Anticipating Injuries and Health Problems in Elite Soccer Players Using Dynamic Complexity

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1. Background

- **Injuries** and **health problems** of soccer players often **appear abruptly** and unexpectedly;
- **Complex systems theory** suggest that these events can be preceded by **Early Warning Signals** (EWSs) [1];
- **Dynamic complexity** (DC) is an EWS reflecting changes in variability and turbulence [2,3];
- We tested whether changes in DC, detected in soccer players' **psychophysiological measures**, anticipate injuries and health problems.

2. Methods

- **14 male players** of a Dutch major league (**Eredivisie**) club were measured on every training and match day over two competitive seasons;
- We collected **psychological and physiological self-reports** on self-efficacy, motivation, mood, rating of performance, enjoyment, recovery (**Figure 1**), and we used **heart rate sensors**;
- **Time-loss injuries** and **health problems** (OSTRC-H2) were the outcome measures;
- We calculated the DC of the self-reports and sensor data in a seven-day window to detect **increased variability** before injuries and health problems occurred.

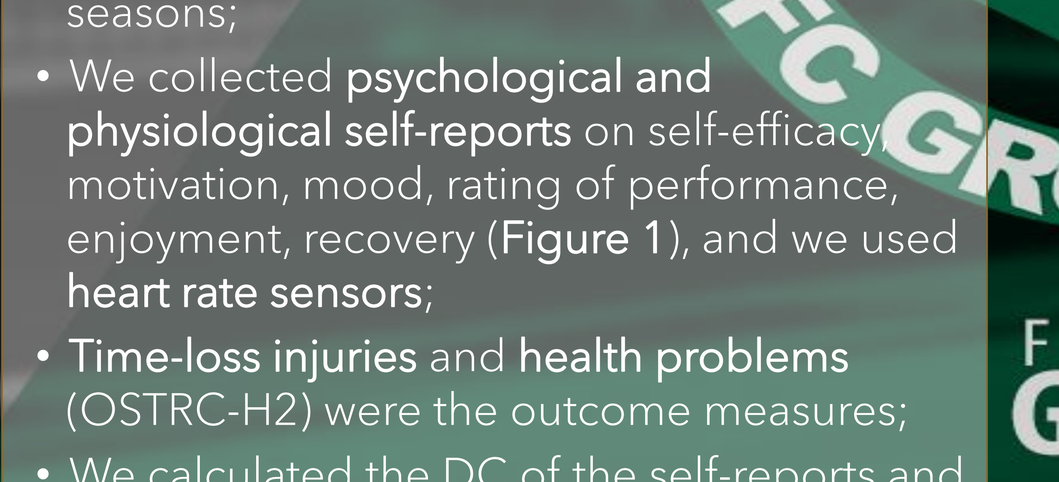

Figure 1. Illustration of the tailor-made app that we made to fill out the self-reports on a tablet computer.

3. Results

- Players experienced **2.7 injuries** and **8.3 health problems** on average across two seasons;
- In the **five days before** injuries and health problems, DC increased in **26% and 33%** of the payers, respectively (**Figure 2**).

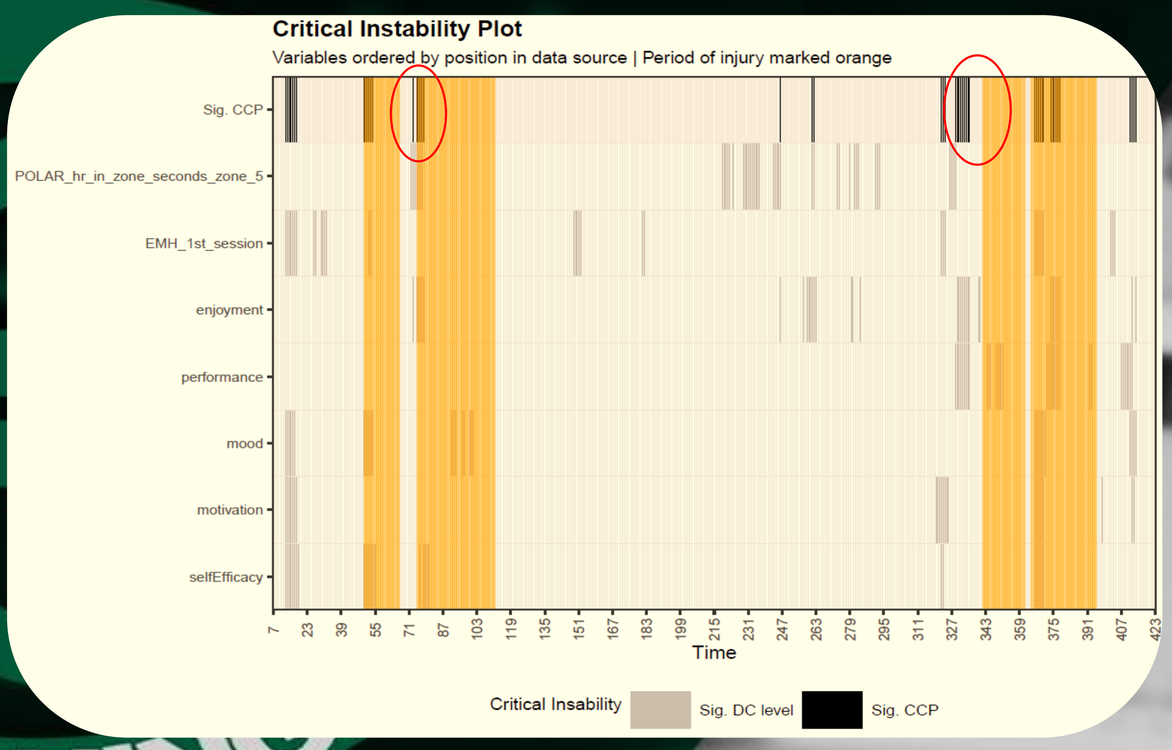

Figure 2. Critical instability plot showing the significant cumulative complexity peaks (CCP; i.e., all measured variables together) as black lines in the top row, and the significant dynamic complexity level for every single variable as grey lines in the remaining rows. The data represents one player over two competitive seasons. The red circles highlight the CCPs before the onset of an injury. Thus, an EWS.

4. What does this mean?

- Results of this study suggest that EWSs can be used for r**eal-time anticipation of injuries and health problems** in daily soccer practice;
- Future research should test for the robustness of these results within and between individuals and perform **sensitivity and specificity tests**;
- Finding out **how warning signals can be communicated** to soccer players and staff is an interesting avenue.

References

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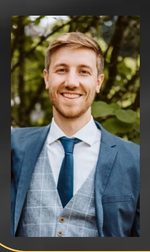
More Information



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The Project