Mapping response properties in lateral intraparietal area (LIP) of the rhesus macaque

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Abstract

Primate sensorimotor area LIP is thought to have a central role in visual attention, saccade guidance and decision-making. Anatomically, it is divided in dorsal and ventral LIP. LIP neurons may exhibit a visual receptive field or a saccade target response field or both. The nature of the visual receptive field, the distribution of these properties and the relationship between maps are not fully understood.

Using a guidance grid and maps from structural MRI, we carried out multiple penetrations orthogonal to the cortical surface to map systematically neuronal response properties across LIP in one Rhesus macaque. We screened cells for activity during a delayed saccade task to targets across the visual screen. If cells showed delay-period activity, we tried to establish a visual receptive field with a patch of moving dots. We collected complete data sets from 24 single cells that both responded significantly to a visual stimulus such as moving dots and also responded in a delayed saccade task in comparison with fixation task on a blank screen. LIP neurons usually had both a clear response field and a receptive field, but sometimes the visual receptive field was ill-defined. As previously reported, visual receptive fields were found generally in the contralateral visual hemifield; response fields could be either contra- or ipsilateral. Cells recorded more posteriorly and ventrally tended to have lower visual receptive fields, progressing upwards with penetrations moving anteriorly.

The visual receptive fields of these neurons were tested for direction and disparity tuning with patches of coherently moving random dots positioned over the receptive field. 29% (7/24) of cells showed significant direction tuning and 38% (9/24) significant disparity selectivity (ANOVA, $p < 0.05$). At sites with significant visual tuning for the isolated single unit (SU), multi-unit activity was usually also tuned. We then studied the combination of stereo and motion information to investigate how LIP cells process this cue combination during a relevant perceptual decision. We presented a structure from-motion cylinder over the receptive field of the cell and one of two response targets on the response field. The other target was presented symmetrically in the opposite hemifield. The monkey was trained to discriminate the rotation direction of the cylinder by making a saccade to the appropriate target in a reaction time task. 38% (9/24) of cells were tuned to cylinder disparities (ANOVA, $p<0.05$) and many responded to choices about the cylinder.

In sum, LIP contains at least one crude map of the contralateral visual field and many cells show tuning for direction of motion and binocular disparity.

Keywords: *VISUAL ; BINOCULAR ; SACCADE*

Biography

Professional Career

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Education

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