Distribution of inhibitory interneurons across the bat primary auditory cortex

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Introduction

Sensory processing in the brain relies on tightly regulated neuronal interactions among inhibitory interneurons (INs) and pyramidal cells in the sensory cortex.

In the mammalian primary auditory cortex (A1):

- Acoustic information is processed by specific patterns of responses that arise from IN-pyramidal cell interactions and allow understanding of complex sounds such as language
- Exact role of INs in processing complex auditory stimuli is unknown

In our project:

- Characterize the distribution of three IN subtypes across A1 of Mexican free-tailed bats using non-overlapping protein markers Parvalbumin (PV), Somatostatin (SOM), and Calretinin (CAL)

Why bats?

- Reliance on acoustic information during echolocation makes them a good model to study the A1

Hypothesis

We hypothesize that the three cell types will be distributed differently across A1 layers, with Parvalbumin INs occurring most frequently.

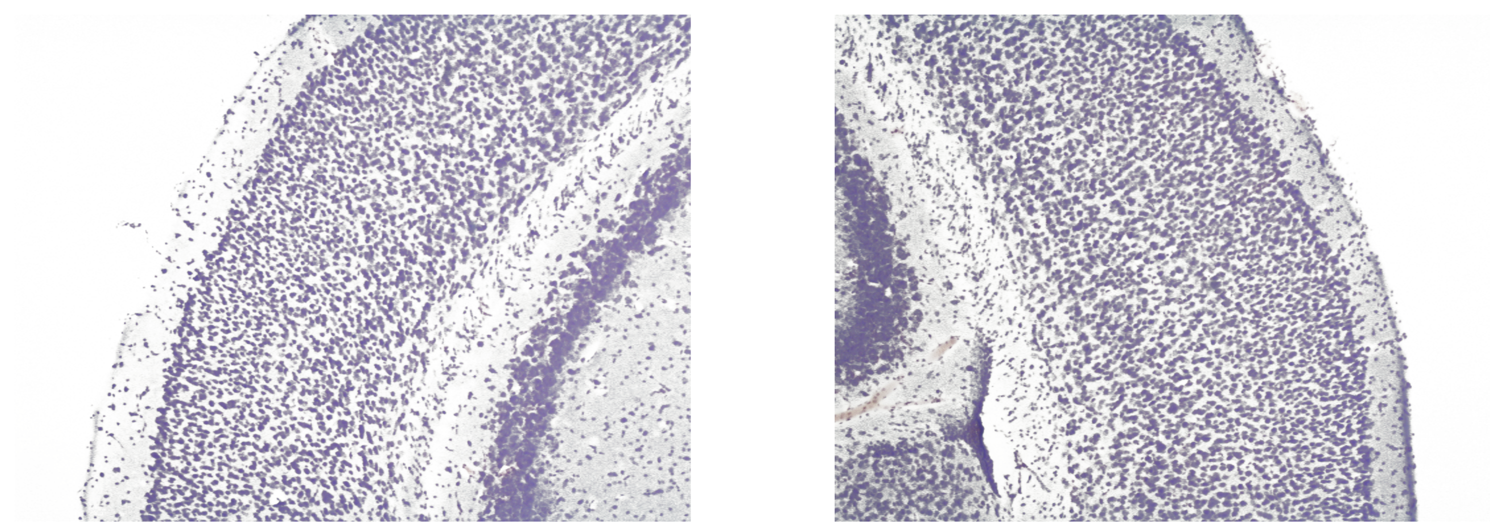
- Parvalbumin in layers III-IV
- Calretinin in layer II/III
- Somatostatin in layer V-VI

Methods

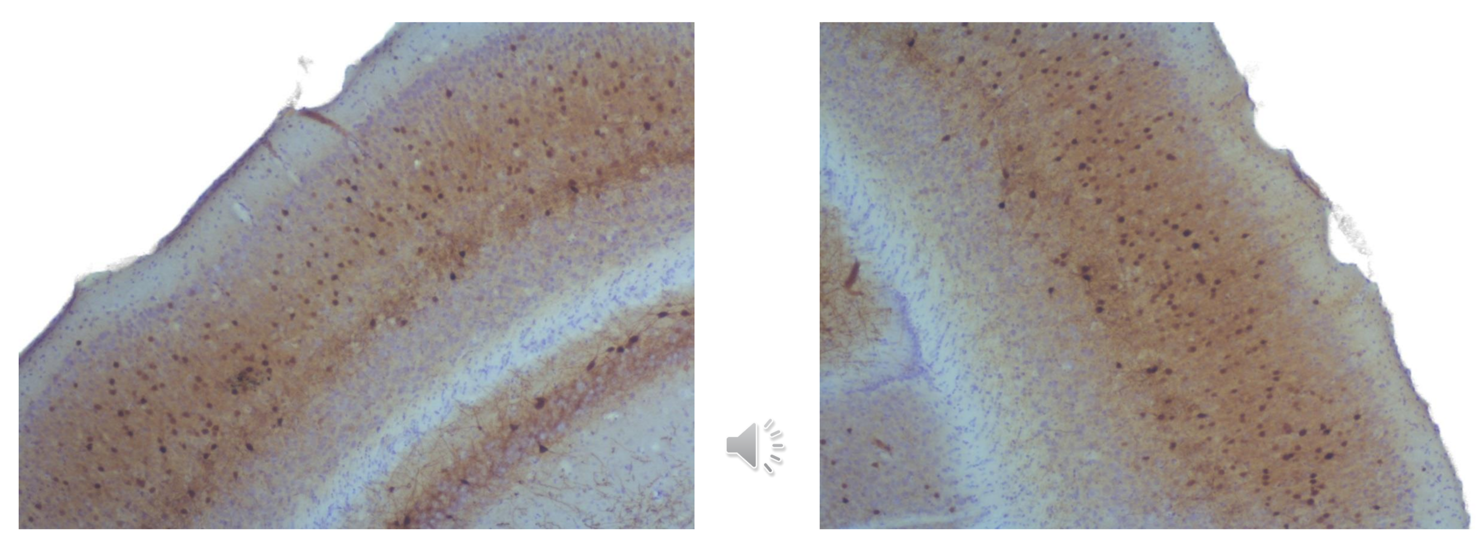
- Antibodies specific to the proteins (parvalbumin, somatostatin, calretinin) used to stain 40 µm coronal sections
- FIJI (ImageJ2) used to conduct semi-automatic cell counts at different depths within A1

Results

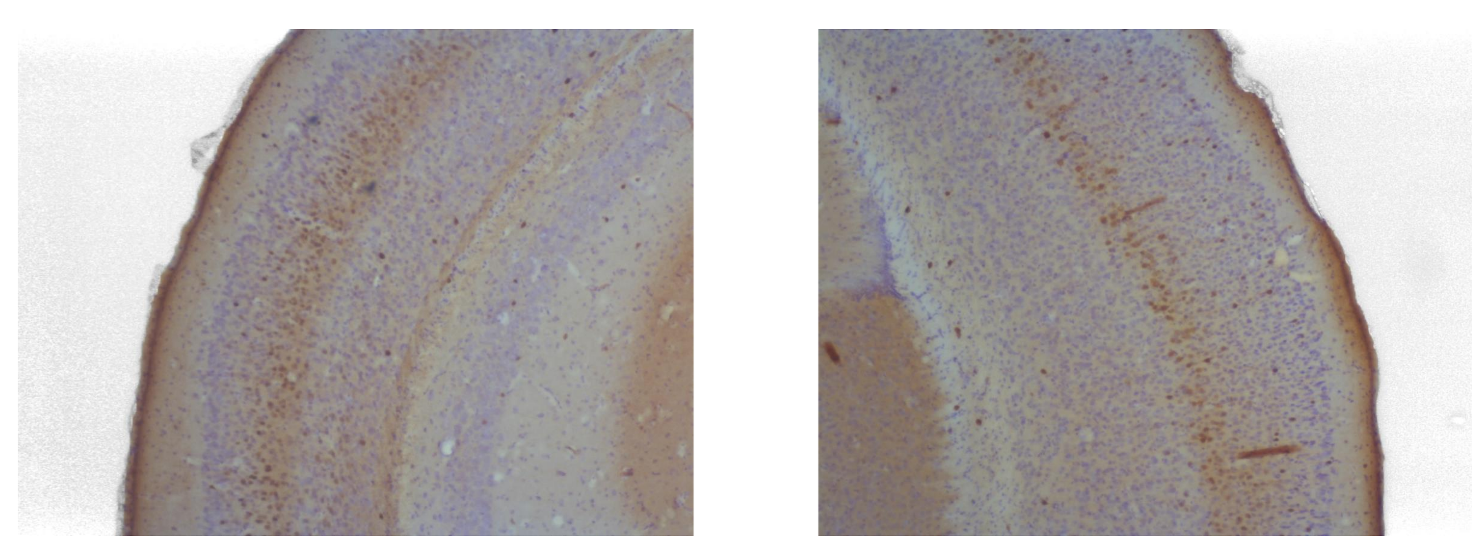
Nissl staining of Mexican free-tailed bat A1



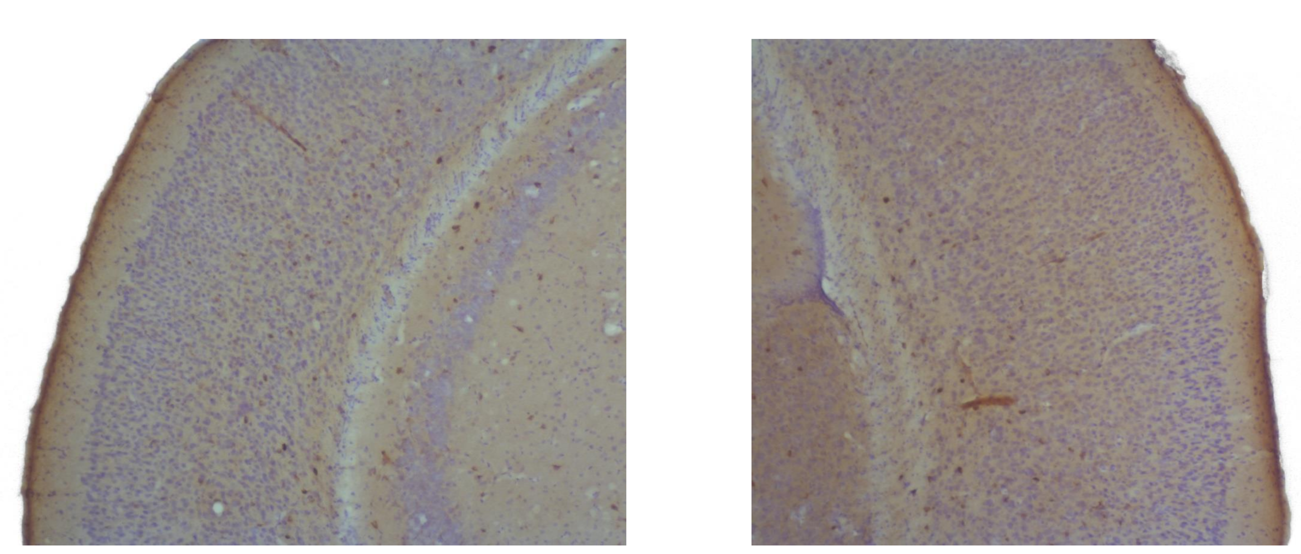
PV IN's in bat A1



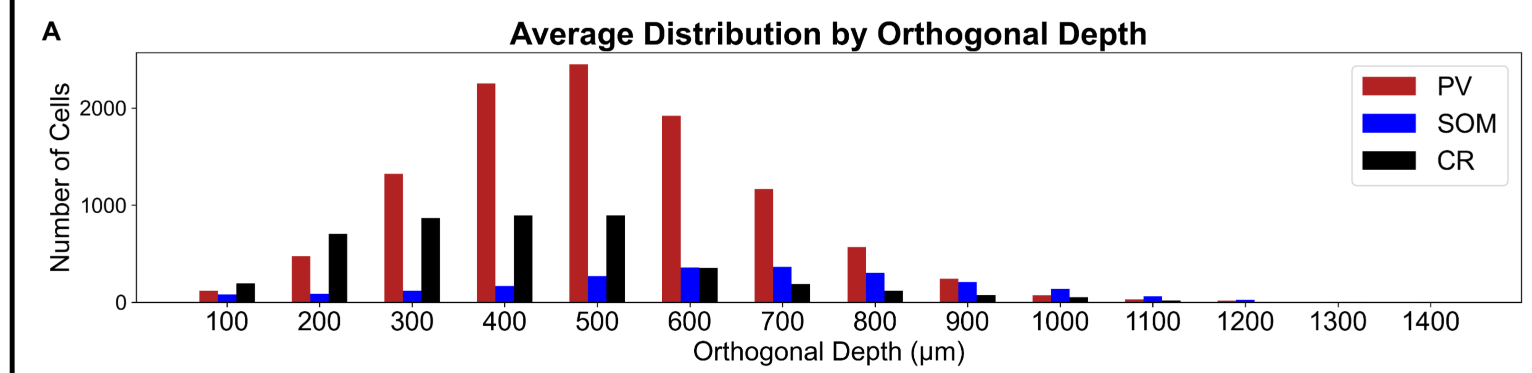
CAL IN's in bat A1

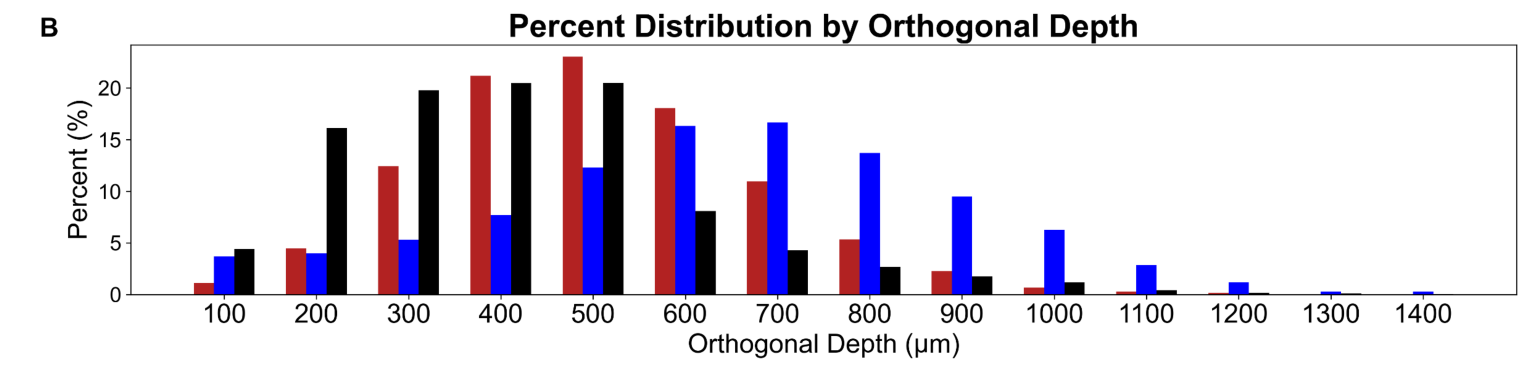


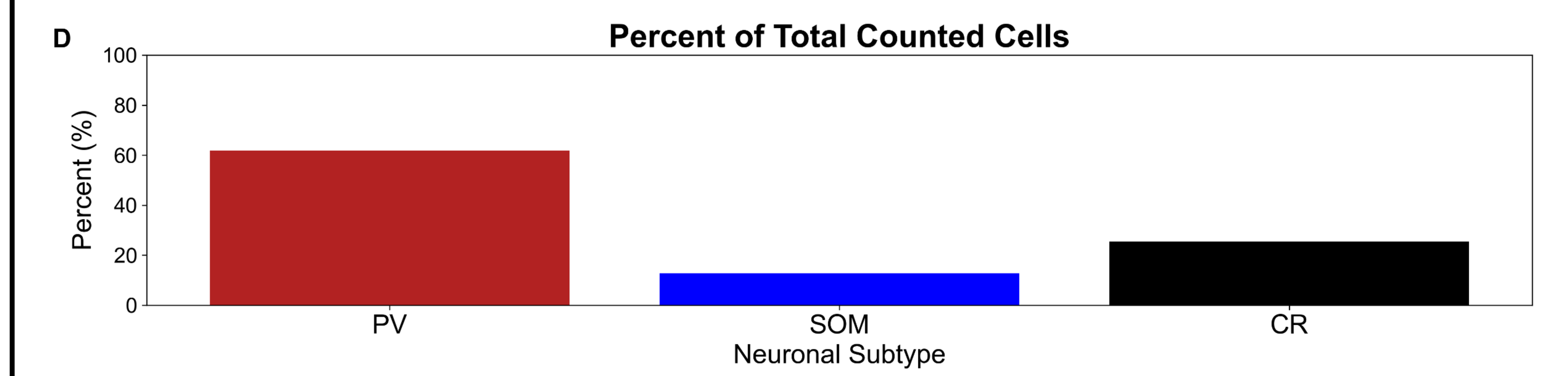
SOM IN's in bat A1



0.25 mm

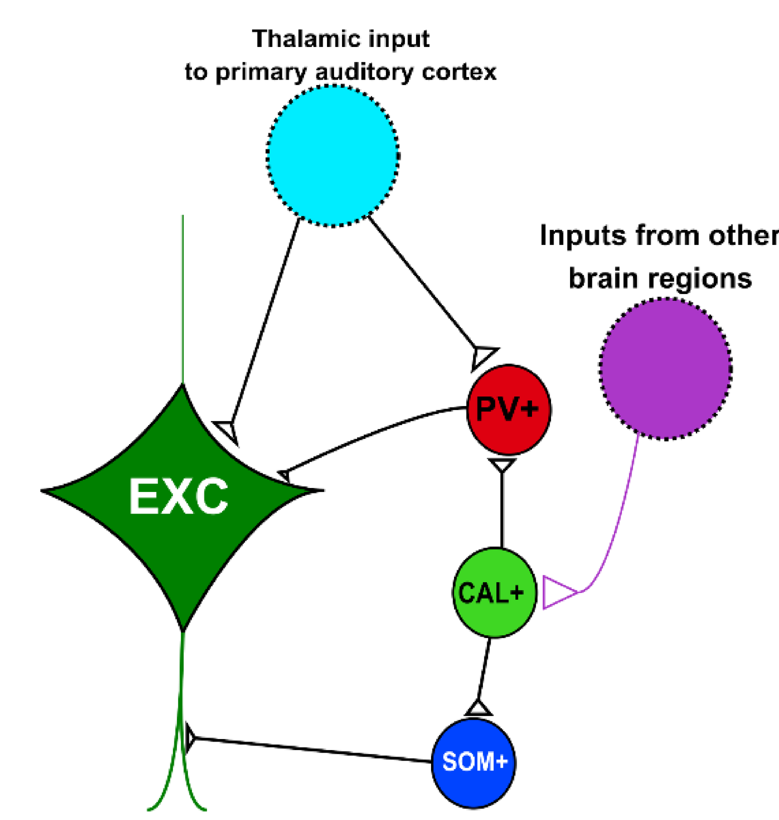






- Parvalbumin: layers III-IV, corresponding to 300-600 µm in depth; occur in larger quantities than Calretinin and Somatostatin
- Calretinin: layer III, corresponding to 200-500 µm in depth.
- Somatostatin: layers V-VI, corresponding at 600-800 µm in depth

Proposed Mechanism of Auditory Processing



Schematic of excitation/inhibition circuitry in A1 and the role of each IN subtype in maintaining the circuit dynamics that ultimately result in stimulus recognition and comprehension

Conclusions

Parvalbumin, Calretinin, and Somatostatin INs are distributed differently across A1 layers. This distribution is similar to what has been seen in other mammals. Despite these similarities, this distribution still leads to object discrimination during echolocation. This provides an interesting avenue for further research.