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Research Article

Control of saccade initiation in a countermanding task using visual and auditory stop signals

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Abstract. We examined inhibitory control in an oculomotor countermanding task, where the primary task required a saccadic eye movement be made to a target and a less-frequent secondary task required that the movement be halted. Previous studies have used a visual stimulus presented centrally on the fovea as the signal to stop or countermand a saccade. In these previous studies, there are at least two possible sources of saccadic inhibition: (1) sensory stimulation at the fovea can elicit a bottom-up mechanism, where a visual transient signal can delay or inhibit the developing saccade command; and (2) information based on the task instruction can be used to initiate a top-down mechanism to halt the movement. In the present study, we used both visual and auditory stop signals to test the hypothesis that the bottom-up mechanism is activated only after presentation of a foveal visual stop signal. Subjects were instructed first to look at a central spot and then to look to an eccentric visual target that appeared randomly to the left or right of center. On about one-third of the trials, a stop signal was presented. Three types of stop signals were used with equal probability: a broad-band noise burst (auditory), a central fixation spot (visual), and a combination of the auditory and visual stimuli (combined). Saccadic reaction time and stop-signal accuracy were used to calculate stop signal reaction time (SSRT), an estimate of the time required to inhibit the eye movement. Mean SSRT was longer for the auditory stop signals (201 ms) than for the signals with a foveal visual component (visual 113 ms; combined 91 ms). We conclude that a foveal visual stop signal in an oculomotor countermanding task changes the measure of inhibitory control to reflect not only inhibitory processes but also the sensory information afforded by stimulation at the fovea.

Key words. Eye movement - Oculomotor countermanding - Saccade - Inhibitory control - Human