# LESION-INDUCED NEUROGENESIS: A COMPARISON BETWEEN NEUROGENIC VERSUS NON-NEUROGENIC BRAIN REGIONS

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## Introduction

Adult neurogenesis (the birth of new neurons derived from adult stem cells) holds the possibility of contributing to structural and functional recovery following brain damage. Adult neurogenesis occurs naturally in vertebrate animals in limited brain regions (e.g., the hippocampus). Injury-induced neurogenesis, however, has been shown to occur in additional brain regions that are normally non-neurogenic (e.g., the avian hypothalamus and mammalian neocortex). Lesion-induced neurogenesis has yet to be investigated in both neurogenic and non-neurogenic regions in the same study. This study will directly compare the effects of injury to neurogenic and non-neurogenic regions of an adult song bird, the zebra finch.

## Methods

- Experimenters will bilaterally lesion groups of male zebra finches in one of three locations: the hippocampus (HP; neurogenic), the higher vocal center (HVC; neurogenic), and the hyperstriatum accessorium (HA; non-neurogenic).
- BrdU (a marker of cell proliferation) will be administered to all birds 24 hours post-lesion. All birds will be perfused 7 days following surgery.
- Five sets of tissue will be obtained with slice thickness at 40µm. One set will be Nissl stained to determine the extent of the lesion. Other sets will be used for immunohistochemical (IHC) protocols.
- IHC will be used to label cells expressing BrdU and NeuN (a marker for mature neurons). Using computer assisted light microscopy, we will count all cells that are labeled both with BrdU and NeuN in the three regions. A cell that is double-labeled with both of these markers is considered to be a newly born neuron.
- Experimenters will compare the cell counts of each lesioned group to an unlesioned control group to test for any significant differences.

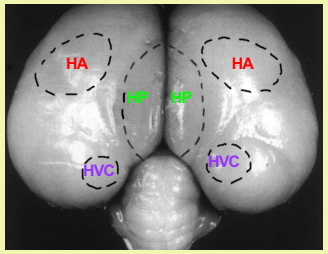


Figure 1: Depiction of lesion areas

Table 1: Group Descriptions

| Lesion Type | Neurogenic | BrdU | Perfused |
|---|---|---|---|
| Hippocampus (HP) | Yes | 1 day Post-Lesion | 7 days Post-Lesion |
| Higher Vocal Center (HVC) | Yes | 1 day Post-Lesion | 7 days Post-Lesion |
| Hyperstriatum Accessorium (HA) | No | 1 day Post-Lesion | 7 days Post-Lesion |
| No Lesion (sham) | N/A | 1 day Post-Lesion | 7 days Post-Lesion |

## Hypothesized Results


Figure 2 Comparison of cells positively labeled for both BrdU and NeuN in HP between sham control group and HP-lesioned group. It is hypothesized that the HP lesioned group will have significantly more double-labeled cells than the sham group.

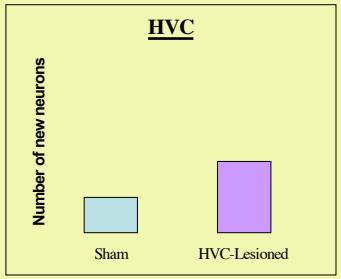


Figure 3 Comparison of cells positively labeled for both BrdU and NeuN in HVC between sham control group and HVC-lesioned group. It is hypothesized that the HP lesioned group will have significantly more double-labeled cells than the sham group.

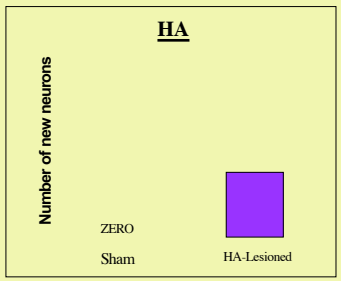


Figure 4 Comparison of cells positively labeled for both BrdU and NeuN in HA between sham control group and HA-lesioned group. It is hypothesized that the HP lesioned group will have significantly more double-labeled cells than the sham group.

## Tissue Images

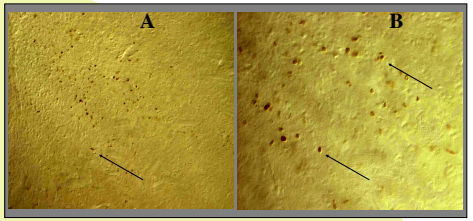


Figure 5: Demonstration of single-label BrdU IHC. Arrows indicate cells positively labeled for BrdU. Images were taken at 20x (A) and 40x (B).

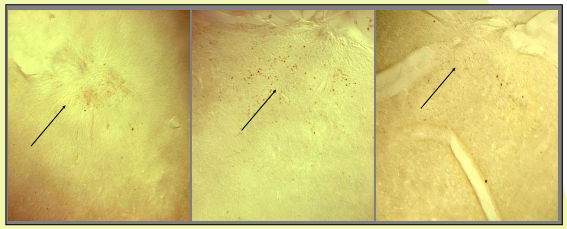


Figure 6: Illustration of lesion slice in three brain regions following single-label immunohistochemistry for BrdU at 10x. Arrows indicate location of lesion.

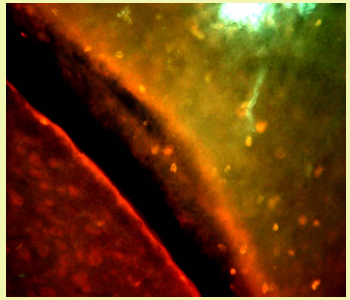

Figure 7: Demonstration of BrdU (green) single-labeled cells, NeuN (red) single-labeled cells, and double-labeled BrdU/NeuN (yellow) cells.

## Summary and Conclusions

- It is expected that there will be greater levels of neurogenesis in groups that receive a lesion to one of the three regions (e.g., HP, HVC, and HA), when compared to an unlesioned control group.
- Due to the fact that the HP and HVC are inherently neurogenic, significantly more neurogenesis after injury is expected to occur in these locations.
- The results of the proposed study could shed light on possible endogenous repair mechanisms for both neurogenic and non-neurogenic regions of the brain.
- Such findings could contribute to a clearer understanding of the purpose of these new adult cells and how we may use and possibly manipulate extant mechanisms for future treatment options following brain damage.