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"THE DEVELOPMENT, CYTOARCHITECTURE, AND CIRCUITRY OF THE VENTRAL LATERAL GENICULATE NUCLEUS "

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ABSTRACT

In the visual system, retinal axons convey visual information from the outside world to dozens of distinct retinorecipient brain regions. In rodents, two major areas that are densely innervated by this retinal input are the dorsal lateral geniculate nucleus (dLGN) and ventral lateral geniculate nucleus (vLGN), both of which reside in the thalamus. The dLGN is well-studied and known to be important for classical image-forming vision. The vLGN, on the other hand, is associated with non-image-forming vision and its neurochemistry, cytoarchitecture, and retinothalamic connectivity all remain unresolved, raising fundamental questions of its role within the visual system. Here, we sought to shed light on these important questions by studying the cellular and extracellular landscape of the vLGN and map its connectivity with the retina. Using bulk RNA sequencing and proteomics, we identified extracellular matrix proteins that form two molecularly distinct types of perineuronal nets in two major laminae of vLGN: the retinorecipient external vLGN (vLGNe) and the non-retinorecipient internal vLGN. Using in situ hybridization, immunohistochemistry, electrophysiology, and genetic reporter lines, we found that vLGNe and vLGNi are also composed of diverse subtypes of neurons. In vLGNe, we discovered at least six transcriptionally distinct subtypes of inhibitory neurons that are distributed into distinct adjacent sublaminae. Using trans-synaptic viral tracing and ex vivo electrophysiology, we found that cells in each sublamina receive direct inputs from retina. Lastly, by genetically removing visual input, we found that the organization of these sublaminae is dramatically disrupted, suggesting a crucial role for sensory input in the cytoarchitectural maintenance of the vLGN. Taken together, these results not only identify novel subtypes of vLGN cells, but they also point to new means of organizing visual information into parallel pathways - by anatomically creating distinct sensory channels. This subtype-specific organization may be key to understanding how the vLGN receives, processes, and transmits light-derived signals in the subcortical visual system.

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PUBLICATIONS

Sabbagh U, Somaiya RD, Fox MA. Development and maintenance of subtype-specific vLGN sublaminae. In prep.

Su J, Liang Y, **Sabbagh U**, Olejníková L, Russell AL, Pan YA, Triplett JW, Fox MA. A cell-ECM mechanism for connecting the ipsilateral eye to the brain. Under review.

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PRESENTATIONS

Poster: **Sabbagh U**, Govindaiah G, Somaiya RD, Wei JC, Ha RV, Guido W & Fox MA. Diverse GABAergic neurons form subtype-specific sublaminae in the ventral LGN. Gordon Conference on Thalamocortical Interactions. Ventura, CA, US.

Oral: **Sabbagh U** & Fox MA. Dissecting the Structure and Circuitry of the Ventral LGN. Gordon Conference on Thalamocortical Interactions. Ventura, CA, US.

Poster: **Sabbagh U**, Wei J, Ha R, & Fox MA. Diverse inhibitory neurons form specialized laminae in the ventral LGN. Society for Neuroscience. Chicago, IL, US.

Poster: **Sabbagh U**, Monavarfeshani A, & Fox MA. Distribution and development of molecularly distinct perineuronal nets in visual thalamus. Society for Neuroscience. San Diego, CA, US.