

Study of eye movement in the Sternberg memory task

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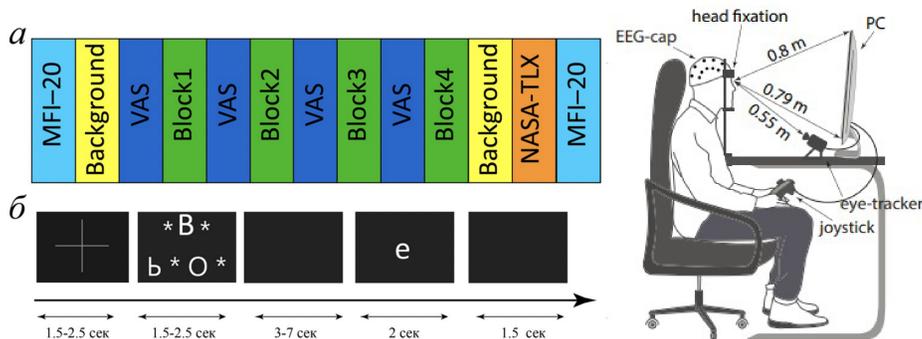
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Introduction

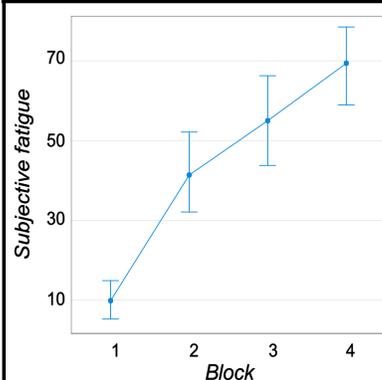
Recording and analyzing eye movements allows access to internal forms of activity, such as fatigue, interest, or attention levels. In addition, gaze-tracking technology reveals factors that determine high levels of learning. Also, various brain-computer interfaces are being developed based on eye-tracking technologies.

Methods

The design of the experiment was based on the Sternberg paradigm and was as follows: the subject took the MFI-20 test. After that, the recording of his oculomotor activity began. First, the person took the VAS, a test for subjective fatigue. After that, the main part of the experiment started. At first the person was shown a white cross on a black background to attract attention for a couple of seconds. Then a stimulus in the form of a set of letters was demonstrated for a couple of seconds. There could be from 2 to 7 letters, with an asterisk replacing the missing letters. All letters were capitalized. Then there was a pause for 3-7 seconds. After that there was a trial, a demonstration of one letter, and the test person had to choose if this letter was in the recently demonstrated set or not, and press the appropriate remote. After that, the background went on again for a second and a half. The block consisted of 72 repetitions of this sequence of actions, 12 for each difficulty. After that, the person was tested again for subjective fatigue. This was the case for four blocks. This was rounded off with NASA-TLX tests, the task of which was to determine how much strain the task caused, and the re-run of the MFI-20.

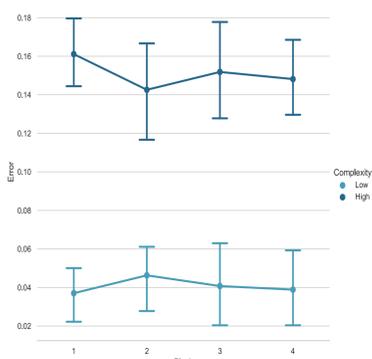


Results



			P value
block	1	2	0.000236
block	1	3	0.000078
block	1	4	0.000001
block	2	3	0.006679
block	2	4	0.000338
block	3	4	0.003916

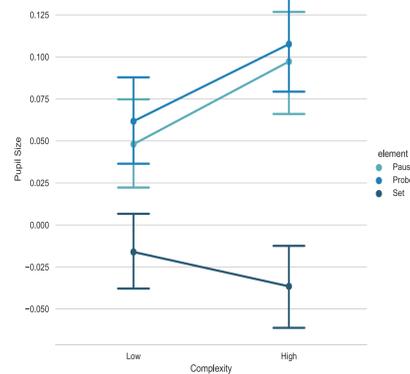
Dependence of subjective fatigue on block; post-hoc analysis using the Holm correction showed differences between subjective fatigue estimates in all conditions between all blocks.



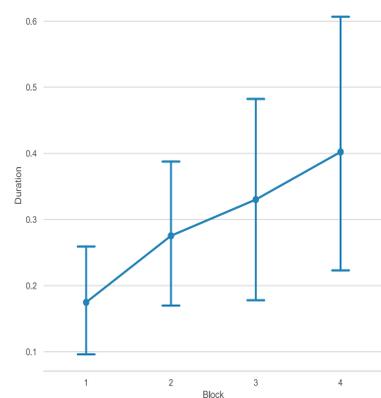
Statistically significant differences were found in the percentage of committed errors between different test item difficulties (P-value < 0.0001); No significant differences were found in the percentage of committed errors during the experiment.

Dependence of the percentage of committed errors on the stage of the experiment for high and low complexity.

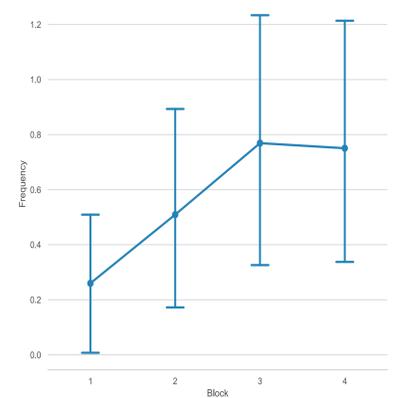
Results



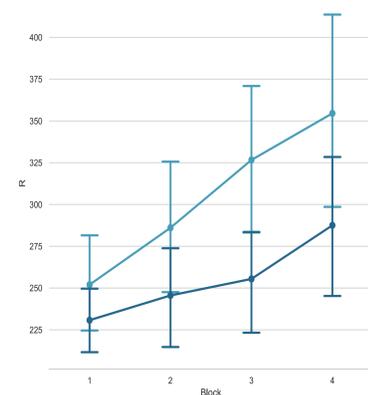
Dependence of pupil size during the different elements of the experiment at different difficulties; the behavior of the pupil during the demonstration of the set of letters is fundamentally different from that of the other elements, which is explained by the illumination factor.



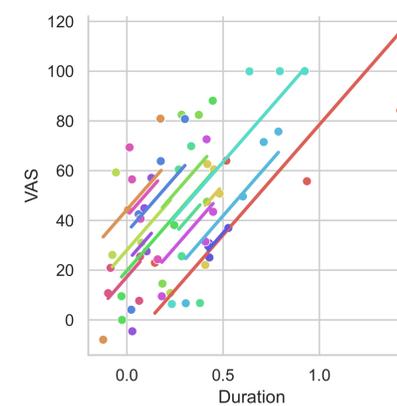
Dependence of blink duration on the stage of the experiment.



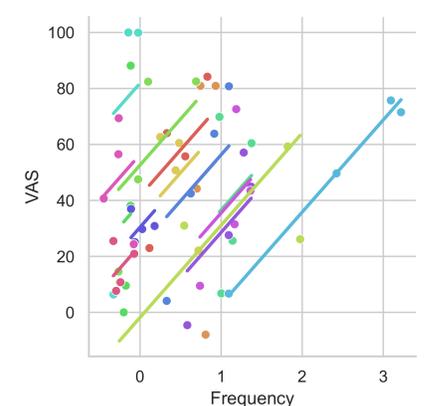
Dependence of blink frequency on the stage of the experiment.



Dependence of the average distance between the eye and the center of the screen on the stage of the experiment; this characteristic shows that the eye has adapted to the task and has begun to follow most of the screen.



Dependence of subjective fatigue on blink duration, $r = 0,6$



Dependence of subjective fatigue on blink frequency, $r = 0,49$

Conclusion

Changes in subjective fatigue during the experiment were revealed; Differences in the percentage of committed errors between different difficulties of test tasks were revealed; The adaptive mechanisms of the organism to the task were revealed; Correlations between behavioral and physiological characteristics were found to be in good agreement with known results; A significant influence of the illumination factor on physiological characteristics was found.