Sensorimotor functions of thalamic pulvinar and pulvinar-cortical interactions

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Flexible primate cognition and behavior depend on the concerted activity across distributed brain circuitry, including inter-hemispheric and thalamo-cortical interactions. Modern concepts of distributed processing underscore the significant contribution of higher-order thalamic nuclei such as the pulvinar — a highly interconnected thalamic structure that co-evolved with the neocortex during primate evolution. In my presentation, I will offer a brief history and discuss a series of recent causal perturbation, imaging, and electrophysiological studies aimed at elucidating the contributions of the pulvinar to bihemispheric visuomotor processing of eye and hand actions in space. To address pulvinar-cortical interactions, I will first describe the brain-wide effective connectivity and time-specific effects on oculomotor choice behavior elicited by pulvinar microstimulation. Then, I will illustrate the spatial and hand-specific deficits induced by inactivation, along with associated changes in connected cortical regions at the level of single neurons and population activity. I will discuss these effects in the context of inter-hemispheric competition and compensatory mechanisms. Subsequently, I will summarize how pulvinar neurons encode visuomotor saccade and reach contingencies, as well as postural variables such as gaze. Based on these results, I will argue that the role of the dorsal pulvinar extends beyond the purely visuospatial domain and active cortical state maintenance, encompassing reference frame transformations, flexible selection, and integration of visually guided eye and hand actions. In conclusion, I will speculate on the possible contributions of pulvinar-cortical circuitry to social cognition and dynamic social decision-making.