CALIFORNIA STATE UNIVERSITY SAN MARCOS

PROJECT SIGNATURE PAGE

PROJECT SUBMITTED IN PARTIAL FULLFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE

MASTER OF SCIENCE

IN

BIOTECHNOLOGY

PROJECT TITLE: Piecing Together the Visual Corticothalamic Retinotopic Map of the Mouse

AUTHOR: Jamie Evora

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PARTIAL FULLFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF
SCIENCE IN BIOTECHNOLOGY.

Julie Jameson Ph.D.
PROJECT COMMITTEE CHAIR

SIGNATURE

DATE

4/15/14

4/15/14

4/15/14

Brian Norris Ph.D.
PROJECT COMMITTEE MEMBER

SIGNATURE

DATE

Massimo Scanziani Ph.D.
PROJECT COMMITTEE MEMBER

SIGNATURE

DATE
Abstract

Piecing Together the Visual Corticothalamic Retinotopic Map of the Mouse
Howard Hughes Medical Institute at UCSD
Jamie Evora
April 15, 2014
Professional Master’s Degree Program
Cal State University, San Marcos

Vision is an important sense; it allows animals to create an image of the surrounding environment based on emitted or reflected photons. The sensory interface that transforms photons into electrical signals that can be interpreted by the brain is the retina of the eye. From the retina, these electrical signals are conveyed via axons to a wide array of neuronal networks, many of which are not fully understood. One of the principal targets of retinal axons is the dorsal lateral geniculate nucleus (dLGN) of the thalamus, a structure in charge of relaying information from the retina to visual cortex. The dLGN is however not the only thalamic nucleus that transmits visual information to the cortex. The lateral posterior (LP) nucleus of the thalamus is also part of the vision circuit relaying messages to cortical structures. In contrast to the dLGN, LP does not get visual information directly from the retina. Its main inputs are the superior colliculus and visual cortex itself. The precise anatomy of axonal projection originating each of these two thalamic nuclei is still not completely understood. Here we use viral tracing approaches in the mouse to identify the exact cortical regions targeted by the thalamocortical axons emanating from dLGN and LP. We discover that in primary visual cortex (V1), dLGN and LP have in part complementary and in part overlapping projection pattern: The dLGN projects axons in layers I, IV and VI, while the LP projects to layer I, and the deeper layers of V1. In secondary visual cortex (V2) the projection pattern of LP become denser and the border between V1 and V2 shows a rapid increase in axon density as well as overlapping projections to dLGN axons in V2. These studies further confirm previous work on cats and primates, and validate the mouse as an outstanding model to study vision.
Piecing Together the Visual Corticothalamic Retinotopic Map of the Mouse

Howard Hughes Medical Institute at UCSD
Jamie Evora
May 14, 2014

Faculty Advisors:
Project Chair: Julie Jameson Ph.D.
Committee Member: Massimo Scanziani Ph.D.
Committee Member: Brian Norris Ph.D.
Overview

• Introduction/ Background
• Project Aims
• Materials and Methods
• Results
• Discussion
The Retina uses the Thalamus to send signals to the Cortex to process visual information


Molecular tools have made the mouse an ideal model to study vision.

- Genetic manipulation of mice
- Production of hundreds of transgenic mouse lines
- Genetic tools for mice
Project Aims

• Determine the individual projection patterns of dLGN and LP in visual cortex

• Determine if these axonal projections show evidence that the thalamus regulates information between cortical areas.

• Confirm the mouse as a model for studying vision.

Materials and Methods
dLGN injected with AAV8-Cherry and the corresponding projections in Visual Cortex.
dLGN axons prefer the middle layer (IV), but can also be seen in layer I and the deep layers.
The dLGN projects to V1 as well as V2.
The LP shows a different projection pattern to dLGN.
LP axons prefer the superficial and deeper layers of V1.
m2AChR staining helps to prove that LP axonal projections differentiate between V1 and V2.
Overview of the results

• Both Thalamic Nuclei project to V1 as well as V2.
• Axon projection patterns of dLGN favor layer I, and IV, while LP favors layer I and V in V1.
• LP axons differ between V1 and V2.
• dLGN and LP axons have a part complimentary, part overlap in their axon projections to the cortex.
Discussion

• Axon projections between dLGN and LP suggest a complimentary structure for delivering visual messages to other brain areas.
• Axon projections coincide with previous studies on the cat and monkey.
• Validation from other species shows a pattern between species as well as confirms the mouse as a model organism to study vision connectivity.