

Oculomotor examination

Eye movements were examined in all subjects using a binocular video-based eye tracker (mobile eBT Eye brain, Ivry-sur-Seine, France, www.eye-brain.com, 300 Hz sampling rate and 0.5° spatial resolution). Saccades were automatically detected according to a velocity threshold (Eye brain software) but were individually inspected and manually corrected by the experimenter if necessary. The left eye trace was analyzed by default, however the right eye was used if the left eye signal was contaminated by artifacts. Saccades perturbed by blinks or other artifacts were discarded (less than 10% of the trials in all subjects). Saccades with a latency below 80 ms were considered anticipatory saccades and rejected, and SRT between 81 and 130 ms were considered “express saccades”.

Three different tasks were performed in the same order in one session of 30 minutes duration (Figure 1): i) Simple prosaccades horizontal and vertical; ii) Simple antisaccades horizontal and vertical; iii) Mixed horizontal pro- and antisaccades. Subjects were seated in a calm, dark room with their chin supported by a chin strap and their forehead in contact with a frontal support. They faced a flat, 26 in. LCD screen (ProLite, Iiyama model PL 2600, size 550 mmx344 mm) located 60 cm in front of them at eye level.

i) Simple horizontal and vertical prosaccades: This task started with the onset of a green central fixation point (size: 15 x 15 pixels; luminance: 120 cd/m²) that was presented for a pseudorandom duration of 2800, 3200, 3500, 3800, 4000 or 4100 ms. The fixation point was then turned off and 200 ms later, a red peripheral target (15 x 15 square, luminance 120 cd/m²) appeared during 1000 ms at a 13° right or left location, or at a 13° up or down location. Twenty-eight saccades were recorded. Latency, velocity [average (V_{avg}) and maximal (V_{max})] and gain were analyzed for each saccade. Then an average of all saccades for each metric was performed in each patient. Latency was defined as the reaction time from the target onset to begin of the saccade. Gain was defined as the ratio between saccade amplitude and target location (Figure 2).

ii) Simple horizontal and vertical antisaccades: The task design was the same as in the prosaccade task, with the exception that the color of the central fixation point was red. Subjects were instructed to look as fast as possible in the direction opposite to the peripheral target. A total number of 32 saccades were recorded. Latency, error rate and rate of corrected errors were extracted. Saccades perturbed by blinks or other artefacts were discarded (less than 10% of the trials in all subjects). In the pro- and antisaccade tasks, the latency was defined as the interval between target onset and saccade onset. Latency below 80 ms were considered anticipatory saccades and rejected. Mean latency was determined only for correct antisaccades. Directional errors were defined as saccades initially directed towards the target. The rate of corrected errors (%) was extracted for the horizontal antisaccade task.

iii) Mixed task of pro- and antisaccades: This paradigm was used to evaluate the ability to perform a task in which two task sets, rather than one, must be handled simultaneously, thereby demanding an increased cognitive load, increased demands on working memory, vigilance, sustained attention, motivation and response selection. The central fixation point initially consisted of two vertically aligned and contiguous red and green points, with the same size and luminance as in the two previous tasks. After 3500–4200 ms, one of the two points (red or green) was turned off. The remaining point stayed on for 500 ms,

and subjects were instructed that the color of the fixation point was to be used for selecting the appropriate response to the lateral target: a green point required a prosaccade and a red point antisaccade. A 200 ms gap between the fixation point and the lateral target was used as in the previous tasks. It was confirmed verbally that the instructions had been correctly understood. Seven prosaccades and six antisaccades were presented with an angle of 24° . In each subject, mean pro- and antisaccade latencies and error rates were calculated in the antisaccade task. Then saccades repeated in the same direction were selectively analyzed. Repeated trials were analyzed to provide a mixing cost for latencies and error rates, defined as performance. The performance in repeated trials was subtracted from the performance in the simple tasks of horizontal pro and antisaccades.

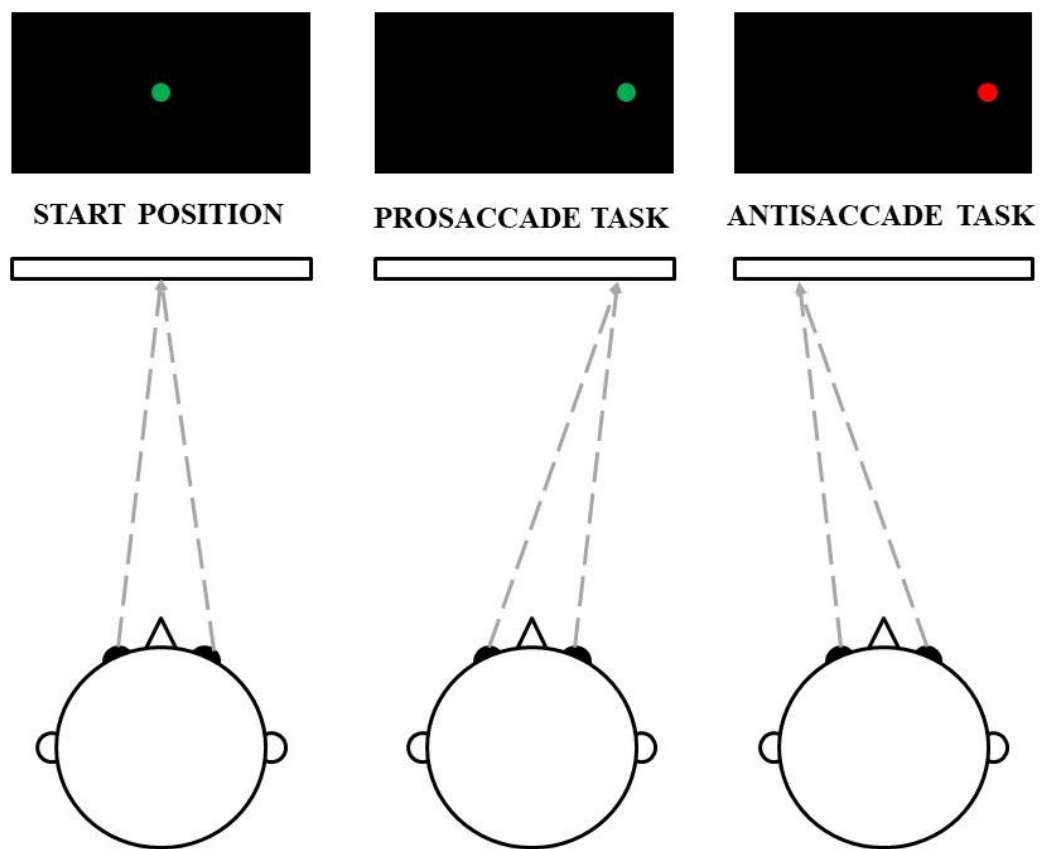


Fig. 1. Eye movement examination trial for prosaccade and antisaccade task.

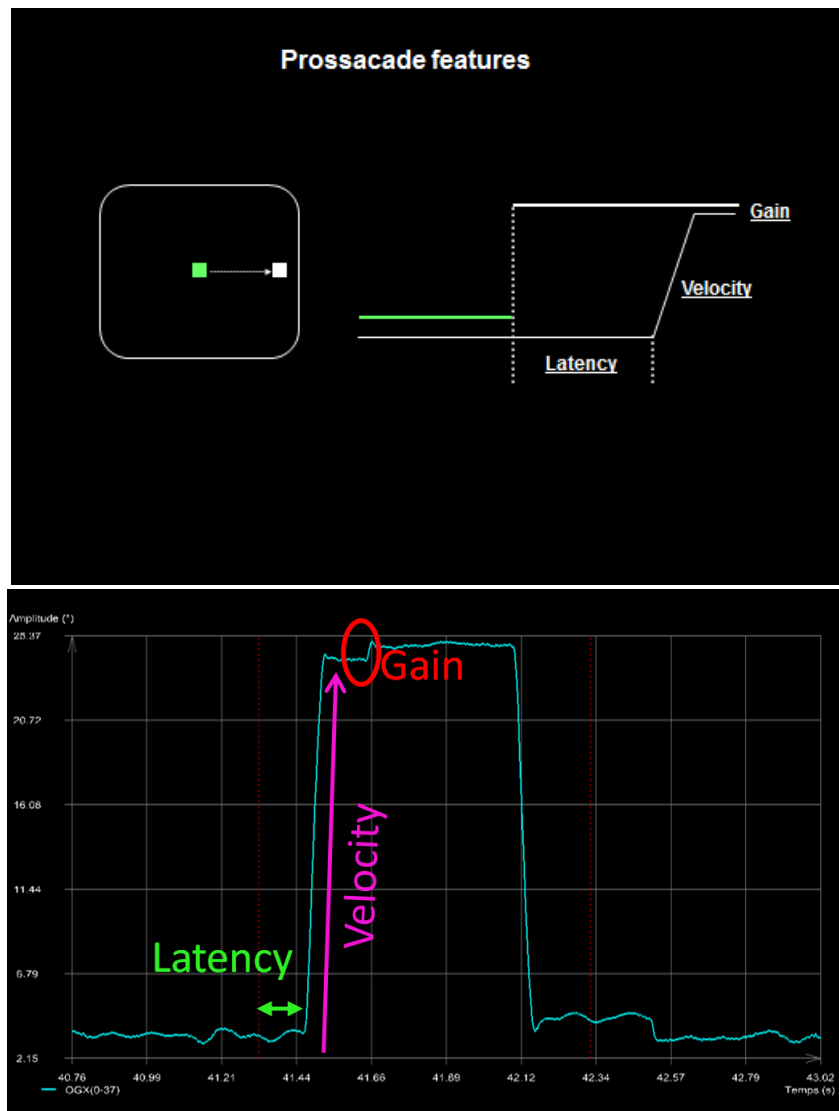


Fig. 2. Example of response to stimuli measured by videooculography in prossacades with associated features.