



Characterising the neurophysiological processes underlying skilled performance in video games

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Introduction

Shooter gaming is a cognitively demanding task that requires sensorimotor skills and fast decision making under stress. Expert gamers exhibit remarkable skills and cognitive abilities, demonstrating superior accuracy, speed, and decision-making compared to novices. Investigating the neurophysiological processes that contribute to these exceptional performances can offer valuable insights into the brain's adaptability and learning potential. Previous work carried out to identify the neural oscillatory processes underlying learning and belief updating in decision-making and motor-learning tasks found dynamic changes in alpha and beta activity associated with belief updating and learning. This is the first study that would use rhythm-based formulations of predictive coding to understand skilled performance in video games. In this study we aim to identify the role that neural, cardiac and respiratory signals play in regulating behaviour while experts play the game Outriders by industry partner Square Enix. Previous interoception research showed that processing stressors or threat signals leads to enhanced neural processing of cardiac information. In this context, bodily signals could convey relevant information about upcoming negative outcomes to the brain.

Research Questions

- To determine if successful game performance is associated with faster adaptation to failures (losing health, death) and is this process mediated by changes in neural oscillations (beta)?
- Is successful performance associated with a tighter interplay between neural and bodily signals – specifically if any modulation of bodily signals can explain variance in successful game performance?
- Can higher variability in the modulation of bodily signals (cardiac, respiratory) over time be associated with enhanced enjoyment during performance?

Hypothesis

It is hypothesized:

- (1) that a reduction in beta oscillations following failure events will contribute to faster learning from negative outcomes and improved performance over time.
- (2) Successful performance will be associated with a tighter interplay between neural and bodily signals
- (3) Higher variability in the modulation of bodily signals (cardiac, respiratory) over time will be associated with enhanced enjoyment during performance.

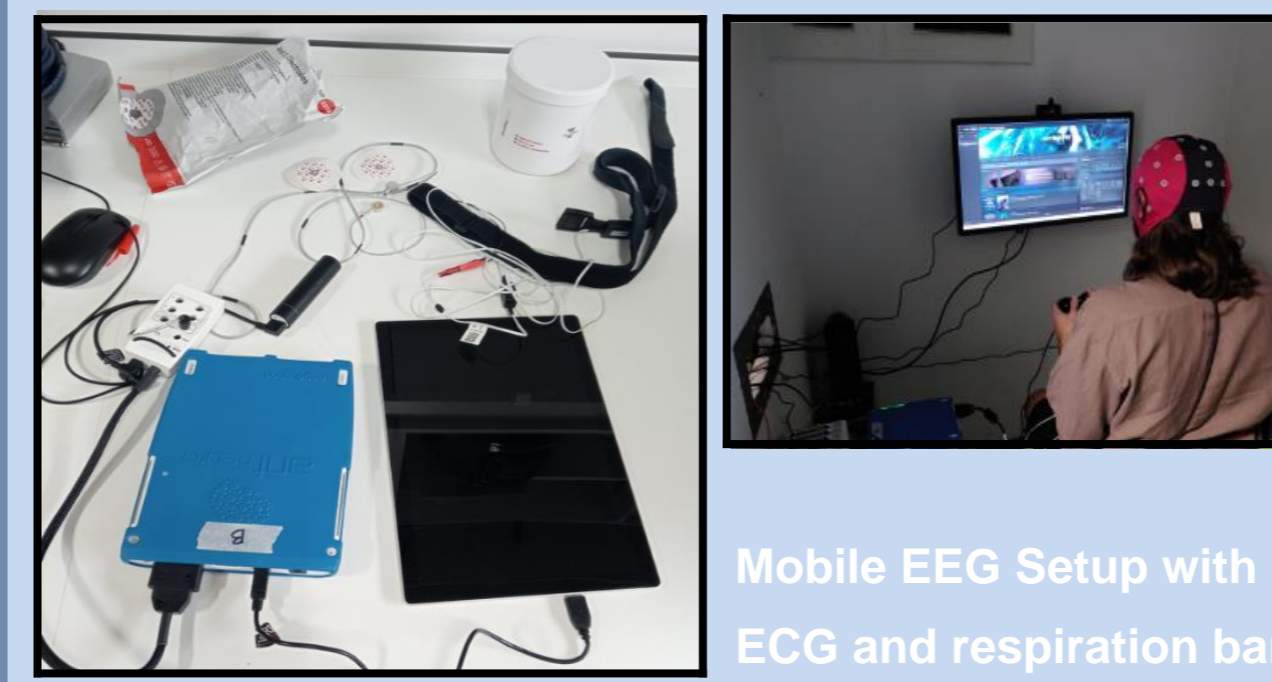
Future Direction

More participant data can be collected to enhance the study, along with possibly including other neural oscillations and their effects.

Experimental Design

1) Demographics : participants are asked to provide demographic information and game playing experience.

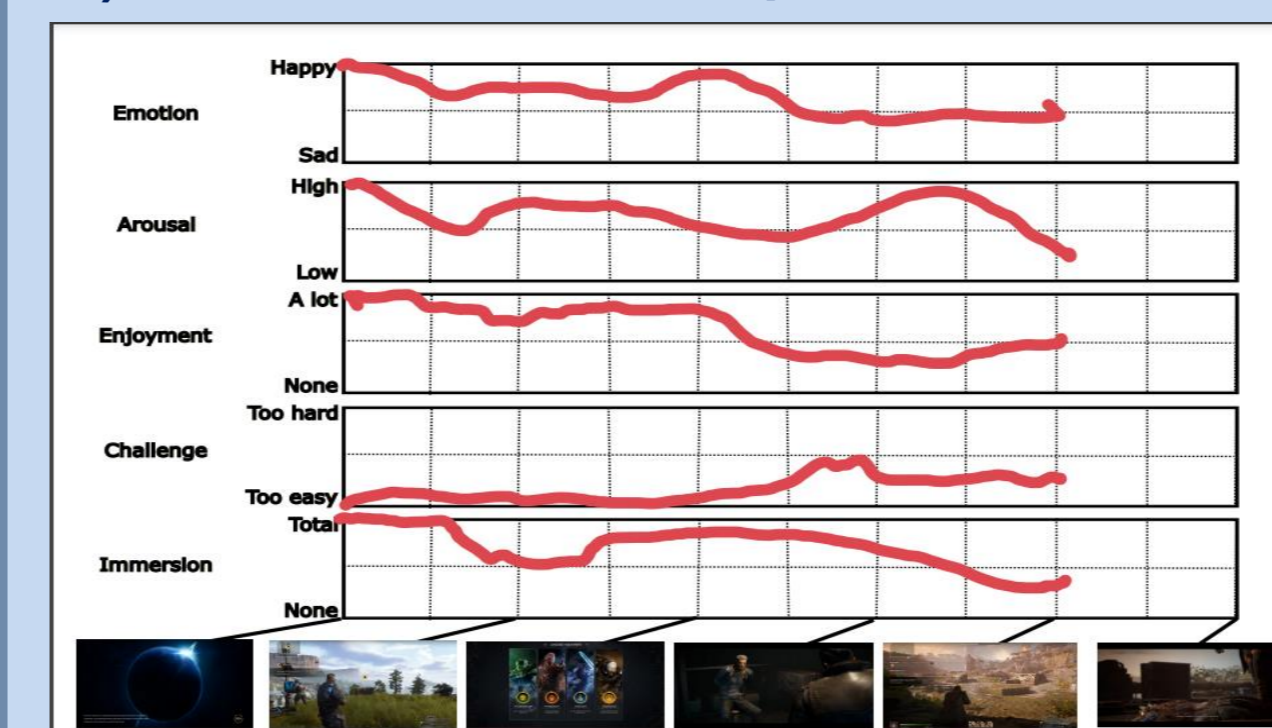
2) Experimental Phase :



Mobile EEG Setup with ECG and respiration band

- Participants are asked to play a Video game (Outriders, Square Enix) while their EEG, ECG and breathing are recorded.
- Antimicrox Software used to collect controller logs.
- Real-time synchronisation between physiological and log data.

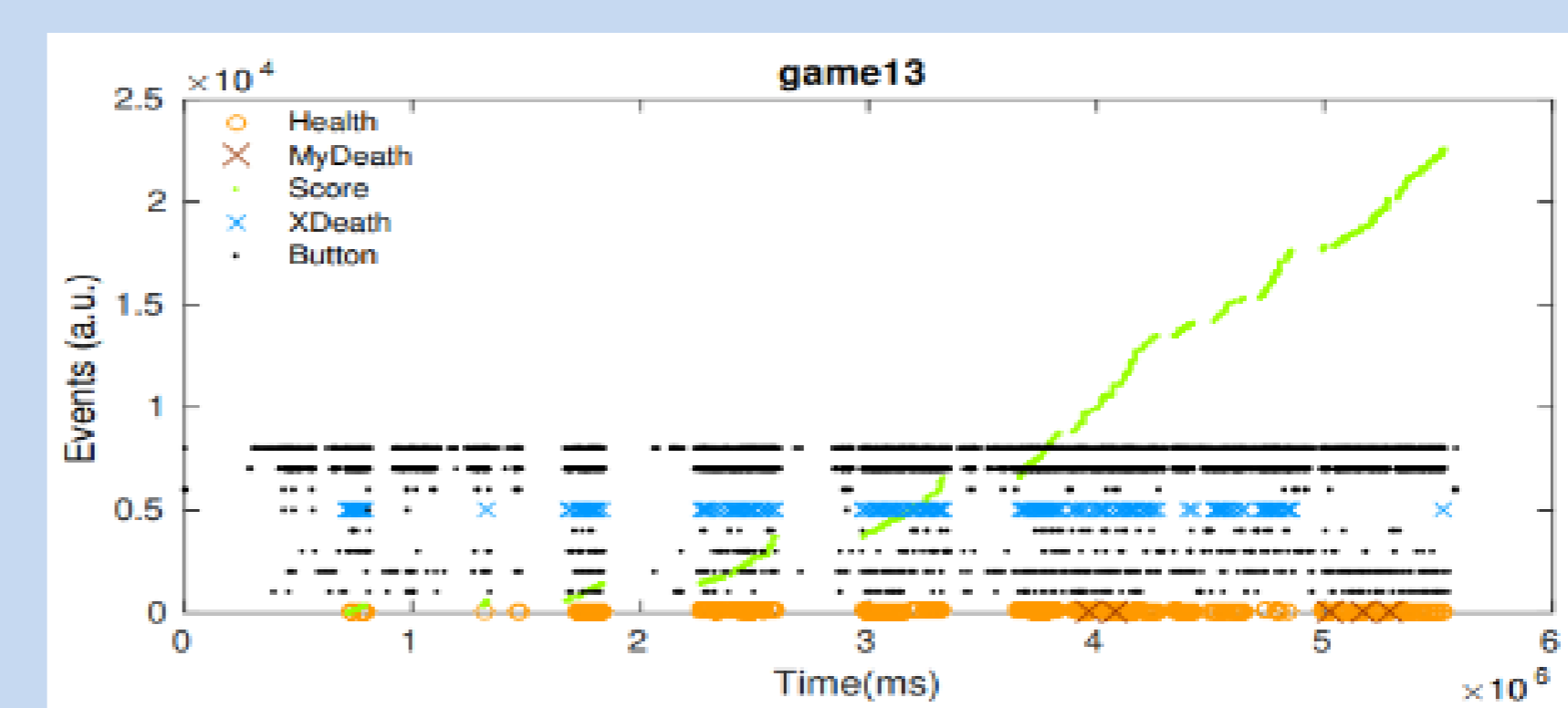
3) Questionnaire phase:



Temporal Tracing Task

- Participants fill out Body Perception Questionnaire, Player Experience Inventory.
- mark the time course of the psychological experience using a temporal experience tracing exercise.

Data Analysis



- Multiple inter-related time-varying signals like Player's health, death events, progress score, kill events will be used as indicators of success or failure of player performance. Player's button presses analysed as motor responses.
- Data preprocessing and analysis using EEGLAB and Fieldtrip in MATLAB.
- Band pass filters corresponding to the beta band to be used to isolate the beta bursts
- A general linear model to be developed to find the correlates between all independent variables and game performance.