

THE IMPACT OF PERCEPTUAL GROUPING ON PERFORMANCE OF CONJUNCTION SEARCH TASK

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INTRODUCTION

According to previous research, analysis of eye movements allows objective, accurate and noninvasive measures (Liversedge et al, 2000) for studying cognitive functions in variety of conditions, central fatigue (Zils et al, 1109-15) including.

Lanther et. al. observed (2013) that the average fixation time in visual search tasks increases when the participants were fatigued. Possible explanations might be that fatigue influences either the ability to initiate an eye movement or the decision to move eyes from one location to another.

The aim of our study is

- to determine how perceptual grouping by color affects the performance of the visual search (experiment 2)
- to evaluate the impact of fatigue on the performance of the visual search task (experiment 1);

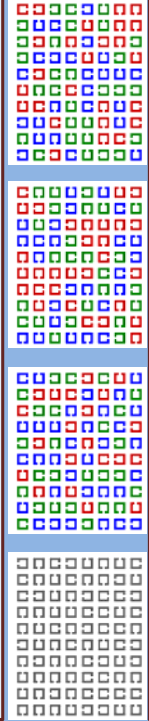
METHOD

Subjects: Eight subjects participated in experiment 1 and seventeen subjects – in experiment 2.

Eye tracking: Stimuli were presented on a CRT (1920 x 1440 pixels, 75Hz) screen. The distance between the participants' faces and the screen was 60 centimeters. Monocular eye movements were recorded with a video-oculograph *iViewX Hi-Speed, 500Hz*.

Task: Subjects had to perform a conjunction search to determine small groups of equal and contiguous symbols by clicking separately on every symbol that belongs to the group.

In the task 1 all symbols were colored grey, whereas in the tasks 2-4 symbols were colored red, blue or green. Coloration was random or systematic (based on perceptual grouping).



Task 1

Task 2

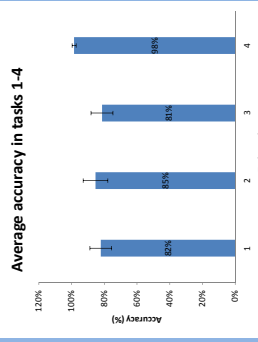
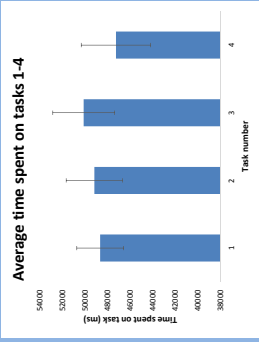
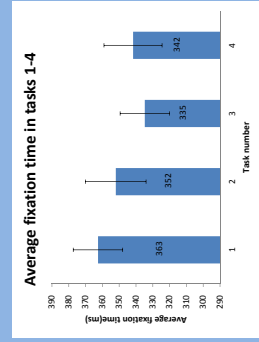
Task 3

Task 4

Task 1 All symbols are colored grey. **Task 2** Symbols are colored randomly. **Task 3** The outer symbol of the group is equally colored with the next symbol (coloration and the type of symbol belong to different groups). **Task 4** Equal and contiguous symbols are equally colored.

RESULTS

Average fixation time, accuracy of task performance and the time spent on performance of the task were analysed with the aim to determine how perceptual grouping by color affects the performance of visual search.



The results suggest that in visual search tasks fixation time cannot be used as the only measure of cognitive load initiated by the task setup; other parameters (such as average saccade amplitude and latency) have to be explored.

In case of symbols grouped according to color the average fixation time tends to decrease (342 ± 17 ms) if compared with randomly colored (352 ± 18 ms) or grey (363 ± 15 ms) symbols.

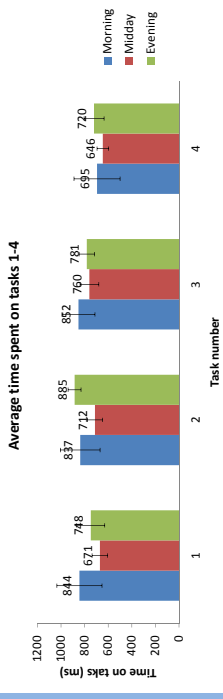
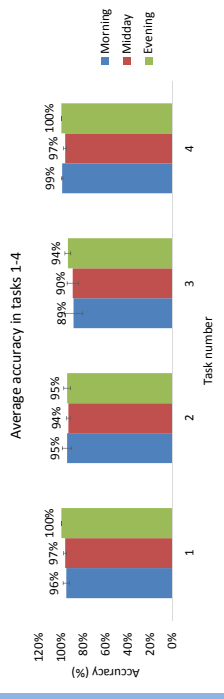
This can be considered as a partial effect of configuration on the fixation times.

An interesting observation is that even though the average fixation time is the shortest in task 3 where the outer symbols of the group were colored in the same color as symbols located next to them, the average time spent on this task was the longest. The accuracy of the performance was also reduced if compared to task 4 where all the symbols of the group were equally colored. The results indicate that the speed up and automatic processes of perceptual grouping can expedite saccadic programming and based on the task might either facilitate or worsen the performance of the visual search task.

In the 2nd experiment the performance of visual search was analysed at different times of the day. In order to explore the impact of the fatigue on the performance of visual search (1) the accuracy of the performance and (2) time of task execution were analysed.

The best accuracy was observed when the equal elements were grouped by color (which corresponds to the results from eye movements' analysis). The performance was even better than without recording of eye movements, suggesting that the chosen scientific method for producing the experiment impacts the performance of visual search task.

The time of the day (when the task was performed) did not significantly affect the accuracy, although a minor tendency indicates better results if the task is performed in the evening.



The average time spent on task does not give statistically significant differences between the results during different time of the day. However, there is a tendency indicating that the average time of the task execution is shorter during the day, suggesting that the performance of certain perceptual and cognitive processes at least partially depends on the particular time of day.