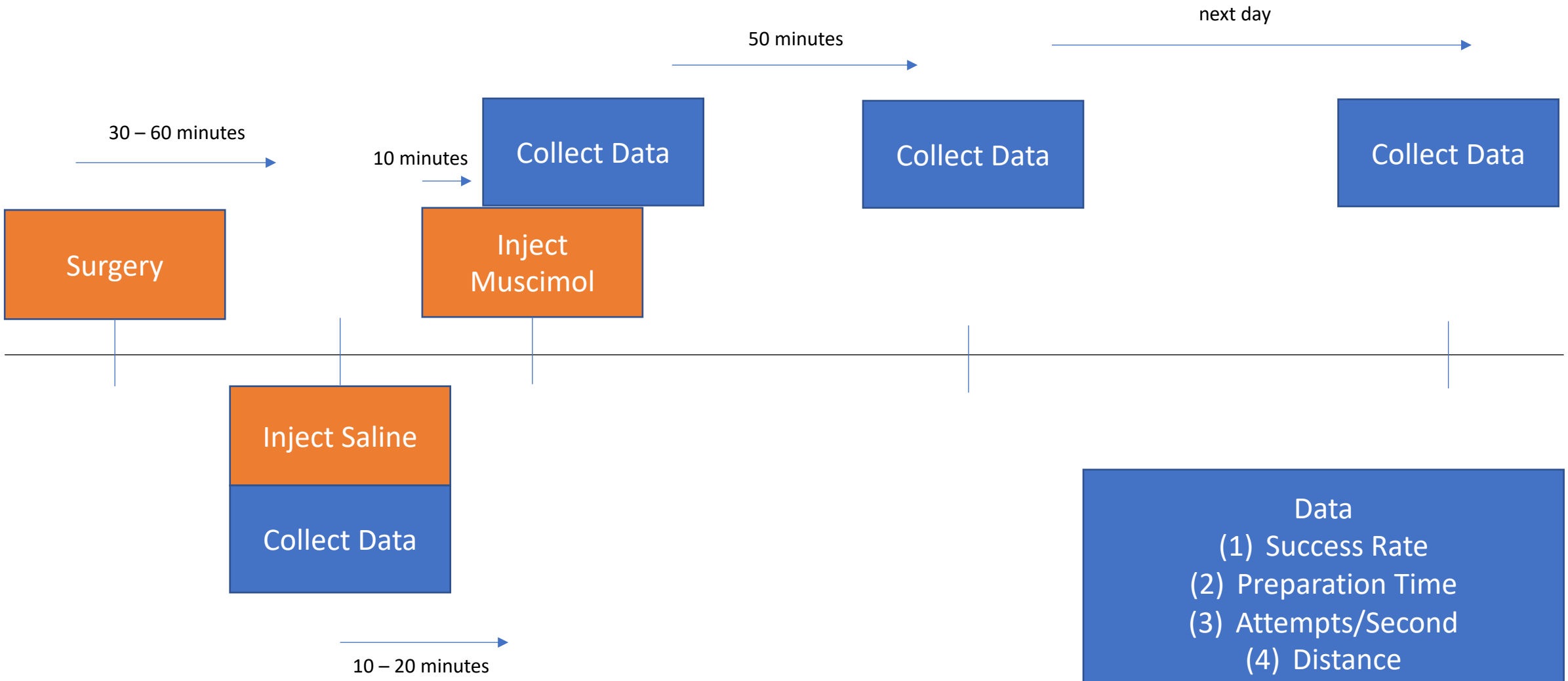




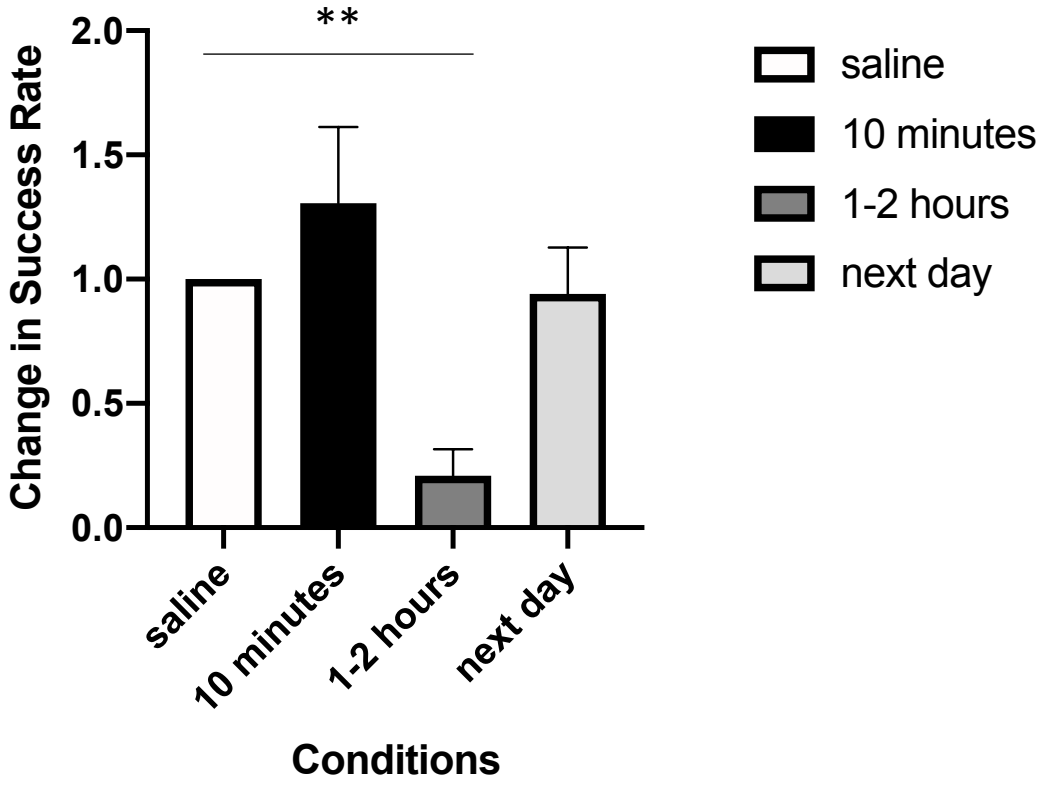
anterior 0.3 mm lateral 1.5 mm

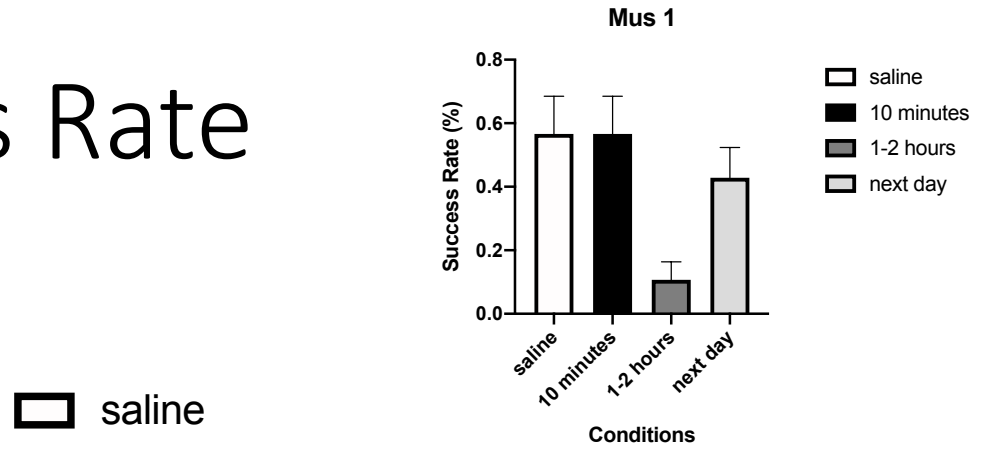
Activates GABBA receptors which inhibits neurons

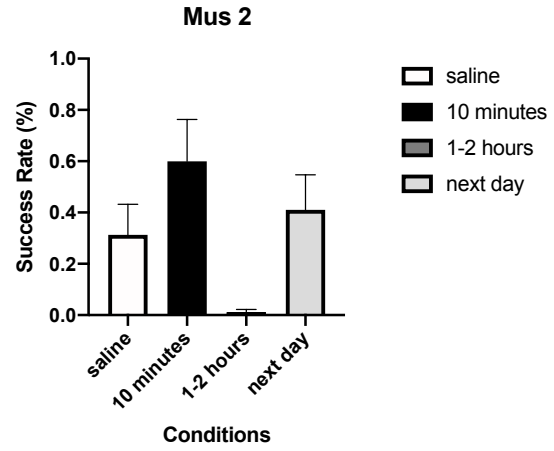
Experimental Design/Variables

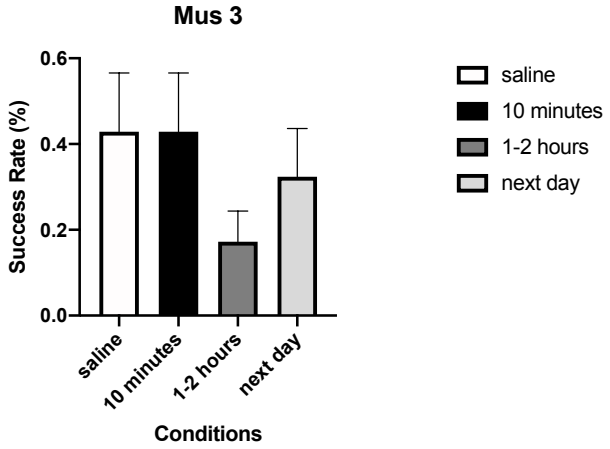


Data - Success Rate



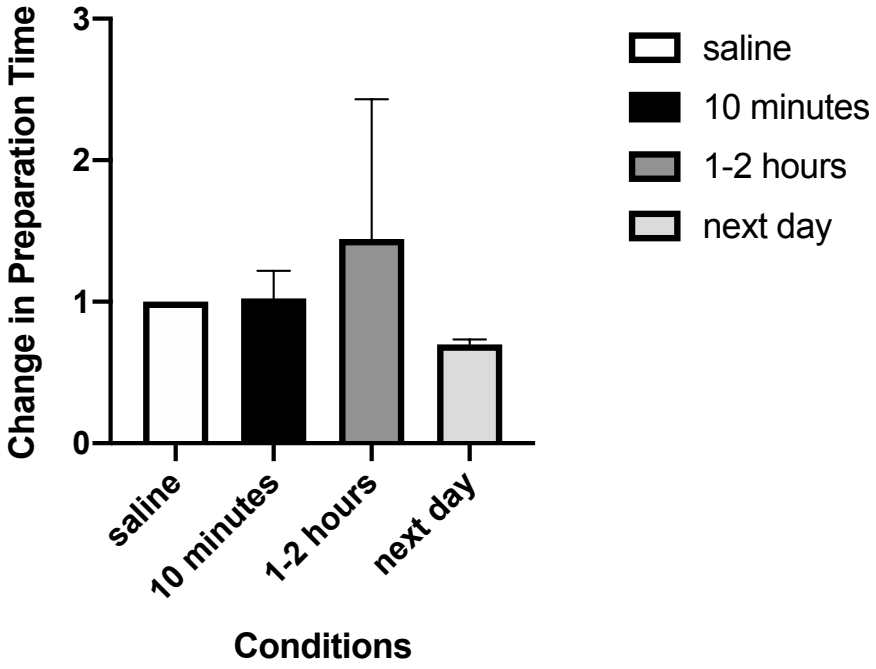


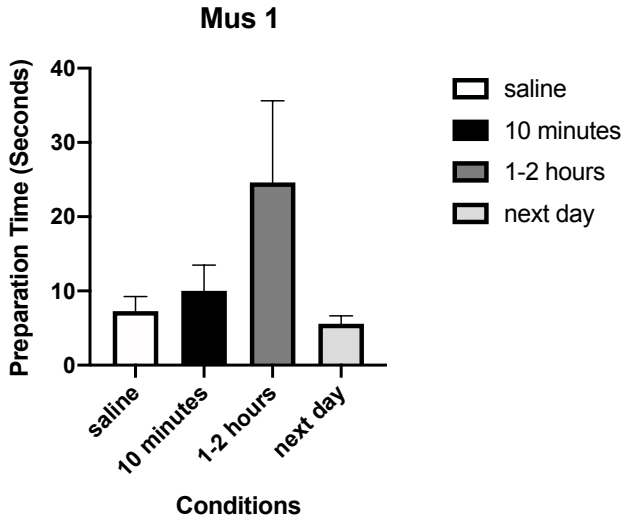


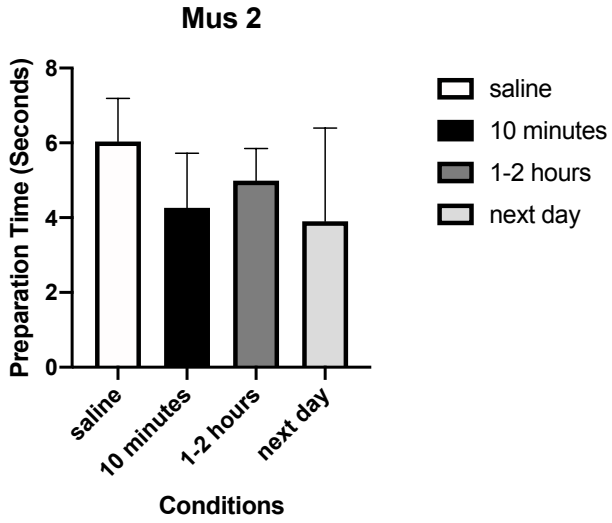


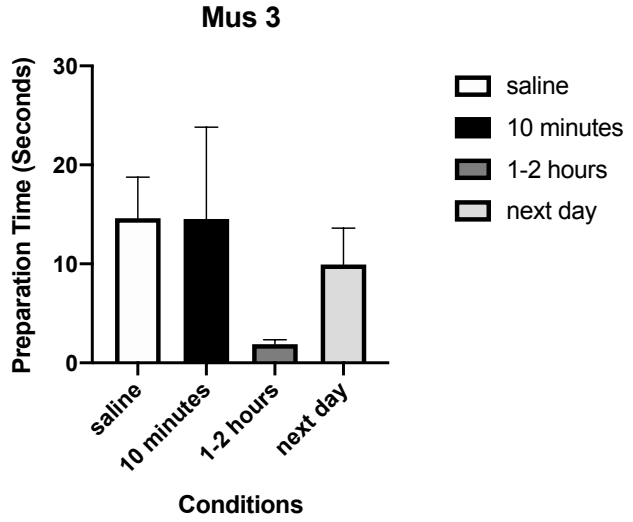
ANOVA P= 0.0176 n = 3

Data – Preparation Time



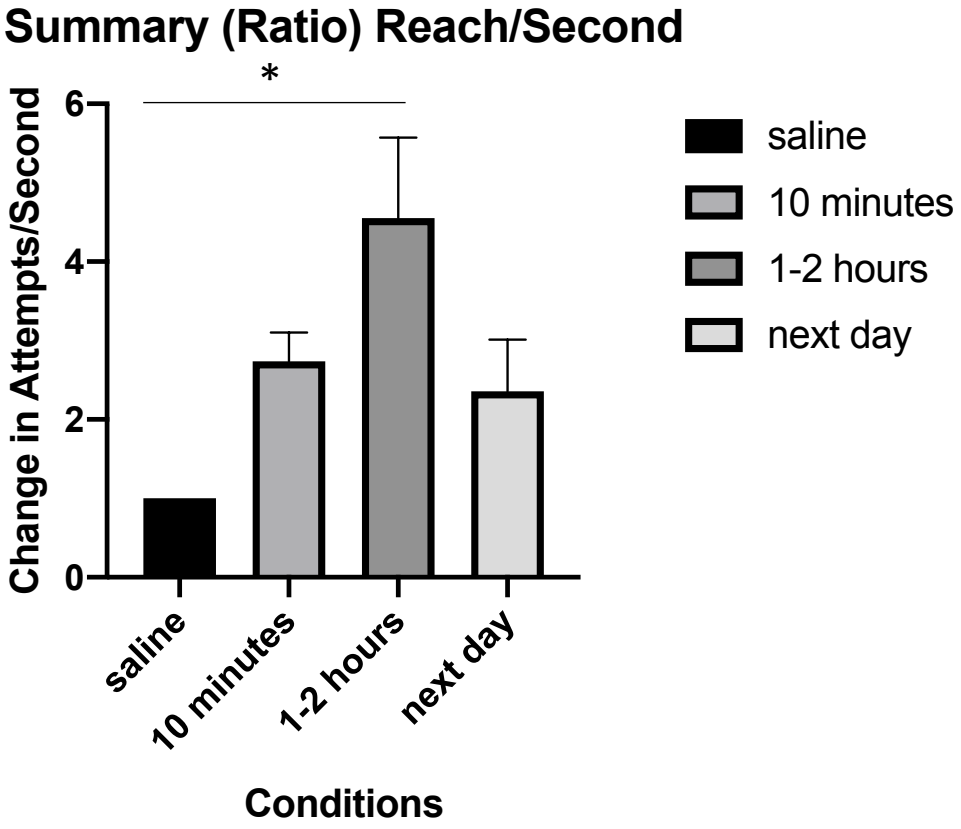


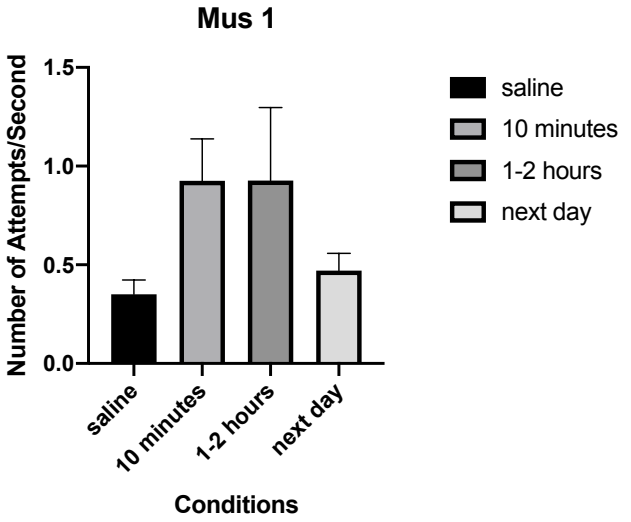


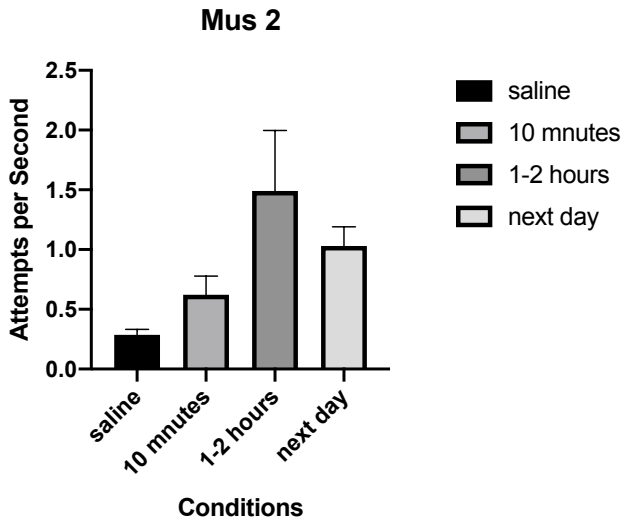


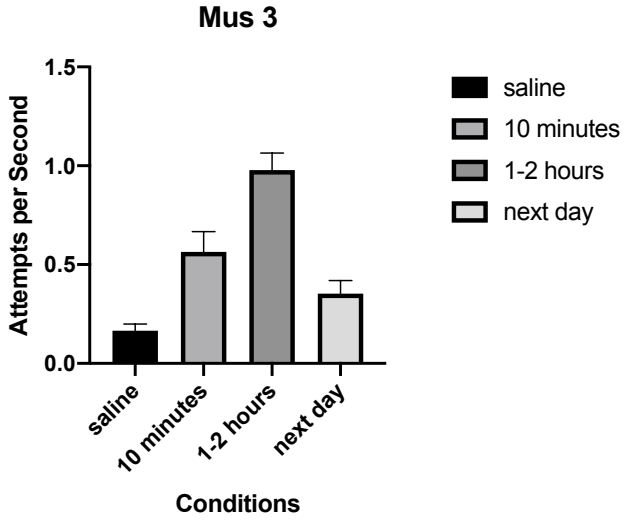
n = 3

Data – Attempts per Second



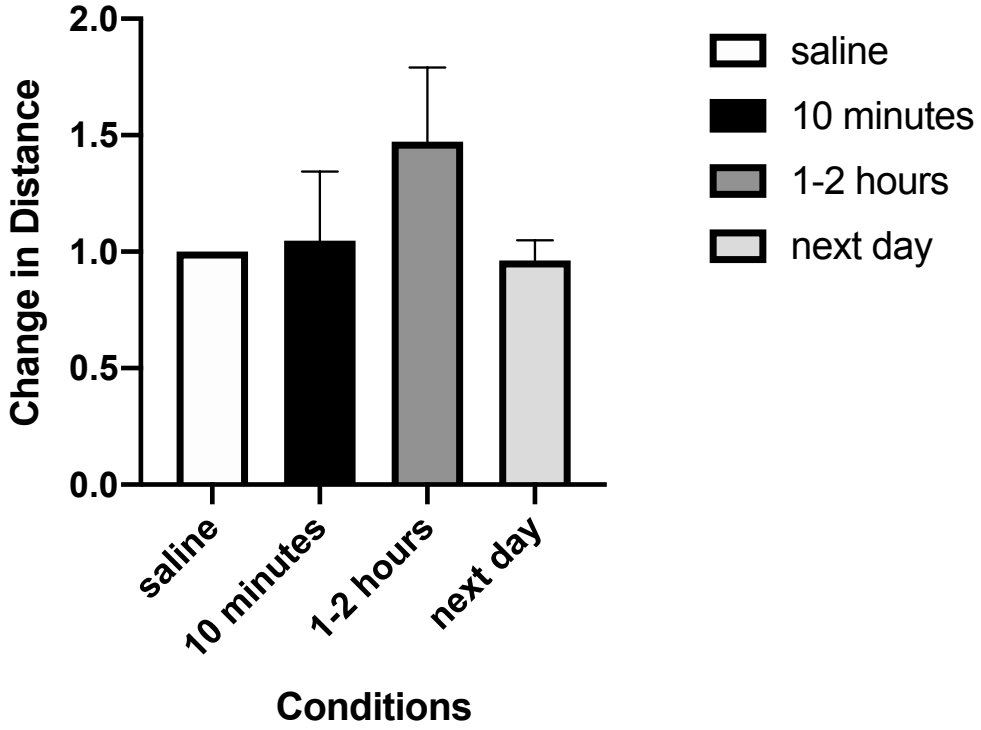


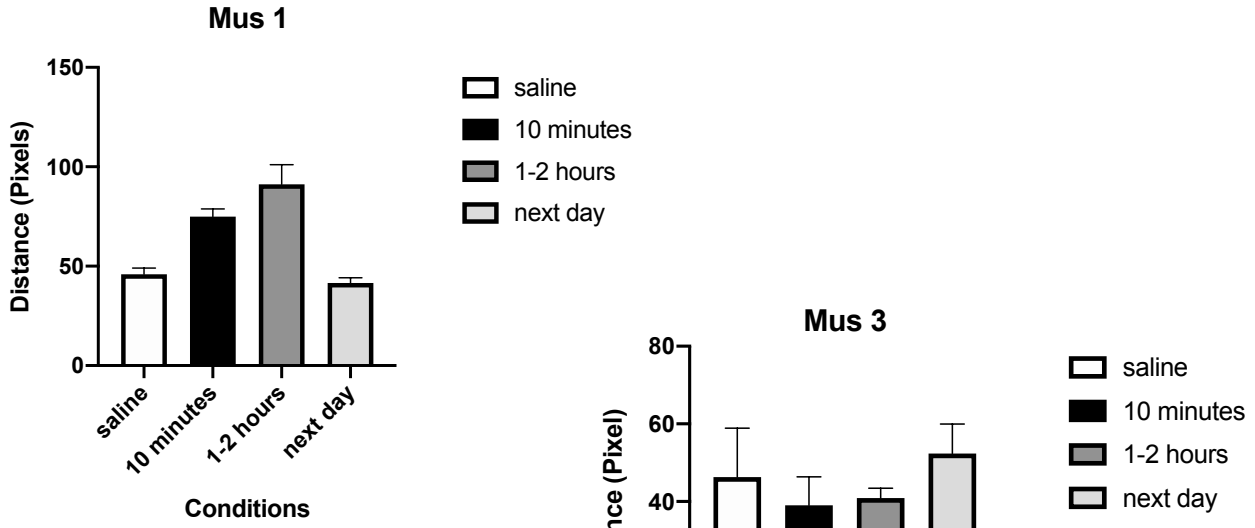


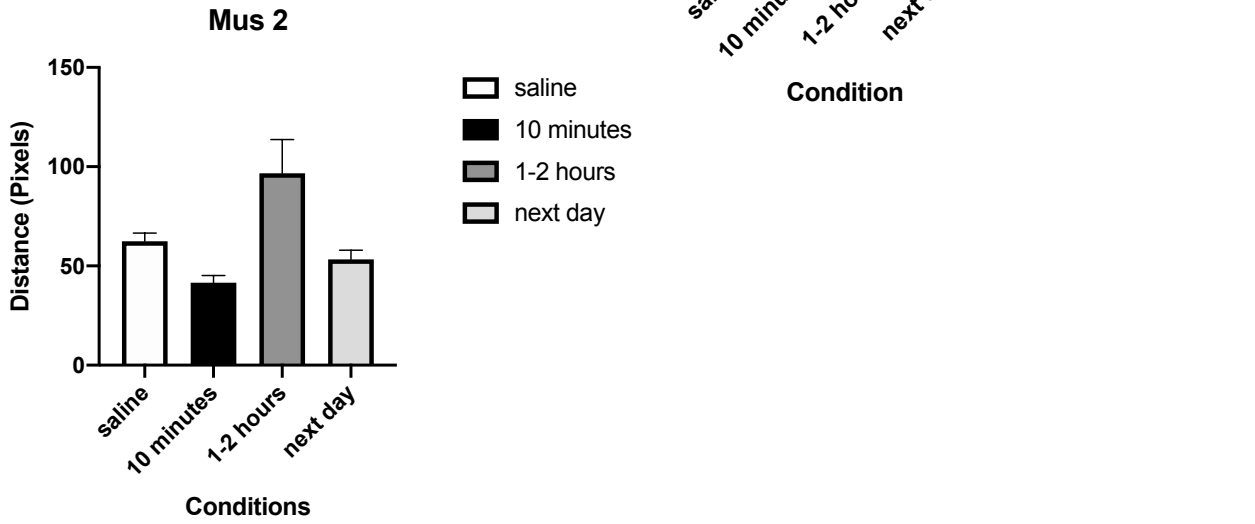


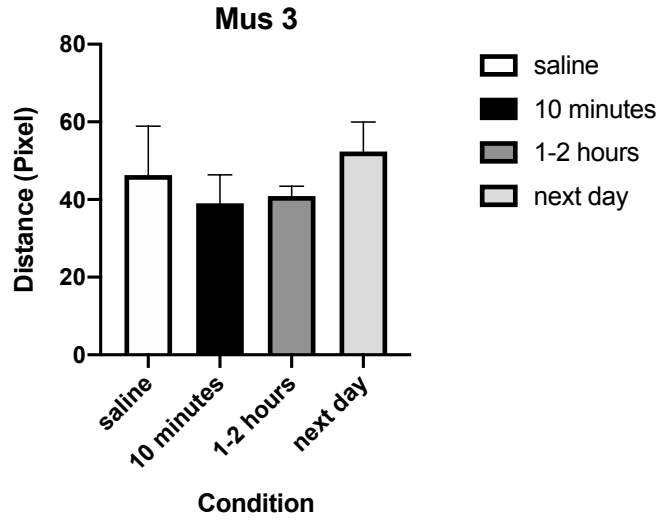
ANOVA P=0.0259 n = 3

Data – Distance









n = 3

Data – Types of Errors (Mus 1)

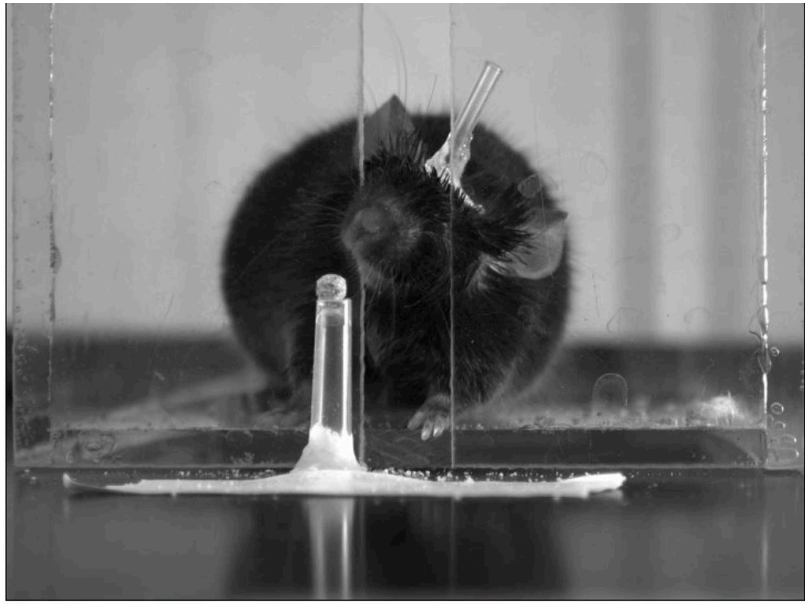
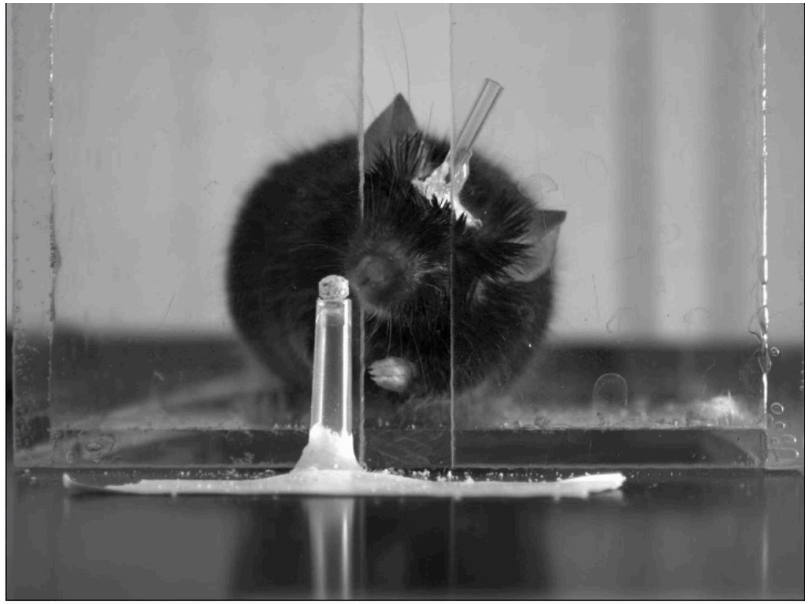
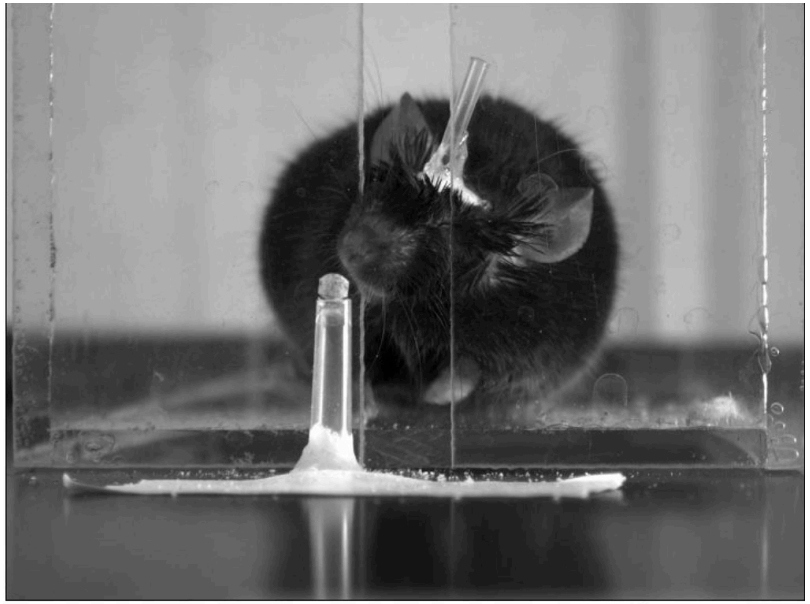
Mus 1 Reach Error



Reach is very off of the targeted pellet.

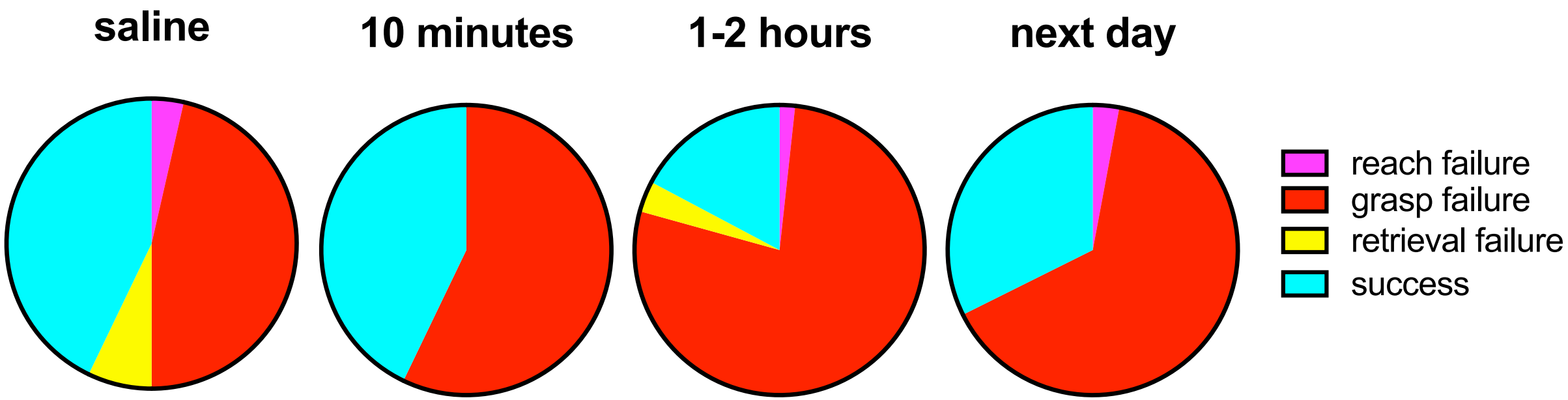
Data – Types of Errors (Mus 2)

Mus 2 Retrieval Error

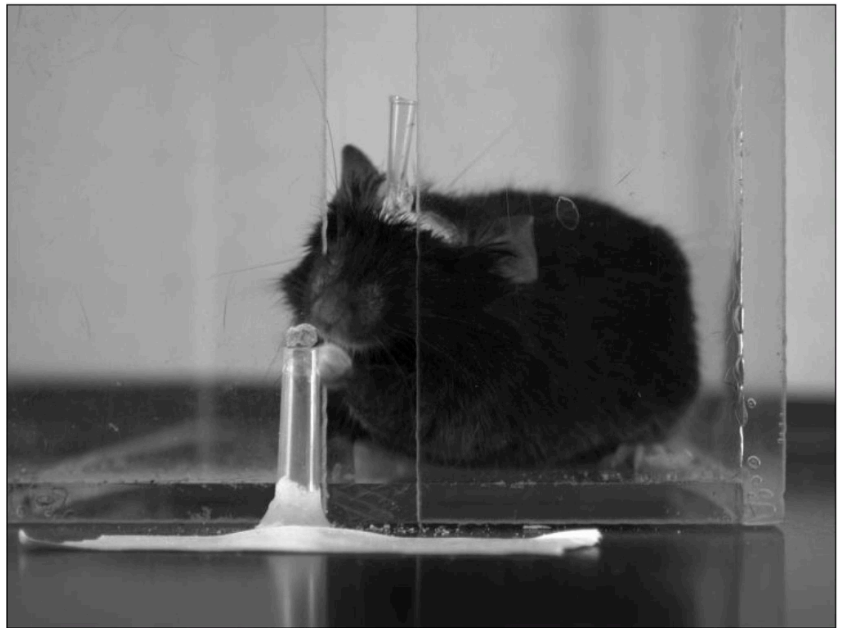
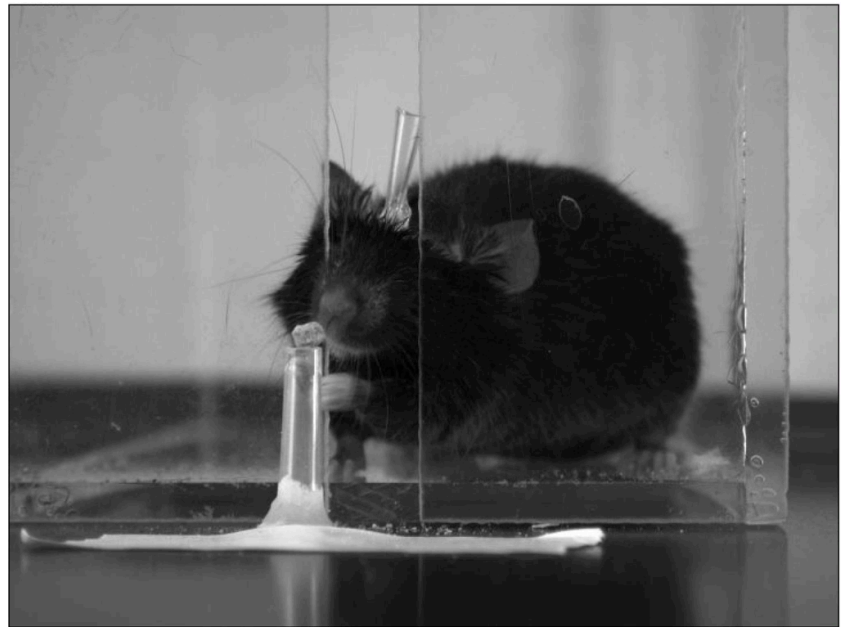




Mouse successfully grabs pellet but doesn’t seem to understand it has the pellet.

Data – Types of Errors (Mus 3)

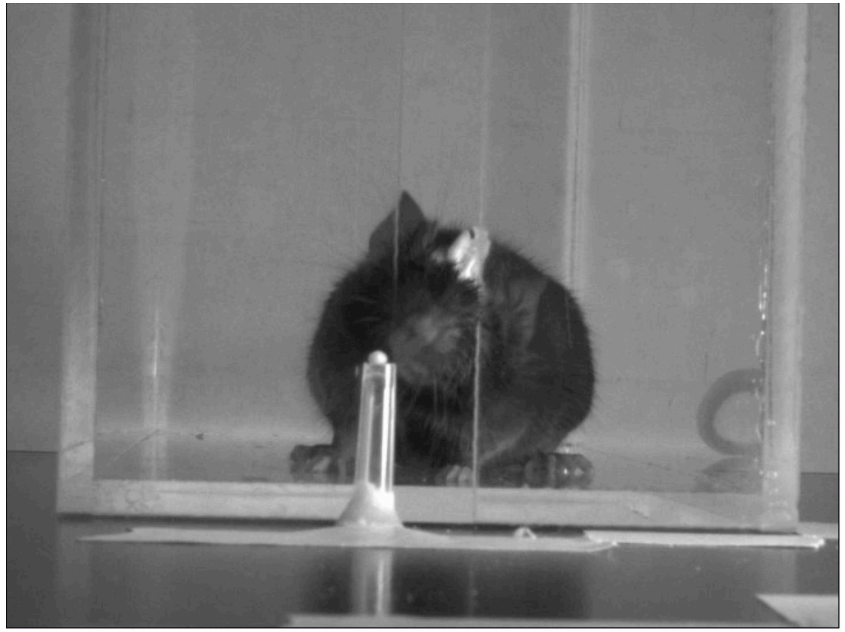
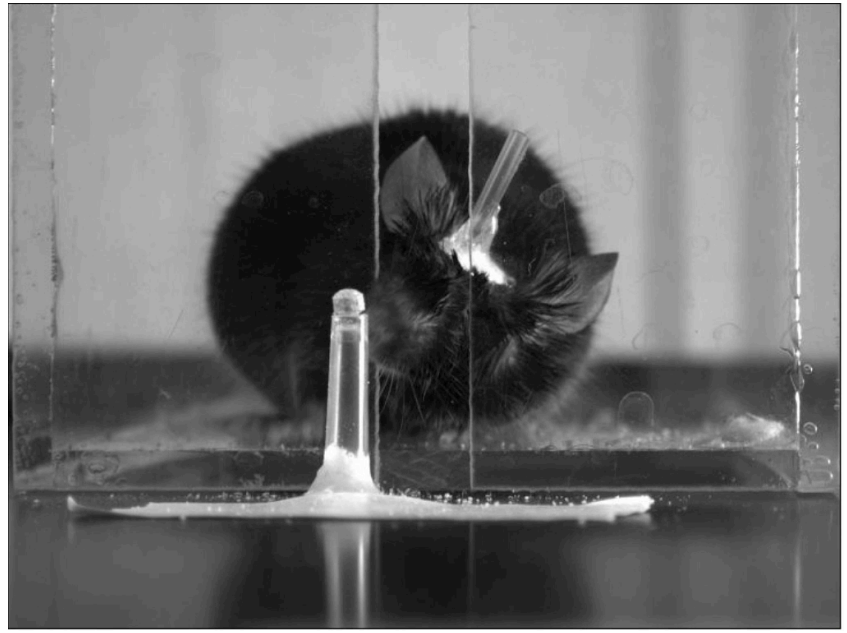


Mus 3 Grasp Error

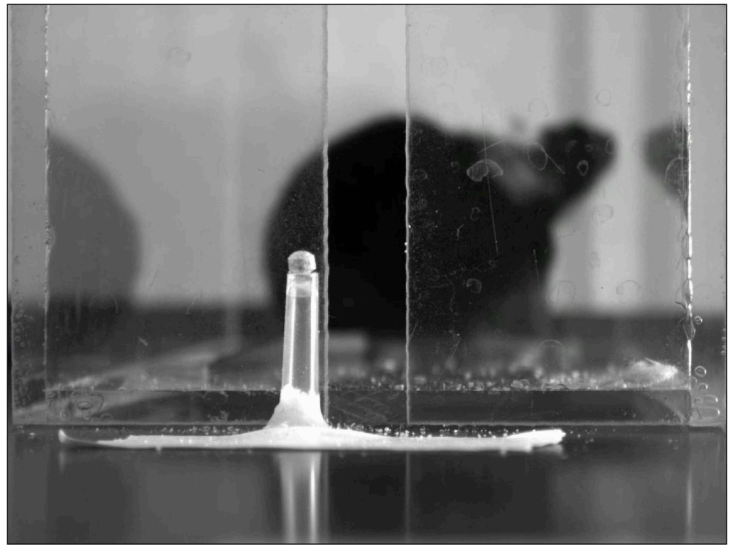




Seems to hit the pellet while reaching.

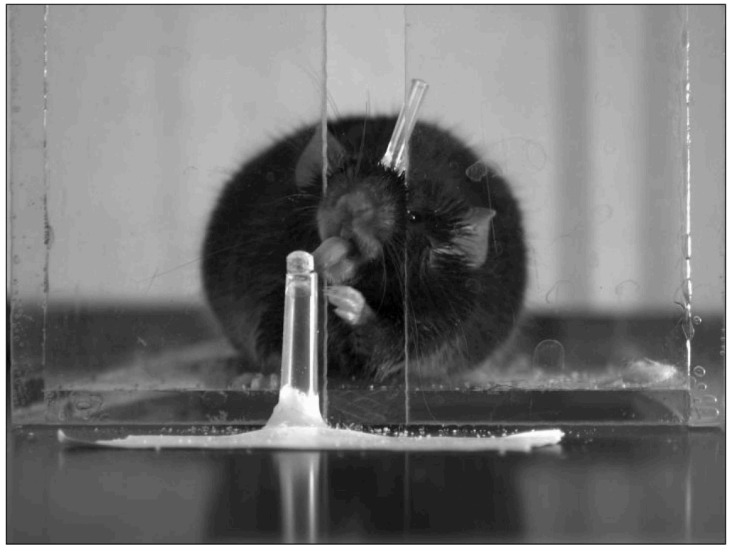
Tongue – Mus 1 and Mus 2

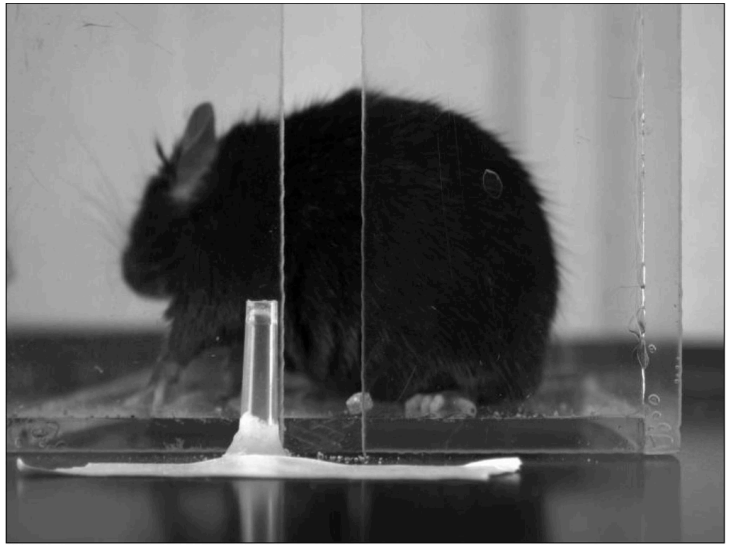
Movements **seemingly** not affected



Walking



Eating



Grooming

Conclusion/Future

- Primary motor cortex is necessary for successfully performance of a pre-learned dexterous reach. Inhibition results in dramatic decrease in success rate 1-2 hours after muscimol is injected.
- Future
  - Why are some functions such as reach affected by motor cortex inhibition while others such as walking are not?
  - Why does the mouse not recognize the pellet once the pellet is in its hands?
  - Why do some of the mice use their tongue once motor cortex is inhibited?
  - More specific and accurate injections of muscimol into the motor cortex.

Acknowledgements

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