Cognitive impairment in patients with post-COVID condition: correlations between eye movements metrics and the Stroop Colour and Word neuropsychological test

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This study investigates the cognitive dysfunction experienced by patients with post-COVID condition (PCC) exploring correlations between eye movement metrics and scores from the neuropsychological tests Stroop Colour and Word Test (SCWT). The results of the study suggest that patients with PCC have an impaired ability to inhibit cognitive interference, as evidenced by correlations found in the visual tasks of anti-saccades and fixation. Correlations found in terms of prosaccades and smooth pursuit seem to be related to other altered cognitive functions, such as reduced processing speed.

Keywords: *eye tracker, eye movements, cognition, Stroop Colour and Word Test (SCWT)*

Purpose

Although COVID-19 patients present primarily with symptoms of respiratory disease, a prevalent symptom of post-COVID condition (PCC) is cognitive dysfunction. It is well established that eye movement control is affected in neurodegenerative conditions [1,2], and a few recent studies suggest that COVID-19 disease may have a similar impact, in particular when patients show cognitive impairment [3]. This study aims to explore correlations between oculomotor performance and scores from the Stroop Color and Word Test (SCWT), which is extensively used in neurophsychology for experimental purposes to measure multiple cognitive functions, in patients with PCC.

Methods

Preliminary data from a sub-group of participants who were taking part in the Nautilus study, a large multi-center study that aims to evaluate and characterize cognition, mental health, and functional capacity of people who recovered from COVID-19, were analyzed. The sample consisted of 65 participants with PCC and 20 control participants. Eye movements were measured using an eye tracker (EyeLink 1000 Plus, SR-Research Ltd., Canada), with the head supported on a chinrest. Participants were seated 60 cm away from a computer monitor where visual stimuli for pro/anti-saccades, smooth pursuit, and fixation tasks were displayed. Eye movement metrics (e.g., saccade latency, amplitude, peak velocity, etc.) were computed and correlated with the direct scores from the SCWT test. Figure 1 depicts
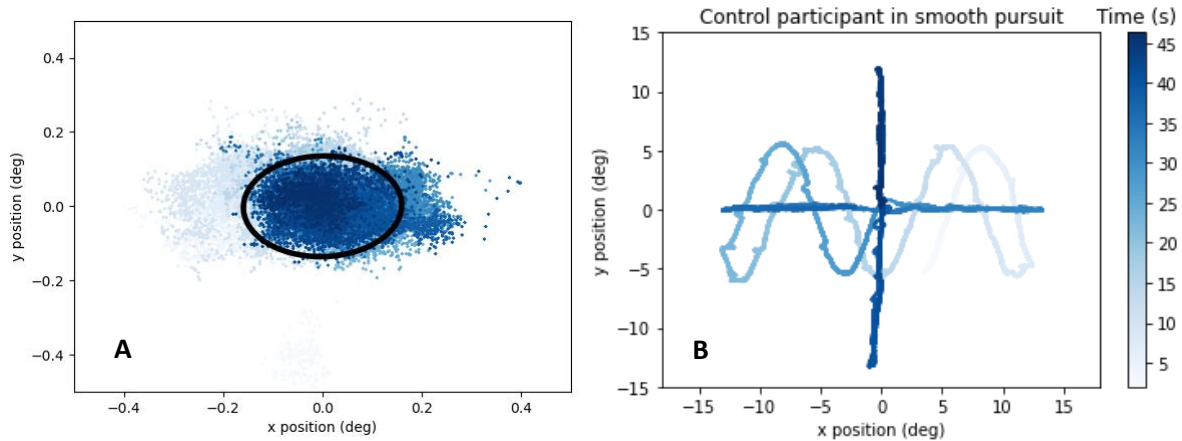
Figure 1. (A) Cloud of points recorded during the fixation task for one participant and the Bivariate Contour Ellipse Area (BCEA) around the central 68% of the fitted distribution of gaze positions. (B) Smooth pursuit test data divided by sinusoidal, horizontal, and vertical trajectories.

an example of the recorded data during the fixation and the smooth pursuit tests.

The SCWT is a widely used neuropsychological test that measures a range of cognitive functions, including attention, cognitive processing speed, and inhibitory control. The test consists of several conditions, including the congruous condition, in which participants are required to read color words that are printed in black ink (W) and name different color patches (C), which is a relatively easy task that requires minimal cognitive effort. However, in the incongruent condition of the SCWT, the task becomes more challenging. In this condition, color-words are printed in an inconsistent color ink, and participants are required to name the color of the ink instead of reading the word (CW). This task involves inhibitory control, as participants need to suppress the automatic response of reading the word and instead focus on naming the color of the ink. Correlations of variables (i.e. eye movements metrics and SCWT scores) were assessed using Pearson's correlation coefficients.

Results

Significant correlations between oculomotor performance and SCWT scores were found for the following metrics: W: antisaccades peak velocity ($r = 0.301; p = 0.018$), mean amplitude of saccades during smooth pursuit ($r = -0.294; p = 0.012$); C: prosaccades latency ($r = -0.239; p = 0.045$), antisaccades peak velocity ($r = 0.253; p = 0.048$), mean amplitude of saccades during smooth pursuit ($r = -0.251; p = 0.033$); fixation BCEA ($r = -0.238; p = 0.043$); CW: prosaccades peak velocity ($r = 0.250; p = 0.036$), antisaccades duration ($r = -0.257; p = 0.049$), antisaccades amplitude ($r = -0.321; p = 0.012$), mean amplitude of saccades during smooth pursuit ($r = -0.403; p < 0.001$), mean amplitude of saccades during smooth pursuit ($r = -0.403; p < 0.001$), fixation BCEA ($r = -0.288; p = 0.014$) .

Discussion

The visual task of antisaccades involves inhibition since participants were asked to fixate a central fixation target and look at the opposite side relative to the peripheral target as fast as possible when it appeared. Similarly, fixation also accounts for inhibition because in this task, participants' eye movements were recorded while they were fixating a central cross and peripheral distractors appeared. Therefore, correlations found in terms of these visual tasks could be attributed to the inability to inhibit cognitive interference in patients with PCC. The other correlations reported in terms of prosaccades and smooth pursuit could be related to other altered cognitive functions such as reduced processing speed.

Acknowledgement

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