Influence of Dynamic Visual Environment on Interference Inhibition

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Résumé

Introduction

Interference inhibition refers to an intricate network of cognitive mechanisms that allow individuals to focus their attention on relevant stimuli and ignoring irrelevant information (Petersen & Posner, 2012), acting as a cognitive filter for information processing and decision-making. In high-demand contexts, such as sports environments or operational conditions where environments are often visually complex, dynamic, and uncertain, interference inhibition serves as a key mechanism supporting accurate decision-making and achieve peak performance. The purpose of the present study was to analyze the effect of a dynamic visual environment on the ability to inhibit interference.

Methods

Thirty-three young healthy participants (25 males, 8 females, 20.5 ± 2.6 years) took part in the experiment. They performed the arrow-version of the Eriksen Flanker Task (EFT), using a virtual reality head-mounted display setup. The EFT requires identifying the direction of a central target arrow while ignoring the four surrounding arrows (*i.e.* the flankers); in congruent trials, flankers point in the same direction as the target, whereas in *incongruent* trials, they point in the opposite direction, thereby acting as distractors. The task was carried out under three conditions: a static background, a background moving rightward, and one moving leftward. The background consisted of a black field dotted with small white points resembling stars. These experimental conditions allowed to analyze the different levels of concordance between the task and the environment in which it was performed. Cognitive performance (error number, response times for valid trials) and oculomotor behavioral data (area of the 95% confidence ellipse enclosing oculomotor behavior) were recorded throughout the experiment.

Results

As a main result, the number of errors made by participants during the incongruent condition of the EFT varied significantly depending on the background condition (Friedman test : $\chi 2$ (2) = 7.879, $p = 0.019$, Kendall's W = 0.119), with a higher error rate observed in the

*Intervenant

presence of a moving background, only when it was discordant with the distractor elements (Conover's post-hoc comparisons : T (64) = 2.825, p = 0.027, rrb = - 0.370). Furthermore, moving background led to a larger 95% ellipse area compared to the static condition (Wilcoxon signed rank test : z = -3.917, $p <$ 0.001, rrb = -0.847).

Discussion

In our context, the observed drop in performance may originate from the increased complexity involved in processing distractors information related to the task environment, which could disrupt the dynamic interplay between cognitive pathways encoding pertinent and conflicting information for executive-level processing (Ridderinkhof et al., 2021). This alteration may impair the individual's conflict monitoring system (Botvinick et al., 2001), thereby compromising the individual's ability to effectively detect and resolve complex interferences. Additionally, the oculomotor behavior results confirm the effect of a dynamic environment, with participants exhibiting greater oculomotor exploration. This may indicate, in association with cognitive performance, a reduction in attentional focus on the key elements that need to be processed. Dynamic visual environment therefore seems to act as an additional distractor, disrupting interference inhibition by increasing the likelihood of errors and modifying the oculomotor behavior.

Conclusion

These findings contribute to a deeper comprehension of the interactive and enacted nature of cognition, revealing how cognitive processes unfold in complex environments. It would be interesting to determine the effect of recurrent exposure to these types of stimuli and environment. Thus, we could better understand how these exposure can impact individuals' cognitive and perceptual-motor abilities over time, which could help maintain long-term engagement in physical and sporting activities.

References

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