

Timing of ascending and descending visual signals predicts the response mode of single cells in the thalamic nucleus rotundus of the pigeon (*Columba livia*)

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Neurons of the pigeon's diencephalic n. rotundus were demonstrated to show visual responses of short and long latency representing ascending signals of the retino-tecto-rotundal system and descending signals from telencephalo-tecto-rotundal fibers. Pigeons thus provide an ideal model to investigate the convergence of ascending and descending visual processing streams at single cell level. Although it is known that rotundal responses of long latency show distinct response characteristics, dependent on the stimulus being presented monocularly or binocularly, the mechanisms underlying these response differences are still unclear. While it is possible that the simultaneity of eye stimulation produces a change of processing, it is also possible that the relative timing and order between ipsilateral and contralateral signals are the decisive variable. To test between both possibilities, we recorded from cells in the pigeons n. rotundus while providing monocular or binocular visual stimulation and varying the delay and order of eye presentations. We revealed that the precise temporal interaction and order of ascending and descending inputs to the tectum decide about late responses with burst or tonic characteristics. When descending signals reached the tectum before the ascending signals, rotundal cells showed late responses that were characterized by burst activity patterns. When ascending input reached the tectum first, responses with tonic characteristic were observed. These effects might become mediated by intratectal mechanisms, the nucleus ventrolateralis thalami, or the bed nuclei of the tectothalamic tract and might constitute the neural basis of a bihemispheric gating function.