

# Sex- and duration- dependent neural circuit control of voluntary exercise behavior



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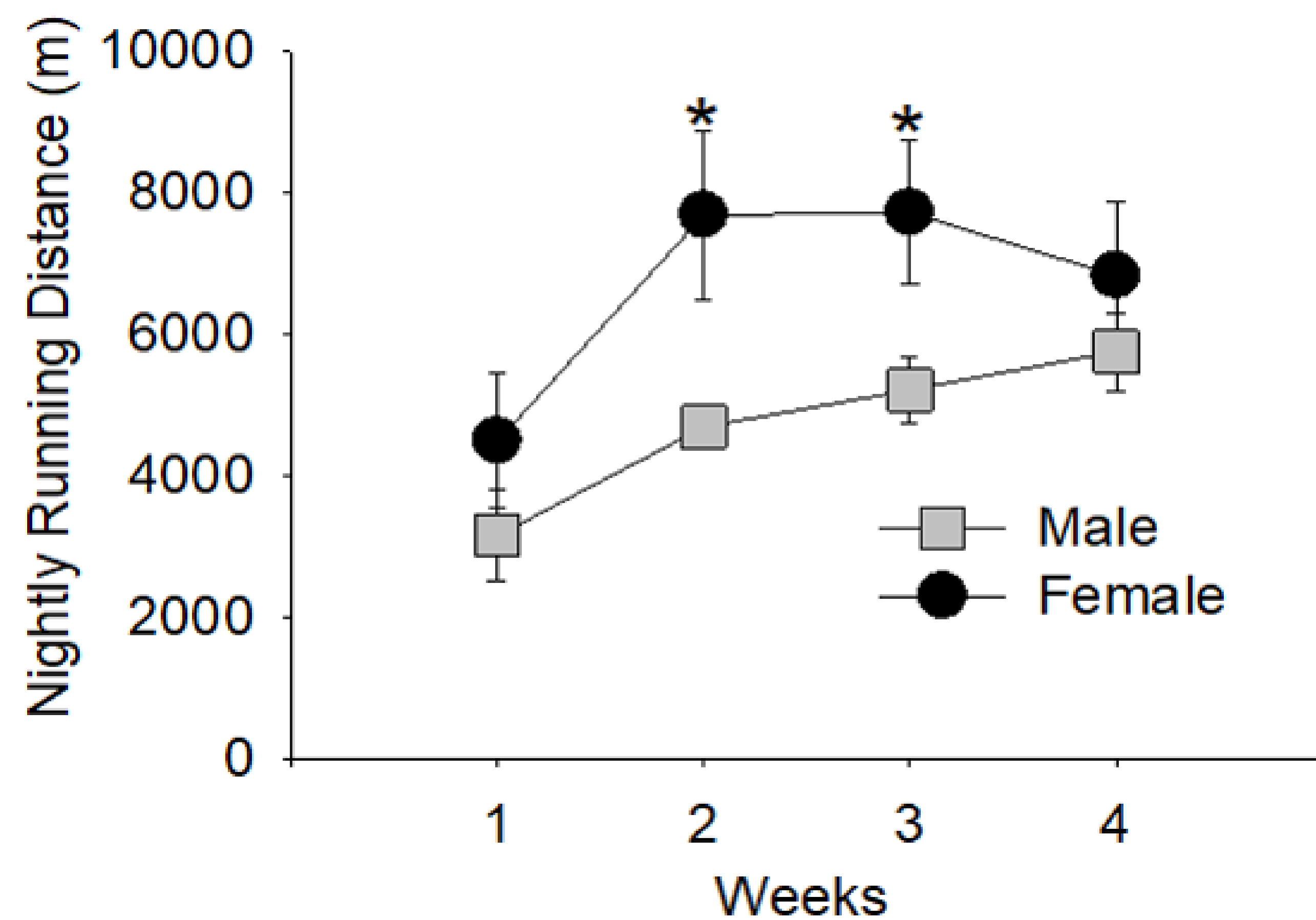
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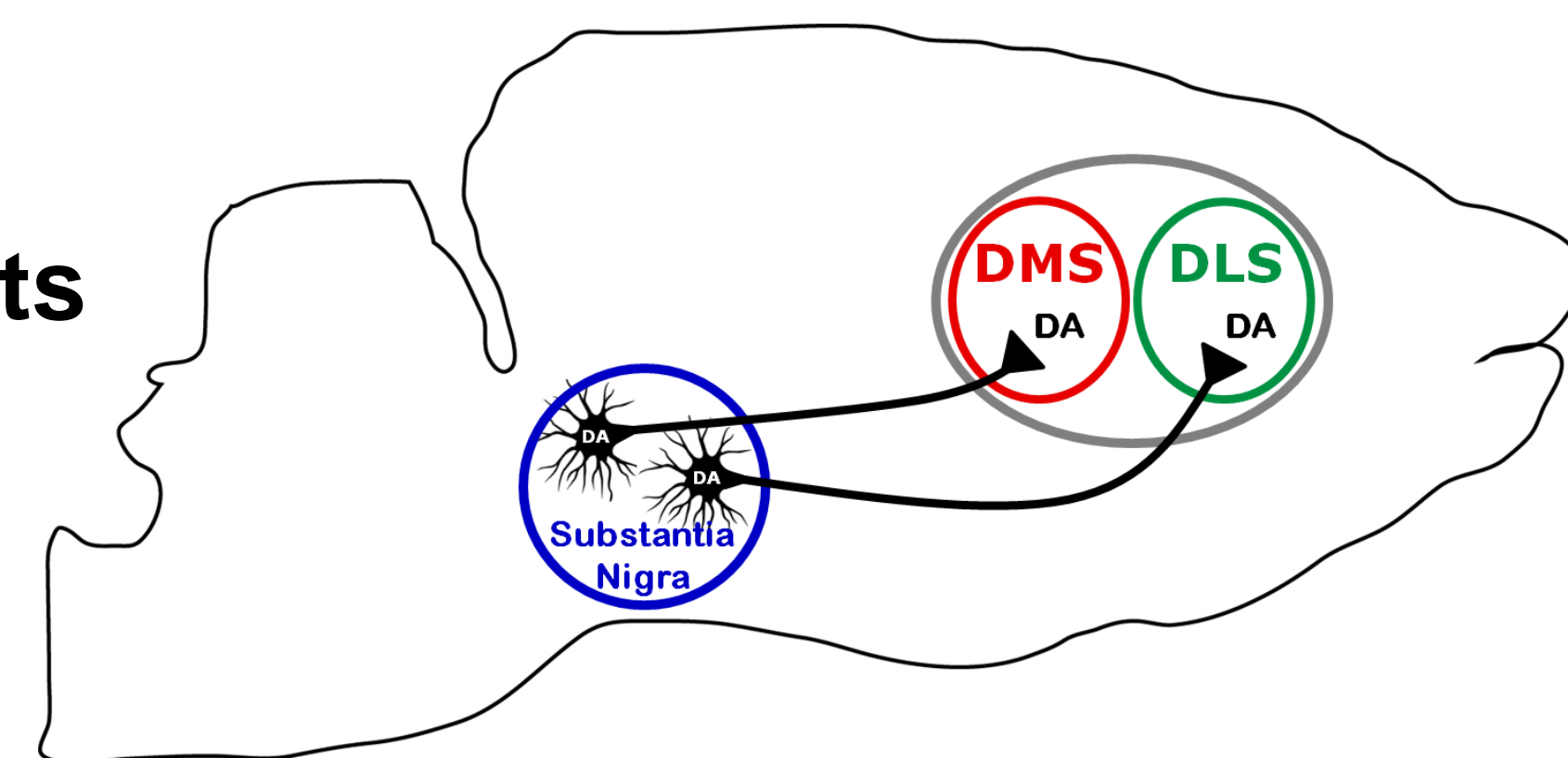
## Background

- Although exercise increases resistance against stress-related psychiatric disorders, participation in exercise is decreasing.
- Identification of the mechanisms controlling exercise could lead to novel strategies to promote exercise participation and could reveal the mechanisms underlying exercise-induced stress resistance.
- Rats demonstrate voluntary exercise behavior consisting of two phases, acquisition and maintenance, which differ between the sexes.



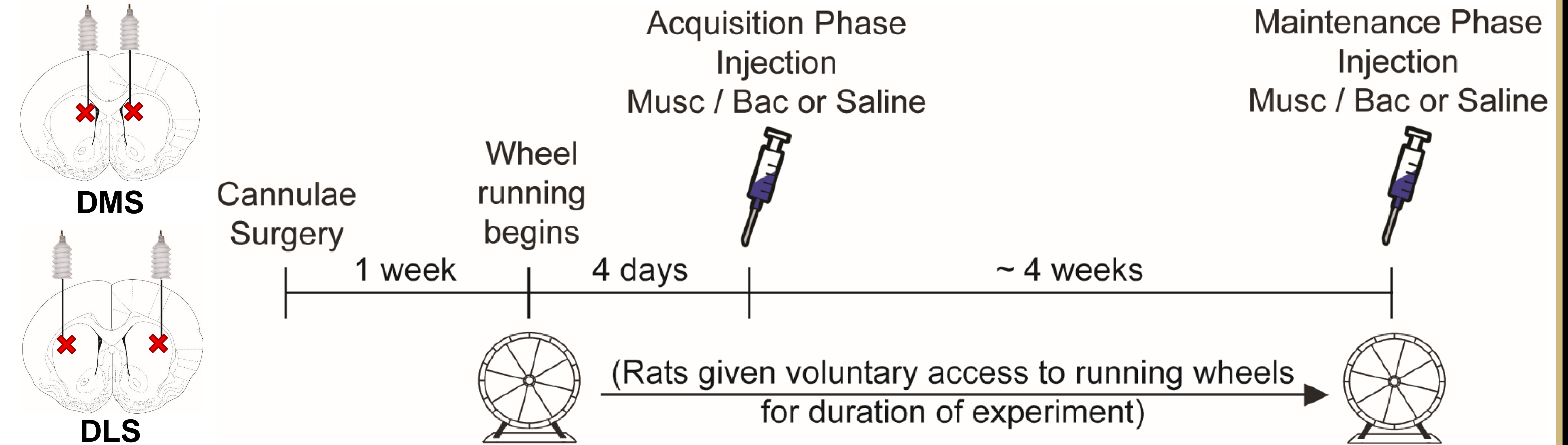
- The dorsal striatum is critical for movement, however, the specific striatal circuits that control voluntary exercise during these different phases are unknown.
- The dorsal striatum consists of two subregions, the dorsomedial striatum (DMS) and dorsolateral striatum (DLS), that are implicated in different learning strategies.

### DA-striatal circuits



- The goal of this research is to determine whether different striatal subregions control voluntary exercise depending on the phase of running and the sex of the animal.

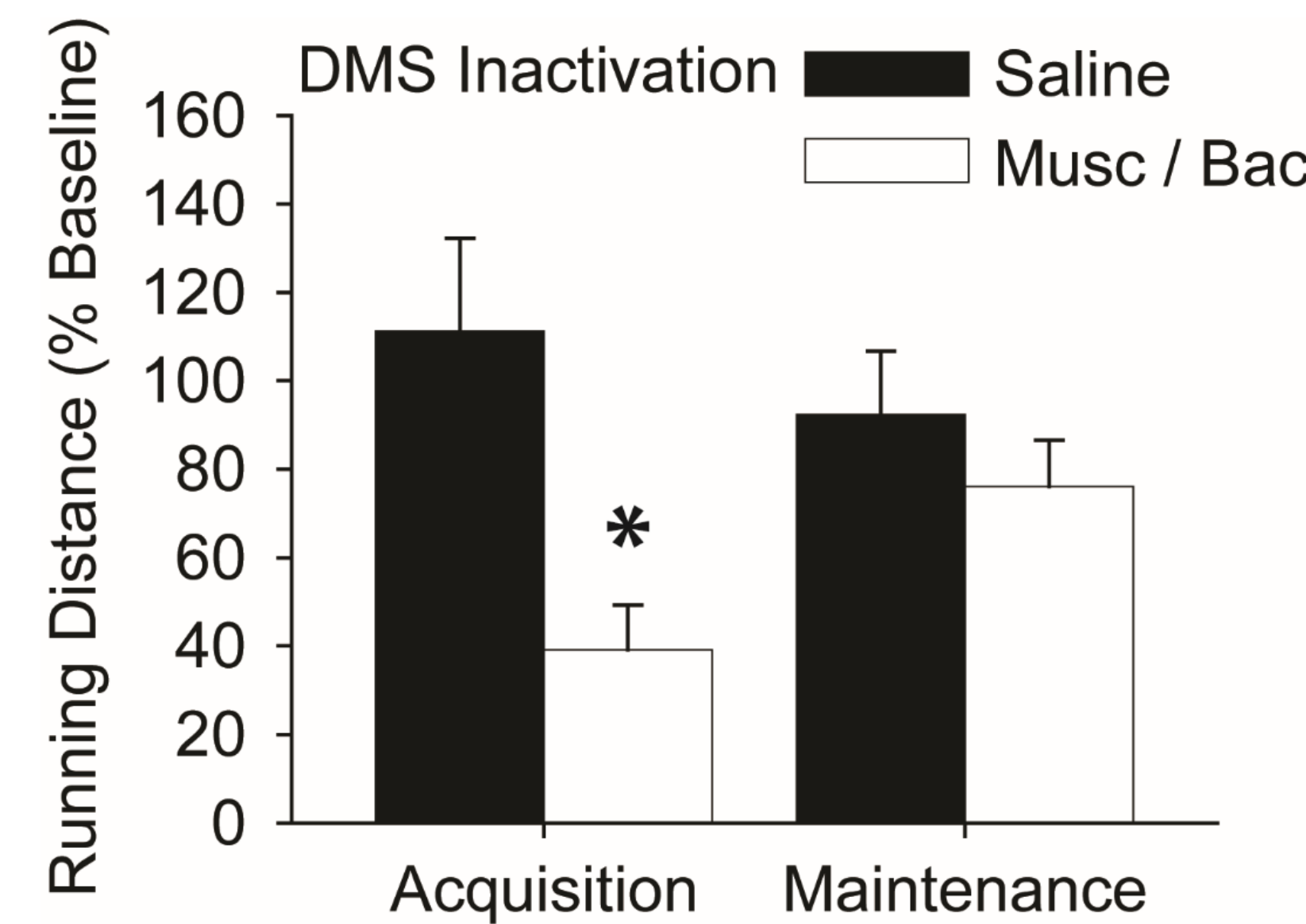
## Methods / Experiment Timeline



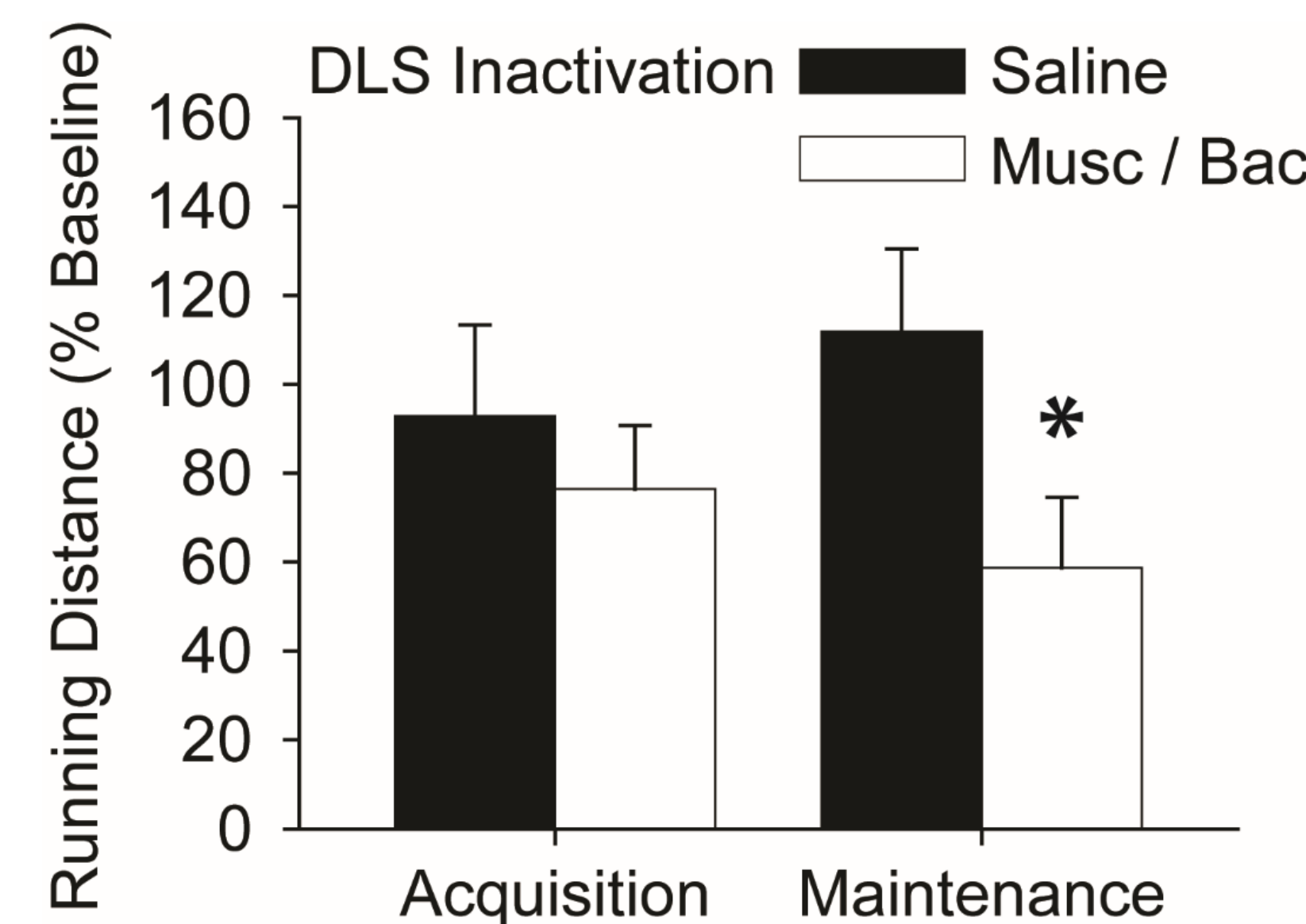
- Implanted bilateral cannulae into either the DMS or DLS.
- Temporarily inactivated either the DMS or DLS using GABA agonists, Muscimol (0.03 nmol) and Baclofen (0.3 nmol), during the acquisition and maintenance phases.
- Characterized female estrous cycle phase daily using vaginal cytology.

## Males

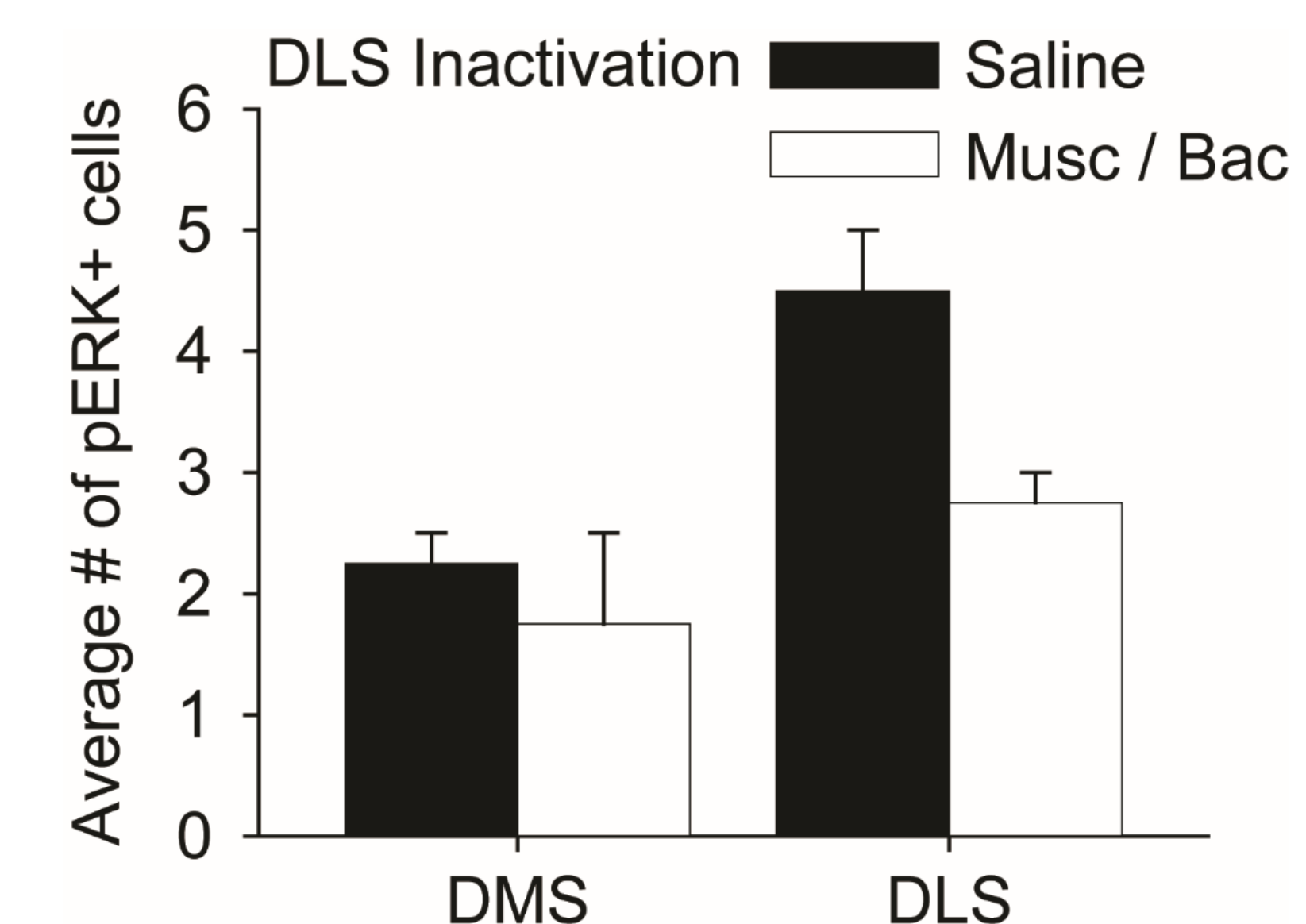
### DMS inactivation reduces running during acquisition, but not maintenance phase.



### DLS inactivation reduces running during maintenance, but not acquisition phase.

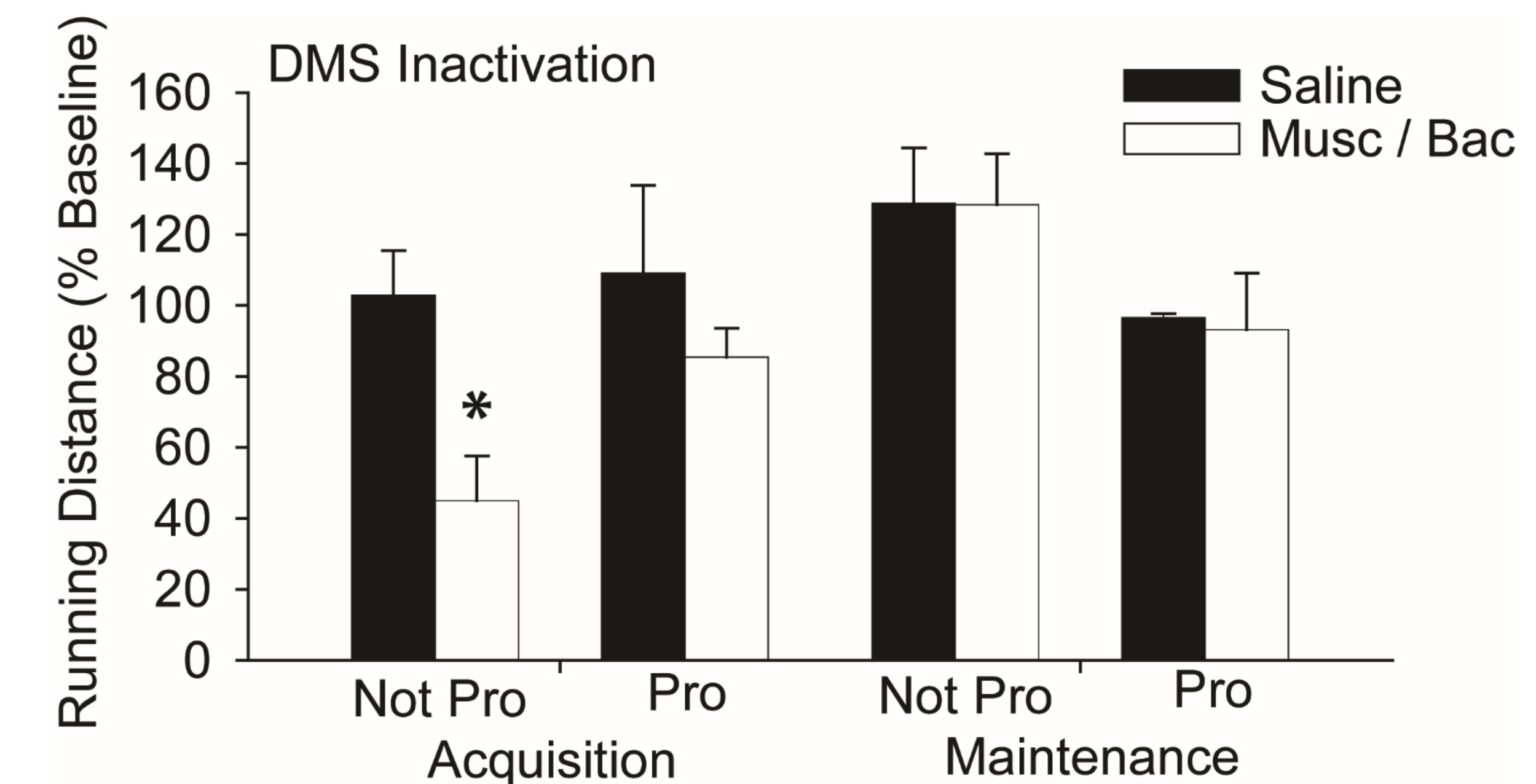


### DLS inactivation reduces the # of pERK+ cells in the DLS during maintenance phase.

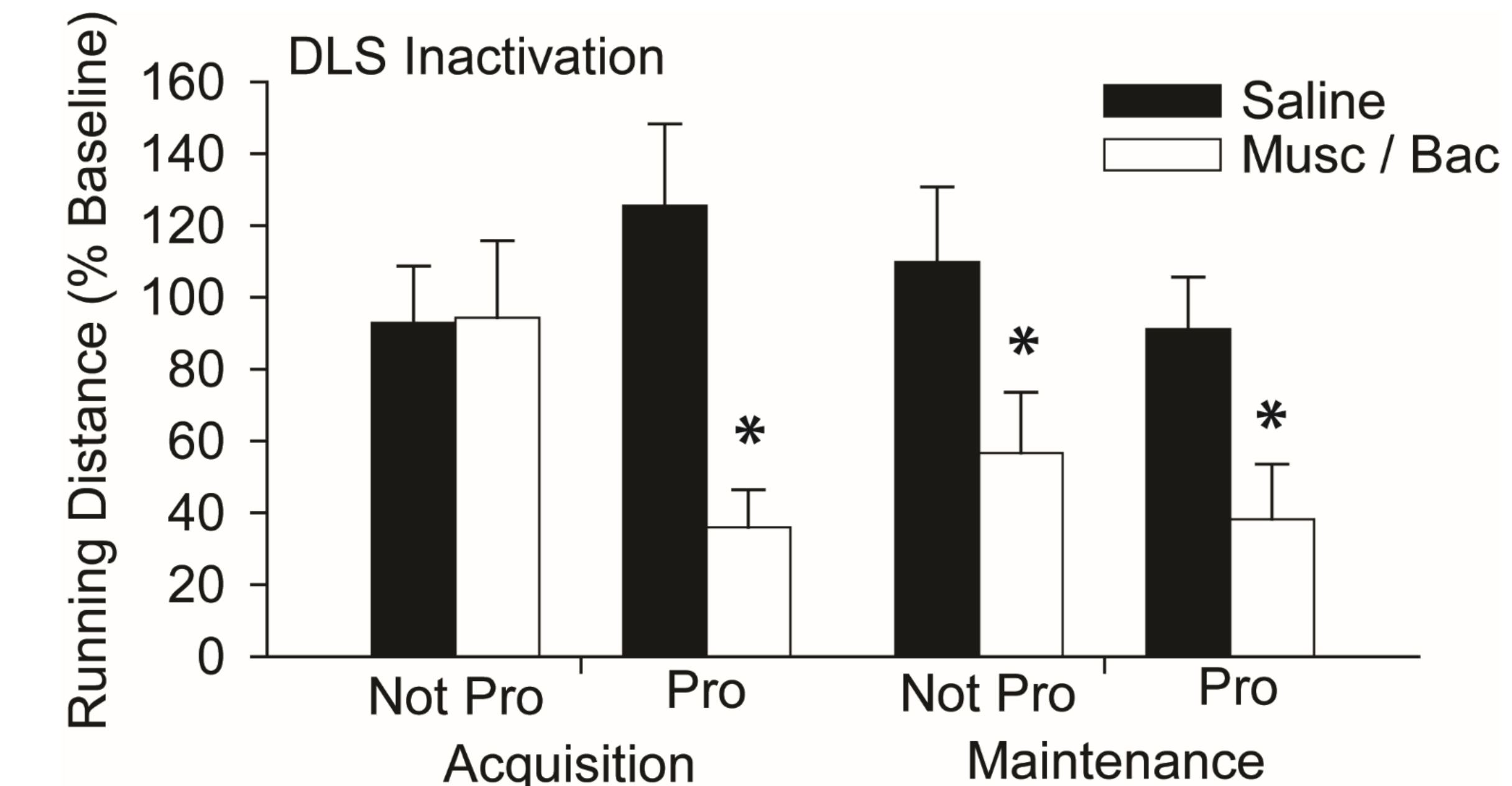


## Females

### DMS inactivation reduces running during the acquisition phase in non-proestrus females.

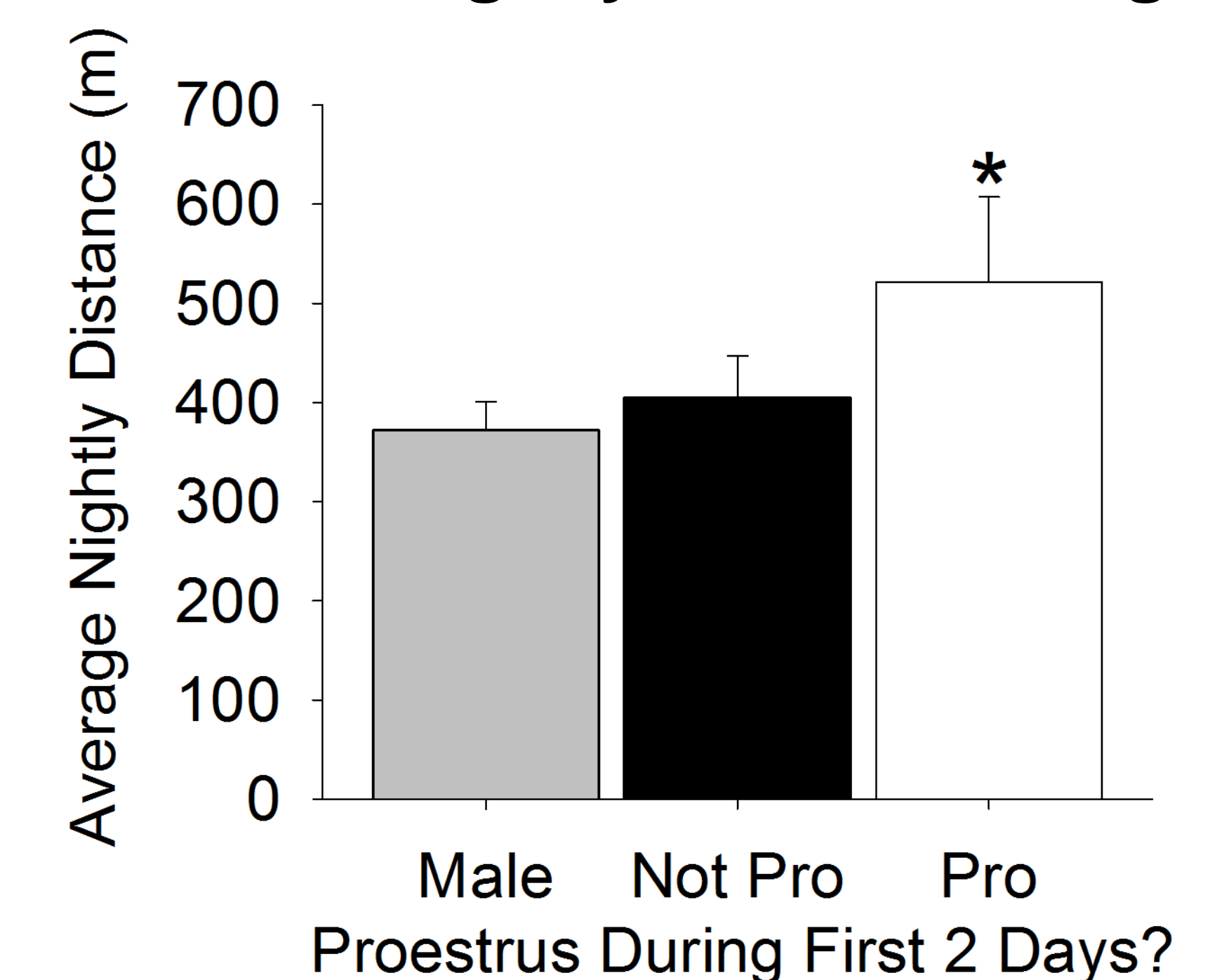


### DLS inactivation reduces running during the acquisition phase in proestrus females. During the maintenance phase, DLS inactivation reduces running regardless of phase.

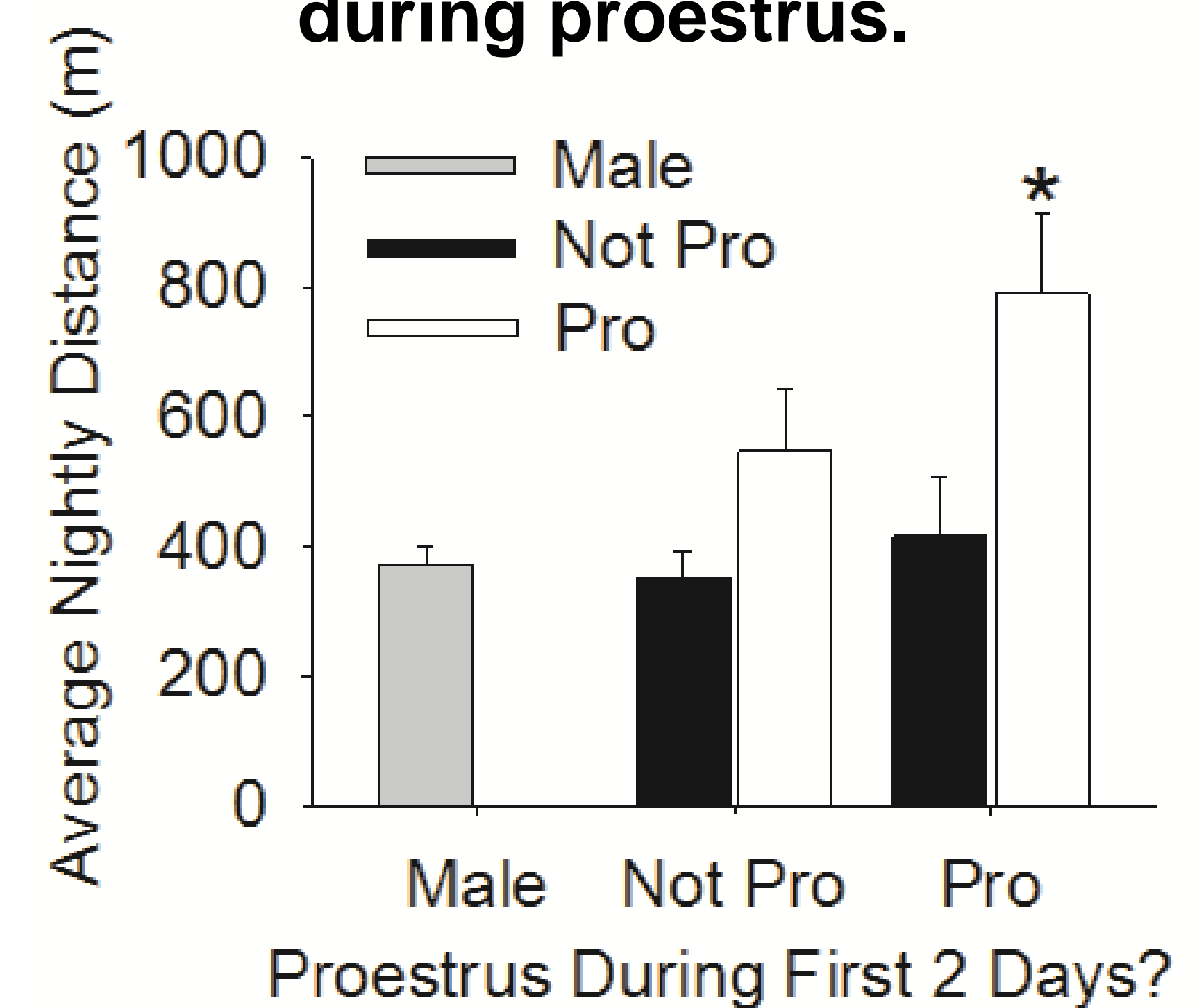


## Estrous Cycle

### Learning to wheel run in proestrus increases nightly wheel running.



### ...Especially when later running occurs during proestrus.



## Conclusions

- Different neural circuits are used to control the acquisition and maintenance of voluntary exercise.
- Male and female rats differentially rely on these circuits to control voluntary exercise behavior. The estrous cycle affects which neural circuit is used to control exercise during the acquisition phase in females.
- These data suggest that running behavior is initially goal directed but becomes habitual over time. Wheel running becomes habitual faster in females than it does in males.



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<https://clas.ucdenver.edu/exercise-neuroscience-lab/>