In-match biosignals predict win/loss and assess expertise

The essence of winning revealed through esports

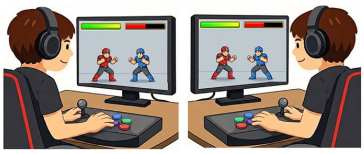
Abstract

Improving competitive performance requires objective evaluation of the mental states and levels of expertise that lead to victory. However, lacking sufficient scientific support, conventional assessments still depend heavily on coaches' experience and intuition. This study measured athletes' physiological states during esports competition and examined whether brain activity could predict match outcomes, as well as differences in physiological responses between advanced and intermediate players. We found that pre-match electroencephalograms could predict match outcomes with about 80% accuracy, that advanced players showed increased muscle activity at decisive moments, and that pronounced cardiac synchronization emerged when advanced players competed against one another. These findings enabled us to quantify, for the first time, the internal bodily states that influence winning and losing, and to establish a new metric for evaluating depth of expertise. This study may support evidence-based training, skill assessment, and mental-control technologies applicable to medicine, construction, and other high-pressure settings.

Understanding winning players' brains and bodies

- In top-level matches between evenly matched players, the mental factor is often said to decide the outcome
- Although this factor has been studied from many dimensions, what happens in the brain and body remains unclear

Focusing on esports
- More dependent on mental than physical
- Accurate bio-signal measurement during matches

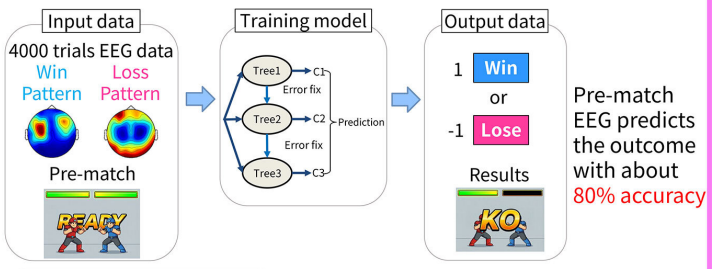


Our study

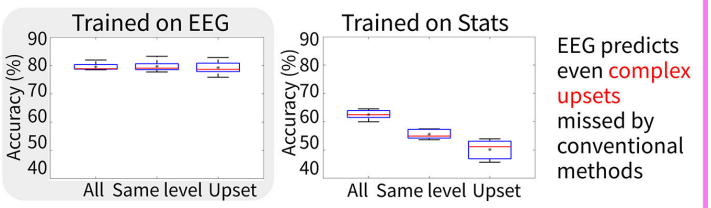
- Physiological recording during fighting video game play
- We tested whether pre-match EEG[1] predicts Win/Lose
- We examined mental-related EMG[2] and HR[3] dynamics that distinguish advanced from intermediate players

1: Electroencephalogram, 2: Electromyography, 3: Heart rate

Revealing the optimal brain state for winning



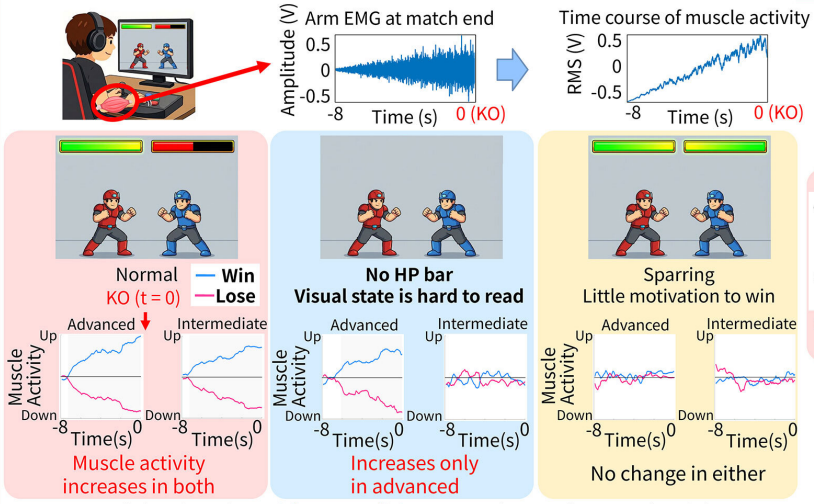
Pre-match EEG predicts the outcome with about 80% accuracy



EEG predicts even complex upsets missed by conventional methods

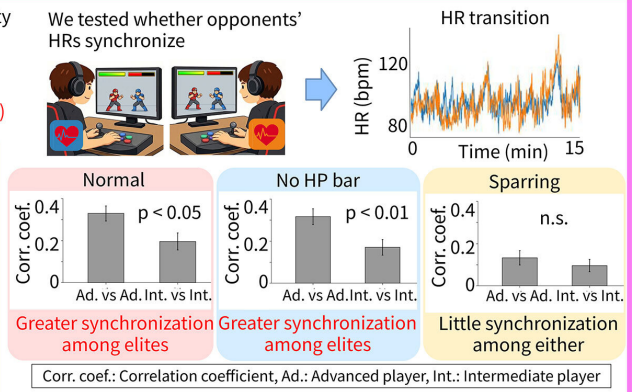
An optimal pre-match brain state helps decide the match results

Muscle activity reveals how experts read key moments



Experts read the situation without explicit cues and exert force at the right moment

HR synchronizes more easily in elite matches



Corr. coef.: Correlation coefficient, Ad.: Advanced player, Int.: Intermediate player

Advanced players share the experience so deeply that they synchronize physiologically with opponents

Clutch ability and expertise level can now be measured objectively

References

[1] S. Minami, H. Koyama, K. Watanabe, N. Saijo, M. Kashino, "Prediction of esports competition outcomes using EEG data from expert players," *Comput. Hum. Behav.*, Vol. 160, 108351, 2024.

[2] S. Minami, K. Watanabe, N. Saijo, M. Kashino, "Task context and player expertise modulate arm EMG linked to win-loss outcomes in esports," *Comput. Hum. Behav.*, Vol. 175, 108850, 2026.

[3] K. Watanabe, N. Saijo, S. Minami, M. Kashino, "The effects of competitive and interactive play on physiological state in professional esports players," *Heliyon*, Vol. 7, No. 4, e06844, 2021.

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