DOES THE LATERAL GENICULATE NUCLEUS (LGN) PAY ATTENTION?

D.W. Royal 1, 2, 4; G. Sary 2; J. Schall 4, 5, 6; V. Casagrande 1, 2, 3, 4, 5, 6
Vanderbilt Univ., Nashville, TN, USA; 4Dept. Physio., University of Szeged, Szeged, Hungary

Introduction
The dorsal lateral geniculate nucleus (LGN) of the thalamus has been long regarded as a simple relay station for visual information passing from the periphery to cortex. In fact, what advantages does this design impart? Furthermore, why should the brain invest resources in constructing and maintaining a sizeable population of LGNd cells, given the enormous amount of other sensory pathways that exist? What is the LGNd, for example, if not the receptive field (RF) properties of LGNd neurons are very similar to those of retinal ganglion cell (RGC) ones. We also know that the LGNd, that other thalamic relay nuclei receive input not only from the periphery (i.e., retina), but also from many cortical and subcortical sources. In the case of the LGNd, these other inputs significantly outweigh, in terms of number and strength, the retinal input. In fact, the precise inhibitory circuitry and array of different transmitter receptors that are located on retinal relay cells and inhibitory interneurons within the LGNd indicate that LGNd may modulate signals related to task relevance and attention.

Methods
Subjects: Two male-barbarian bonnet macaque (Macaca radiata) monkeys
Stimuli: Small, isolated, colored squares optimized for each neuron
Detection of eye movements: Search coil
Physiological recordings: Electroretinographic, single-unit recordings were made via vertical pinpricks from all layers of the LGNd. (1) RFs of recorded cells were located, on average, 15 degrees eccentric to the point of fixation.

Analysis: The timing of significant modulations of activity, including visual response latency, were examined using a Poisson spike train analysis described originally by Stegeman et al. (1985) (Fig. 2). Additionally, the mean firing rate of the cell was determined for the period of time the RF was identified. Because the tasks involved a saccade, this period of time was defined as the saccade latency (mean = 28%) and mean activity (mean = 26%) when the correct target was in the RF, regardless of whether the non-RF target location was in the hemifield ipsilateral or contralateral to the RF. Only two cells showed significant enhancement of activity when the non-RF target was correct (in both cases the enhancement was less than 10%).

Results

Conclusions
1. LGNd cells demonstrated enhancements in peak and mean firing rate during tasks where monkeys were rewarded for choosing a target presented inside the RF over a target presented outside the RF:
2. No changes in LGNd activity were seen when monkeys were rewarded for either remaining fixated or making a saccade to the RF based upon a false cue.
3. These results suggest that LGNd activity is enhanced under conditions where monkeys must allocate spatial attention to a target in the RF.
4. Future studies will require that we demonstrate these changes in LGNd activity in a task (manual) that does not involve saccadic eye movements.