**Motor adaptation through the predictive saccades: fMRI study of the eye movemets.**

T. Vasconcelos1, D. Gomes1, E. Amaro2, K. Lukasova2,3

1Faculty of Psychology, CRUZEIRO DO SUL, Sao Paulo. 2NIF/LIM44, FMUSP, Sao Paulo, 3CMCC, UFABC, Sao Paulo.

**Introduction:** Saccades are rapid eye movements and its properties can be altered by advanced knowledge of target position. These kinds of saccades are called the predictive saccade and are characterized by the reduction of the time between the target appearance and the triggering of the saccades to almost 0ms. In predictive saccade task, the target appears alternating in constant frequency and speed on the left/right side in a square wave like manner that allows for the anticipation of the eye movement and functional adaptation to the task. The aim of this study was to access the brain activation during predictive tracking to investigate the motor adaptation circuitry.

**Materials and Methods:** 10 healthy university students participated in the study and all signed the informed consent approved by the Ethics Committee of the university (FMUSP 089/11). All participants were screened for general cognitive functioning. The task consisted in the appearance of a black point on the gray background that induces predictive saccade motion in fast speed target movement. In the block design, for 40 seconds the participant followed the movement of the point alternating in 500 milliseconds intervals, followed by 20 seconds rest cross fixation and 40 seconds slow alternation of 1667 milliseconds for reflexive saccades. The compliance with the task was verified by integrated eye tracking. Images were acquired in a 3T scanner (Philips Achieva). Single shot echo planar imaging was used with parameters: repetition time (TR) of 2000 ms, echo time (TE) 30 ms, flip angle 90°, slice thickness 3.0 mm, gap 0, matrix size of 80 x 77 pixels. The total duration was approximately 9 minutes and the total of 240 volumes were acquired.

**Results:** Predictive compared to reflexive saccades showed activation in fronto-pariental regions, mainly in the bilateral frontal eye fields, supplemental eye field, intrapariental sulcus anterior part, bilateral inferior temporal gyrus and cerebellum. The comparison of reflexive to predictive saccades showed activation in posterior cingulate gyrus and left inferior temporal gyrus.

**Discussion:** Studies in monkeys have largely reported on spatial tuning of the lateral intraparietal cortex (LIP), but have only recently shown a specific role of the supplementary eye field (SEF) and the neurons within this area in sequential state representation and timing. Our results showed that the direction of upcoming saccade can be coded by intraparietal regions with the SEF providing detailed information on upcoming motor intention and the timing of the saccade sequence.

**Conclusions:** Successful execution of predictive saccades is supported by an internal estimation of the stimulus timing together with the feedback of previous saccade monitored by fronto-parietal system.

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**Figure 1.** Representation of activation during predictive saccades task in healthy adults (N=10). On the left reflexive saccades > predictive saccades comparison showed activation in posterior cingulate gyrus and left inferior temporal gyrus. On the right, predictive saccades > reflexive saccades activation [cluster Z>2.3; p<0.05; the scale depicted in the figure Z=2.3 to 4.0; brain template MNI152].