Two Subdivisions of Macaque LIP Process Visual-oculomotor Information Differently

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While the cerebral cortex is thought to be composed of functionally distinct areas, the actual parcellation of area and assignment of function is still highly controversial. An example is the much-studied lateral intraparietal area (LIP) (1, 2). Despite the general agreement that LIP plays an important role in visual-oculomotor transformation(3), it remains unclear whether the area is primary sensory (4) or motor(5) related (the attention-intention debate). Although LIP has been considered as a functionally unitary area, its dorsal (LIPd) and ventral (LIPv) parts differ in local morphology and long-distance connectivity(6-9) (7, 10). Particularly, LIPv has much stronger connections with two oculomotor centers—the frontal eye field and the deep layers of the superior colliculus, than does LIPd(7, 10). Such anatomical distinctions imply that compared with LIPd, LIPv might be more involved in oculomotor processing. We tested this hypothesis physiologically with a memory saccade and a gap saccade task. We found that LIP neurons with persistent memory activities in memory saccade are primarily provoked either by visual stimulation (vision-related) or by both visual and saccadic events (vision-saccade-related) in gap saccade. The distribution changes from predominantly vision-related to predominantly vision-saccade-related as the recording depth increased along the dorsal-ventral dimension. Consistently, the simultaneously recorded local field potential (LFP) also changes from visual evoked to saccade evoked. Finally, local injection of muscimol (GABA agonist) in LIPv, but not in LIPd, dramatically decreases the proportion of express saccades. With these results, we conclude that LIPd and LIPv are more involved in visual and visual-saccadic processing, respectively.

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