Enhancing Cognitive Performance in Extreme Medical Environments: The Impact of Action Video Gaming

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INTRODUCTION

AVIATION MEDICINE plays a critical role in extreme medicine, ensuring aircrew can operate safely under high-stress conditions.

The **CBAT** assesses cognitive skills vital for aircrew, including multitasking and decision-making under pressure. This study explores whether **ACTION VIDEO GAMING**, known to enhance similar cognitive abilities[1], can improve CBAT performance and impact aircrew selection. Additionally, it investigates how video gaming might influence the processing of emotional cues in communication, crucial in high-stakes aviation environments

METHODS

CBAT STUDY

QUESTIONAIRE: A questionnaire that asked participants about their most recent CBAT attempt and video gaming habits was distributed to past and present University Air Squadron (UAS) members. A total of 126 filled in the survey however 7 did not reach the inclusion criteria, therefore data analysis was conducted on 119 responses.

VIDEO GAMING STUDY

STIMULI: Participants were presented with 36 different two-syllable pseudo-words, each spoken in four emotions (neutral, fearful, happy, threatening) from both left and right speakers. Three pseudo-words were deviant targets, and the remaining six were standard stimuli[3].

EXPERIMENTAL PARIDAGRAM: Nine action video game players (AVGPs) and seven non-video game players (NVGPs) attended to one loudspeaker and responded to deviant stimuli by pressing the spacebar.

ANALYSIS: EEG measured neural responses to stimuli. Event-related potentials were analysed in four time-windows, and a mixed ANOVA compared attentional location, emotional valence, and group differences in accuracy and reaction times.

RESULTS

CBAT STUDY

QUESTIONAIRE RESULTS: The results in figure 1 show the general trend that **as the number of hours spent playing action video games per week increases, the CBAT score of participants increases**. This is best represented by results showing that of participants who played 0 hours of action video games per week, only 42.3% of them achieved CBAT scores of 131+, yet in the participants who played over 10 hours of action videogames per week 87.0% of them achieved a CBAT score of 131+. At a 0.01 significance level there was a correlation coefficient of 0.393 representing a **moderately positive** correlation between the two variables.

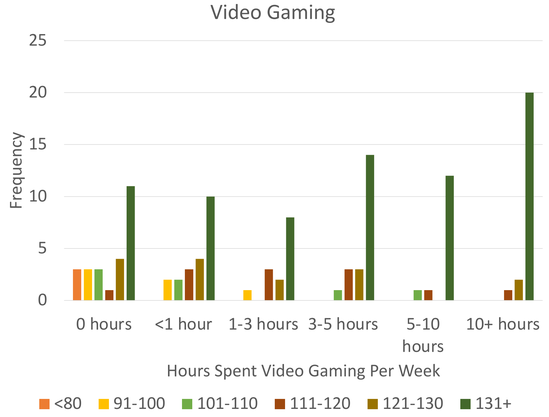


Figure 1: A graph showing the frequency of CBAT scores obtained when playing a set number of hours of action video gaming per week.

BEHAVIOURAL RESULTS

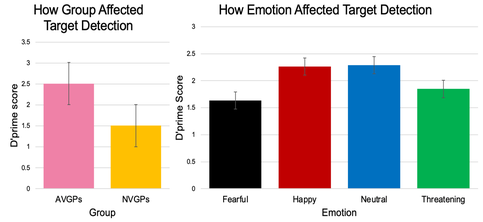


Figure 2: Group effect in d' prime

Figure 3: Emotion effect in d' prime

GROUP EFFECT: ($p=0.003$), AVGPs detected stimuli more accurately, figure 4.

EMOTION EFFECT: ($p<0.001$), neutral and happy stimuli detected more accurately, figure 5.

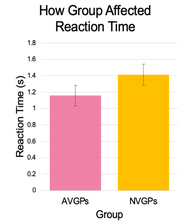


Figure 4: Group effect in reaction times

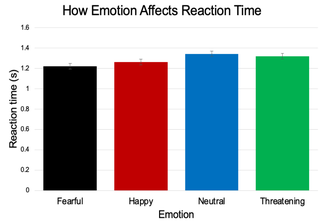


Figure 5: Emotion effect in reaction times

GROUP EFFECT: ($p=0.09$), AVGPs detected stimuli faster, figure 6.

EMOTION EFFECT: ($p=0.012$), fearful stimuli detected faster, figure 7.

EVENT RELATED POTENTIALS

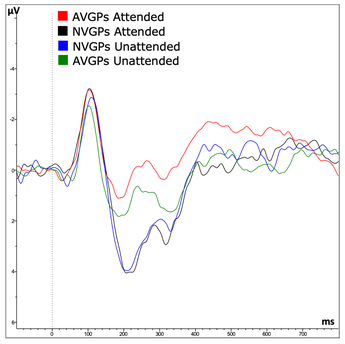


Figure 6: Attention by group effect at cluster 13 (Pz)

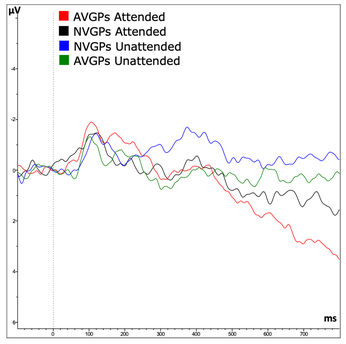


Figure 7: Attention by group effect at cluster 14 (Oz)

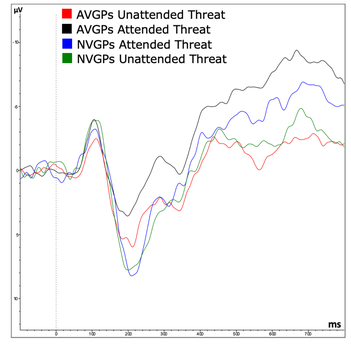


Figure 8: Attention by Emotion to threatening stimuli

EFFECT OF ATTENTION BY GROUP BY CLUSTER: At 240-330ms ($p=0.057$), an attention effect elicited by: AVGPs at more central clusters ($p=0.060$), figure 6, and NVGPs at more posterior clusters ($p=0.025$), figure 7.

ATTENTION BY EMOTION BY GROUP: Attention effect in AVGPs seen in threatening emotion, figure 8.

DISCUSSIONS/CONCLUSION

CBAT AND VIDEO GAMING: A moderate positive correlation: gaming enhances cognitive skills essential for aircrew operating in extreme environments, where quick decisions and task-switching are critical.

BEHAVIOURAL DATA – ACCURACY AND REACTION TIME: AVGPs showed greater accuracy and faster reaction times, translating to better CBAT performance. happy and neutral auditory stimuli were detected more accurately, which could be due to positive stimuli presenting more contrast[4]. Fearful stimuli were detected faster, which could be due to negative stimuli capturing attention[5] and indicates a heightened sensitivity to threats, a crucial skill for survival in high-stress, extreme environments.

VIDEO GAMING AND THE AUDITORY ATTENTIONAL NETWORK: AVGPs exhibited a more efficient and focused auditory attentional network[2] compared to NVGPs, seen by the attention by cluster by group effect[6]. This is likely due to neuroplastic changes from gaming. This enhanced focus is beneficial for processing complex auditory information in noisy, high-pressure environments, similar to those faced by aircrew.

EVENT RELATED POTENTIALS OF VIDEO GAMING AND AUDITORY EMOTION: AVGPs demonstrated a heightened attentional response to threatening stimuli, shown in pronounced N1 and N2 event-related potentials, which reflect initial auditory attentional filtering[7] and discrimination, identification, and categorisation of stimuli[8] respectively. This suggests AVGPs are more sensitive to aggressive emotions, which could be advantageous in extreme, emotionally charged aviation settings where rapid threat detection is essential for safety and performance.

RECCOMENDATIONS: Utilise action video gaming in preparing for operations in extreme environments.

REFERENCES

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