The Great Debate: Subjective vs. Objective Measures to Predict Holistic Fatigue

__Holistic Fatigue:__ An aggregate measure of self-reported fatigue, soreness, irritability, sleep quality, and desire; aka the __Monitoring Score__.

__High Holistic Fatigue__: 80th percentile of fatigue scores for each individual.

Problem: What is the best way to monitor holistic fatigue in your athletes – subjective self-reporting, or objective measurements?

Solution: Objective game features showed more predictive of high-fatigue athletes compared to use of solely subjective measures.

Approach:

Feature Extraction

We were interested in predicting high holistic fatigue for each athlete individually. Therefore, we normalized all subjective measures on a scale of 0 to 1 for each individual athlete. We defined high holistic fatigue to be the 80th percentile of reported fatigue for each athlete.

To evaluate the role of objective measures in predicting high fatigue, we first collected and extracted a number of objective features relating to games. This features included information around game day weather, motion, game statistics and game flow.

Model

We used an XGBoost approach to predict next day holistic fatigue. We selected XGBoost due to performance on non-linear relationships as well as interpretability of feature importance. In order to evaluate the roles objective to subjective measures we compared the performance of models that included only subjective measures, only objective measures, and a combination of both subjective and objective measures.

Findings

Our results suggest that a model containing only objective measures produces the highest accuracy predictions of holistic fatigue. Moreover, we saw similar results for predicting each component of holistic fatigue. We achieved the highest accuracy for predicting fatigue, soreness, and sleep quality with objective measures only and the highest accuracy for irritability and desires with a combination of subjective and objective measures. For all components, game-specific objective measures have value in identifying holistic fatigue.

For predicting holistic fatigue, we see that motion related features have the highest importance. The most predictive features include average acceleration, explosive acceleration time, average AccelLoad, AccelImpluse, and Sprint Distance.

Recommendations

With these results, we recommend integrating objective measures such as acceleration, and sprint distance into athlete monitoring for holistic fatigue. These measures have value as a first alert for potential athlete burn out. Moreover, this method has the potential for use in real time to influence substitution strategy in games to potentially prevent high holistic fatigue.

In terms of next step, first we believe our model could be improved by including more historical data beyond just the previous day. Second, we also believe that with more data this modeling approach could be applied to each individual player to produce personalized insights and recommendations. Third we suggest expanding this paradigm to training data as well as game data. Finally, we believe a weighted monitoring score can product higher accuracy predictions. Preliminary analysis suggests that a monitoring score with weights created through PCA can achieve higher accuracy with an objective and a combined model.