Investigating neural connections between the mouse gustatory cortex and mediodorsal thalamus

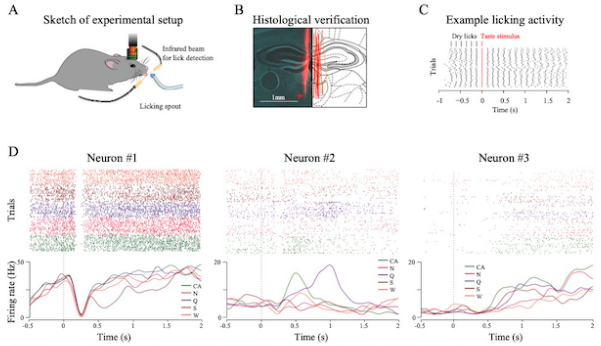
Sydney Carlson, Roberto Vincis, and Katherine E. Odegaard

Department of Biological Sciences and Program in Neuroscience, Florida State University, Tallahassee, FL.

Introduction

Our eating decisions depend on how food tastes and the reward we experience while eating. This information travels from the oral cavity to the brain through interconnected, gustatory-related regions, many of which have been extensively studied in rodent models. Recently, the mediodorsal nucleus of the thalamus (MD), which is not part of the canonical taste pathway, has emerged as a region responsive to taste quality, intensity, and expectation that shares connections with the gustatory cortex (GC). To investigate the extent of how MD activity alters behavioral responses and cortical taste-related neural activity, the ability to selectively manipulate MD projections to GC without affecting other thalamocortical or MD circuits is a key challenge. We addressed this using an intersectional viral strategy: retrograde AAV2/11 delivered to GC combined with Cre-dependent markers in MD. Our results show that we reliably and selectively labeled projections from both the MD and VPMpc, the canonical thalamic nucleus in the taste pathway used as a control, to GC, establishing the foundation for targeted circuit manipulation. Our ongoing analyses aim to determine how MD suppression impacts gustatory-related neural activity and associated behavioral outcomes. Together, this work highlights the utility of advanced imaging and quantitative analysis tools for probing thalamocortical contributions to taste processing and provides a framework for assessing the functional role of MD in ingestive behavior.

1 - MD Neural Responsiveness to Taste Stimuli

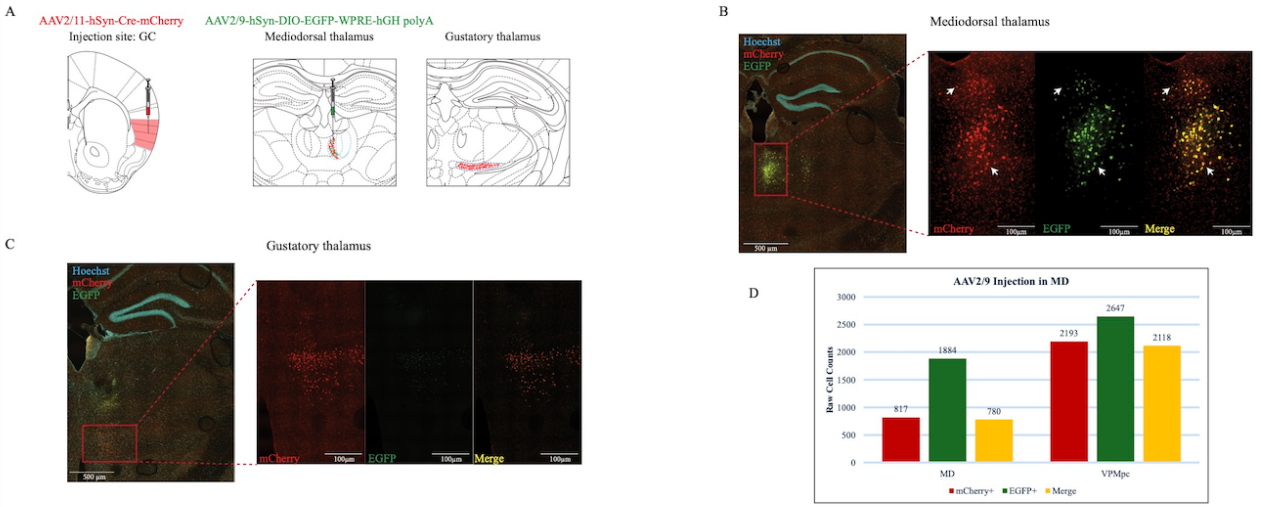


2 - Research Question & Experimental Approach

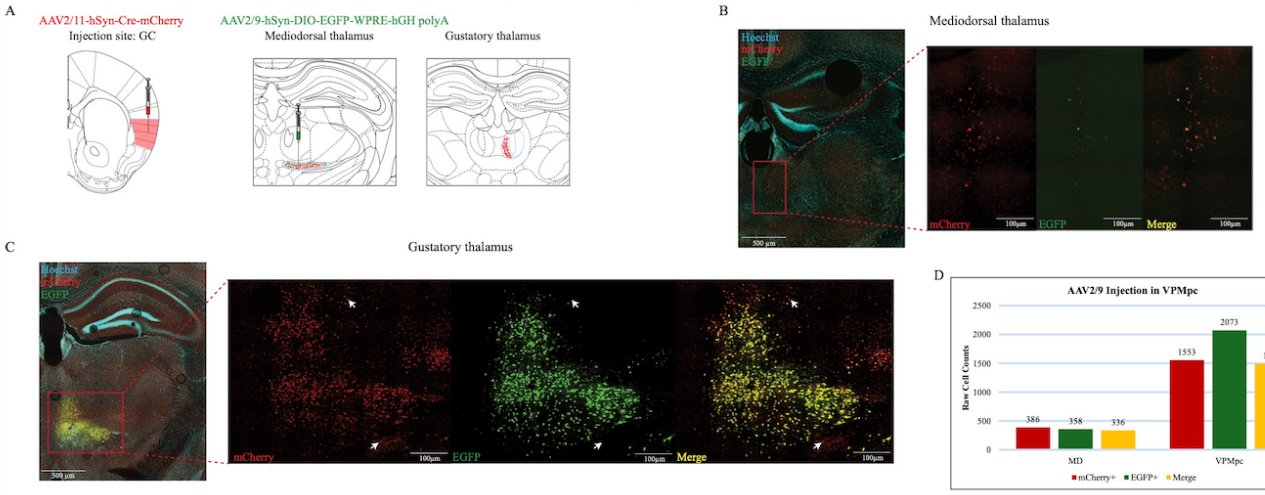
Can we selectively label MD projections to the GC without labeling other thalamocortical or MD circuits?

- Mice received intracranial injections of AAV2/11 in the GC and AAV2/9 in the MD or VPMpc (control).
- Three weeks after surgery, mice were perfused and brains collected.
- Brain tissues were sliced (100 µm thickness) using a vibratome and stained with Hoechst prior to mounting on microscope slides.
- Brains were imaged using a Nikon CSU-W1 spinning disk confocal microscope.
- For better visualization of projections and to facilitate cell counting, slices were imaged at 40X magnification with z-stacks (4 µm steps, 9-12 stacks per image).
- Cells were counted using the ImageJ Cell Counter plugin.

3 - Single-cell Labeling and Quantification - MD



4 - Single-cell Labeling and Quantification - VPMpc



5 - Conclusions

- We can label cells in the MD that project to the MD, however:
  - In both sets of injections, we saw EGFP-labeled cells in regions where the cre-dependent virus was not injected.
  - We also saw mCherry-labeled cells that did not appear to be co-labeled with EGFP.
    - Further imaging and analyses are required to investigate the possiblity of photobleaching and leaking between channels.

Acknowledgements

This work was supported by the R01 DC019326 to R.V. from the National Institutes on Deafness and Other Communication Disorders (NIDCD). The authors would like to acknowledge the utilization of the Nikon CSU-W1 microscope through FSU's Biological Science Imaging Resource. Special thanks to the members of the Vincis laboratory for their support and Julia Won of the Storace lab for her invaluable imaging help and advice.