MSc in Computational Cognitive Neuroscience

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# Inducing Flow and Clutch States in a Video-Game Context

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## Introduction

Flow is an optimal experience that occurs when one is deeply engaged in an autotelic, self-initiated activity that is intrinsically rewarding (Csikszentmihalyi, 1975). In this state, control feels effortless. Research in this field is often contradictory.

Clutch occurs when the activity requires heightened awareness, is pressurized by achieving fixed goals, and control feels effortful (Otten, 2009). It is typically investigated in a sports context, and this study will be the onset of exploring clutch in a gaming context.

## Objectives

- Aim to identify unique EEG and behavioural markers of both flow and clutch states whilst experienced users play a first-person shooter game.

## Hypotheses

1. In a pressurised environment, participants enter clutch state.
2. In an exploratory environment, participants enter flow state.
3. In flow states, we expect there to be increased theta and alpha oscillations over the frontal regions. This would support the Transient Hypofrontality hypothesis (Dietrich, 2004), which suggests that flow is represented by inhibition of the frontal cortex (represented by the alpha waves), and attentional control (represented by theta waves) (Tan et al.,2023).

As the findings in the literature for both flow and clutch states are contradictory, we will conduct an exploratory analysis for both.

## Methods

- Participants complete a skills screening and neuroticism questionnaire, and play the game whilst wearing an EEG.
- This game requires players to shoot at coloured spheres. Red spheres will take away points (negative feedback), but all other colours will gain points (positive feedback). Power-ups can be accessed through shooting cube-shaped targets.
- The game is manipulated to create a flow- (exploration) or clutch- (pressure) inducing environment. Four two-minute practice trials allow participants to understand the mechanisms of the game. Participants complete three two-minute trials of the exploration condition, and three two-minute trials of the pressure condition.
- *Flow-inducing (exploration) condition*: Participants are instructed to find the hidden sequences consisting of four colours. If participants find a correct sequence, they will gain 100 points. This creates a self-initiated exploratory environment.
- *Clutch-inducing (pressure) condition*: Participants are instructed to reach the top of the leaderboard, where participants can use different techniques (for example, using power-ups or sequences) to get as many points as possible in the time limit. This creates a pressurized, goal-oriented environment.
- Participants have two rounds of the above (excluding the practice trials, which are only completed once), completing the flow-state short scale (FSSS) and clutch-state scale (CSS) (Vara et al., 2023), and a temporal tracing task (Jachs et al., 2022) after each round.


- The FSSS and CSS asks participants to rate how much they agree with statements relating to flow and clutch, respectively, during the game. We have also included two self made items regarding subjective experience of pressure and exploration.
- The temporal tracing task asks participants to draw their intensity level of agreement on two statements (regarding flow or clutch) on a scale of high to low throughout the game.

## Data Analyses

- Subjective flow and clutch states will be defined by the results of the FSSS and CSS questionnaires.
- *Independent Component Analysis* (ICA): Clean the data and separate the observed signals into distinct sources.
- *Time frequency analysis*: This is crucial for identifying the frequency components of when participants were subjectively experiencing the most intense flow or clutch states within a trial. It will produce data on how signal oscillations change throughout the trial, which will be incorporated in the mixed-effects model.
- *Mixed-effects model*: We will explore the EEG and behavioural data, accounting for the skill and neuroticism levels between participants in both flow and clutch conditions.
- The two self-made items included in the questionnaire will be used as a manipulation check, to ensure that pressure and exploration relate to their corresponding conditions as designed. This will allow us to infer that increased pressure or exploration have causal effects on flow and clutch states.

## Short Summary

- Aim to identify behavioural and EEG markers of flow and clutch states in a video-game context.
- Participants play a manipulated video game to induce flow (exploratory) and clutch (pressure) states.
- We expect to find data to support the Transient Hypofrontality hypothesis of flow (i.e., increased alpha and theta oscillations in the frontal regions). An exploratory data analysis will be conducted for flow and clutch states.
- Subjective flow and clutch states will be assessed using the FSSS and CSS questionnaires, and the temporal tracing task.
- EEG data will be analysed using time-frequency analysis and a mixed-effects model.

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Csikszentmihalyi (1975); Otten (2009); Dietrich (2004); Tan et al. (2023); Vara et al. (2023); Jachs et al. (2022)