Visually-induced auditory spatial adaptation in monkeys and humans

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Visual information is known to help calibrate perception of sound location. Visual and auditory spatial information arise in different reference frames, with auditory information derived from head-centered interaural cues and visual information derived from the location of retinal activation, an eye-centered signal. In this study, we investigated the influence of visual spatial cues on auditory localization judgments to determine the frame of reference in which such interactions occur.

Visually-guided shifts in sound localization were induced in seven human subjects and two monkeys who made eye saccades to auditory or audio-visual stimuli. On training trials, the visual component of the audio-visual targets was displaced laterally (5° for humans, 12° for monkeys). Interleaved auditory-only probe trials served to evaluate the effect of experience with mismatched visual stimuli on auditory localization. To dissociate head- from eye-centered reference frames, the initial fixation position of the eyes in the auditory-only trials either differed from or equaled the location used during the audio-visual training trials.

This paradigm successfully induced shifts in saccades to auditory-only sounds. The displaced visual stimuli shifted the endpoints of saccades on the probe trials by about 30%. In humans, the magnitude of this shift depended on the direction of the shift relative to the location of the fixation position. In both humans and monkeys, the magnitude of the induced shift was smaller on probe trials with a fixation position different from that used in training trials than when the fixation position was the same. Taken together, these findings suggest that the neural mechanisms underlying the observed spatial plasticity are not strictly head-centered but incorporate information about eye position. This is reminiscent of demonstrations of eye position modulation in the auditory pathway of non-human primates (eg. Groh et al., Neuron, 29:509-518, 2001).