MACAQUE AREA VIP ENCODES VISUAL AND AUDITORY SPACE IN MULTIPLE REFERENCE FRAMES

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Interaction with the environment requires the brain to use spatial information provided by different sensory systems. This information is initially encoded in different reference frames (REFs): visual signals arise in eye-centered and auditory signals in head-centered coordinates. We recently showed that neurons in macaque area VIP respond not only to visual, tactile and vestibular but also to auditory stimulation. Auditory and visual receptive fields largely overlapped. They were determined while the monkey fixated a central target, i.e. while the REFs for both modalities were aligned. In our present study we investigated visual and auditory representations in case the two REFs were misaligned.

We recorded neuronal activity in area VIP of two awake monkeys and mapped visual and auditory receptive fields within the central 60°x60° of space while the monkeys fixated at different azimuthal positions (-10°,0°,10°). To map auditory responses we used a virtual auditory environment based on the monkeys' individually measured HRTFs. We positioned white noise bursts via calibrated headphones at various virtual positions within the mapping range. The visual responses of the cells were mapped with spatially non-overlapping moving white bars. We computed receptive fields for each modality and determined their spatial shift for different fixation positions by means of a 2D cross-correlation analysis. This allowed us to reveal the signals' REFs.

Auditory and visual REFs could be determined for 91 and 124 neurons respectively. Across cells, signals from both modalities were encoded in a continuum between eye- and head-centered coordinates. Representations were slightly biased towards their initial REF, i.e. eye-centered for the visual and head-centered for the auditory domain. We conclude that downstream areas could use this bimodal spatial information provided in an appropriate REF to control different kinds of sensory-guided behavior.

Supported by HFSP & DFG