Sex Differences in Rodent Neuronal Reactivity to Predatory and Non-Predatory Natural Images in the Dentate Gyrus

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Introduction

Heavy involvement of sex hormones in the dentate gyrus (DG) could lead to **sexual dimorphisms** in mice (Madeira et al., 1991; Andrade et al., 2000).

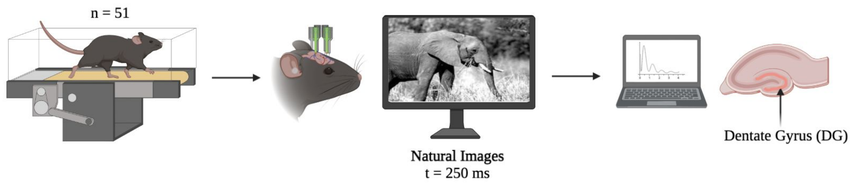
Sex differences in predatory odor recognition have been identified, but the effects of **visual predatory stimuli** on the activity of the DG region have yet to be investigated.

The Allen Institute for Brain Science has published data measuring mice DG reactivity to natural images.

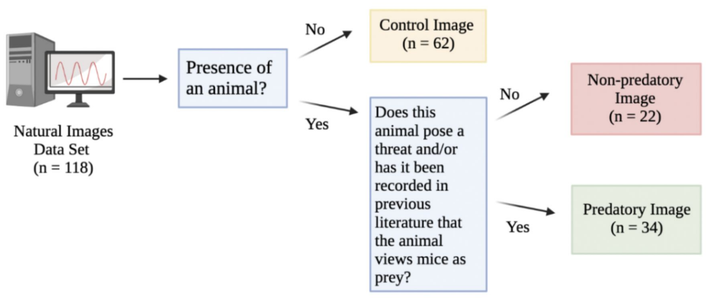
Hypothesis: Female mice will have higher neural reactivity in DG units to natural images with predator images when compared to control and non-predatory images.

Methods

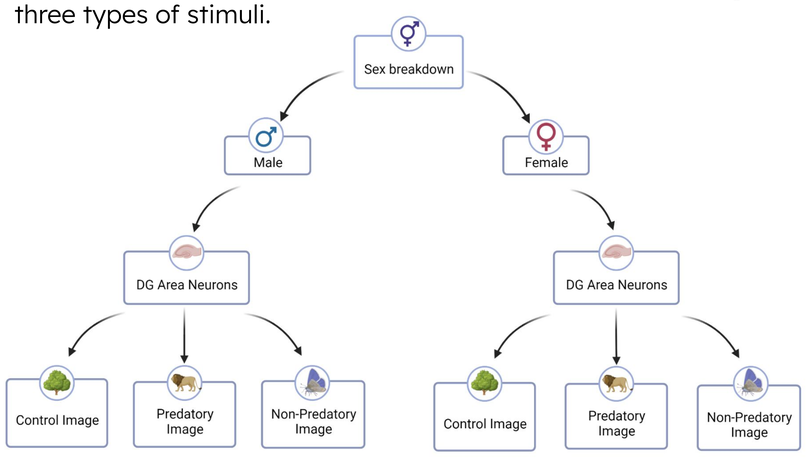
Procedure: 51 mice filtered for DG area from Allen Institute data. Each image was presented 50 times in a randomized order for 250 ms.



Stimuli: 118 natural images were sorted into one of 3 groups: control (non-animal) images, non-predatory images, or predatory images.



Formation of Data Set: Neuropixel data was split into sessions of female and male mice, with DG area neurons reacting to three types of stimuli.



Results

Sex Imbalance in Sample Sizes

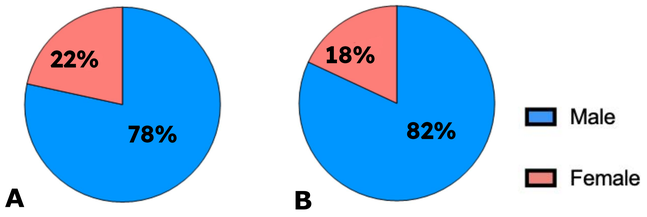


Figure 1. Male samples dominated the data pool on both (A) unit level and (B) session level.

Firing Patterns by Sex and Image Types

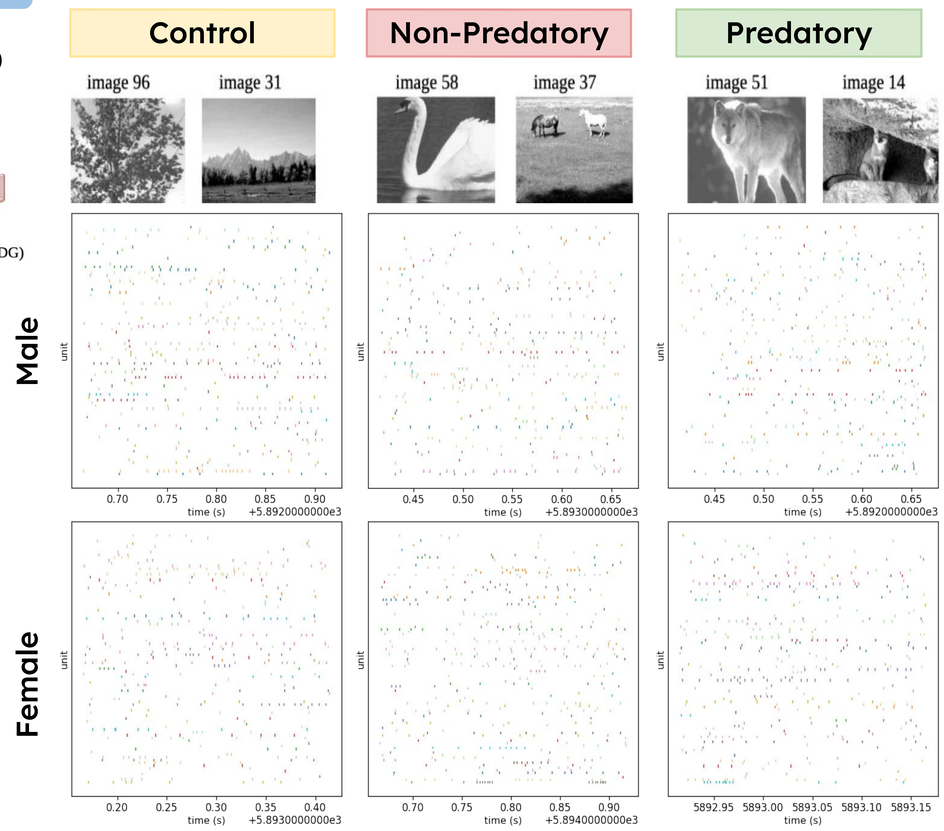
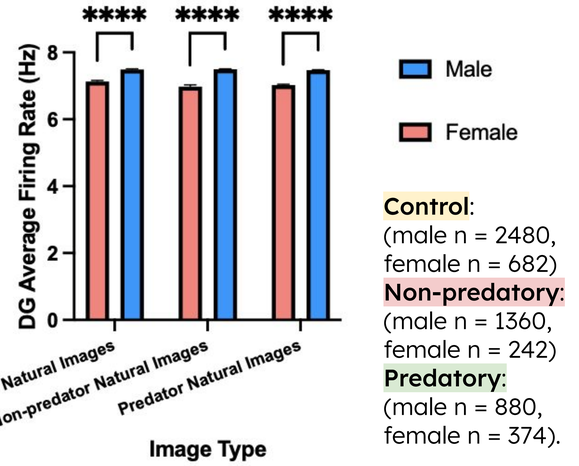


Figure 2. Examples of neural firing patterns from male and female DG units to natural scenes stimuli. Six groups were formed for analysis from a male mouse (session 715093703) and a female mouse (session 751348571). Each dot represents a sorted spike, across all units in the session (y) and time (x).

Male Mice showed Higher Firing Rates



Control: (male n = 2480, female n = 682)
Non-predatory: (male n = 1360, female n = 242)
Predatory: (male n = 880, female n = 374).

Figure 3. Mean firing rates in dentate gyrus neurons of female and male mice viewing control, non predatory, and predatory images. Significance = p-value < 0.0001.

Discussion

The results did not support our original hypothesis. Significance found between neural reactivity among control and non-predatory images in female mice only.

Sex differences were found in all groups. Males had greater reactivity. Sex dimporphism with male mice having larger dentate granule layers/more cells contributed to bulkier output in DG of males (Roof, 1993).

Predatory stimuli didn't cause higher neural activities in females or males. Possible that mice rely on olfactory input more than direct object recognition to threats (Apfelbach et al., 2015).

Limitations:
- Temporal information did not align to pupil data.
- Smaller female sample size.

Future Directions:
- CA areas for further output analysis.
- Sympathetic nervous responses and behavioral analysis.

Contributions

QM was responsible for portions of the result figures and revision. WL was responsible for writing portions of discussion and introduction and formatting the poster. FT wrote the introduction, portions of the discussion and the portions of the result figures. SN was responsible for method section and creating the figures. MD was responsible for writing the figure legends, formatting, and revision.

References

Andrade JP, Madeira MD, Paula-Barbosa MM (2000) Sexual dimorphism in the subiculum of the rat hippocampal formation. Brain Res 875:125–137.

Apfelbach, R., Soini, H. A., Vasilieva, N. Y., & Novotny, M. V. (2015). Behavioral responses of predator-naïve dwarf hamsters (Phodopus campbelli) to odor cues of the European ferret fed with different prey species. Physiology & behavior, 146, 57–66.

Madeira MD, Sousa N, Paula-Barbosa MM (1991) Sexual dimorphism in the mossy fiber synapses of the rat hippocampus. Exp Brain Res 87:537–545.

Roof RL (1993) The dentate gyrus is sexually dimorphic in prepubescent rats: testosterone plays a significant role. Brain Res 610:148–151.

Code