

Can Critical Power be Estimated from Training and Racing Data using Mean Maximal Power Outputs?

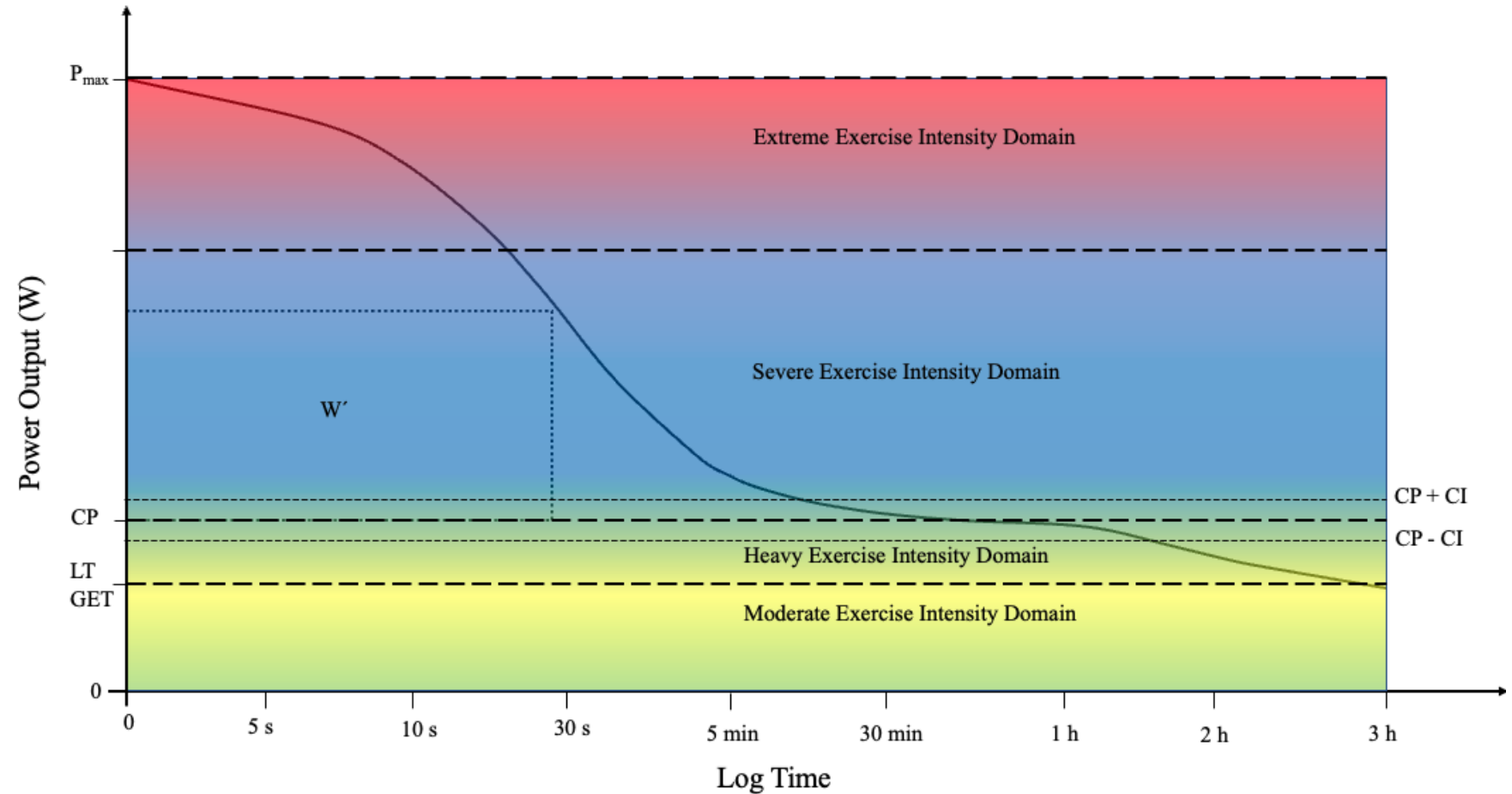
 James Spragg

 Spragg_Perform



What is Critical Power (CP) ?

'...defines the border between the heavy and severe exercise domains and thus separates power outputs for which a physiological steady state can, and cannot, be achieved...'



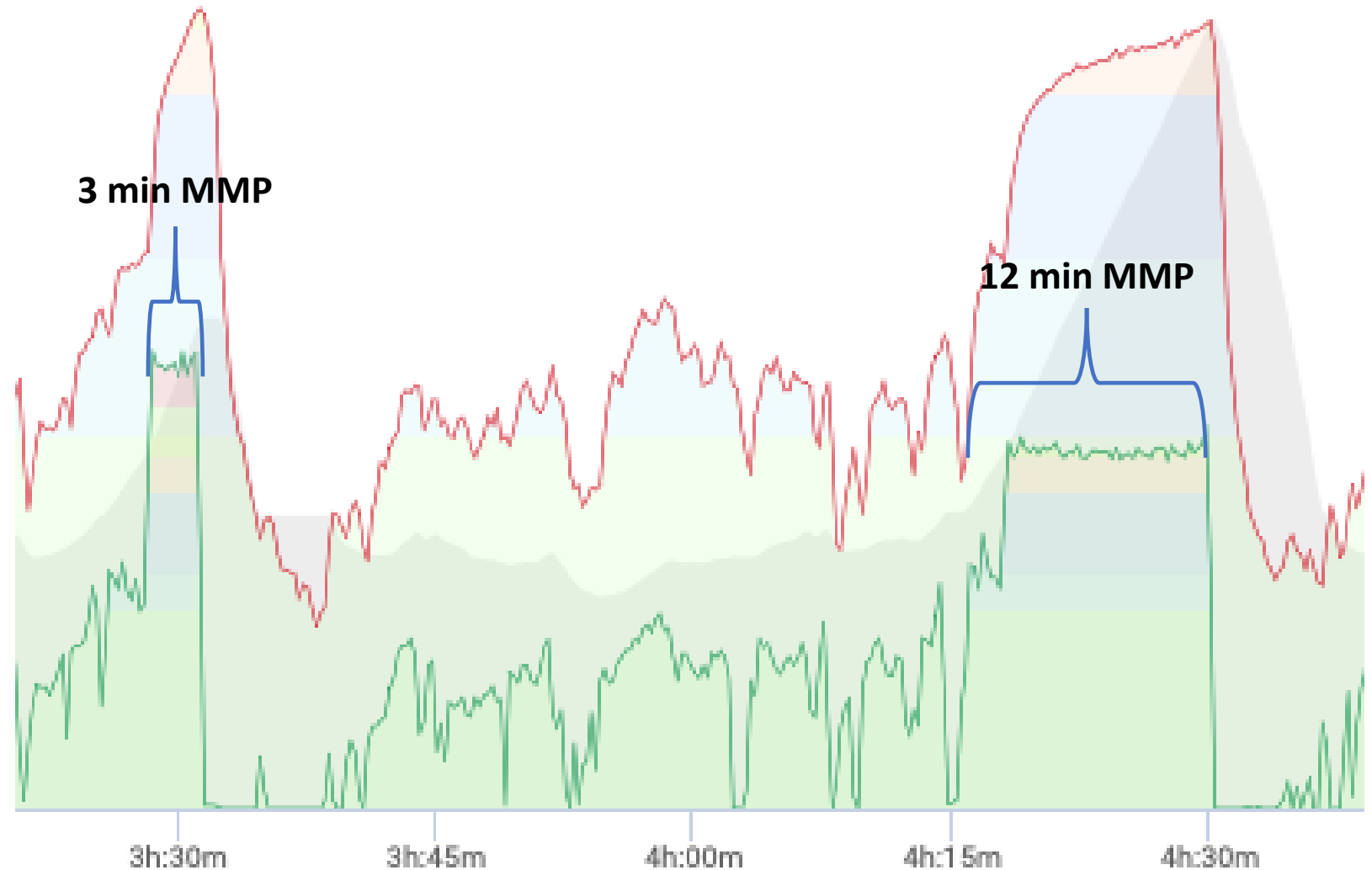
Why is Critical Power useful ?

'...the CP model has found many important uses in performance modelling and training prescription ...'

- Track longitudinal change
 - ‡ A performance metric that changes with changes in underlying physiology
- Performance modelling
 - ‡ CP predicts performance in Road cycling, MTB, Time Trials, Track cycling etc
- Exercise Prescription
 - ‡ Different physiological responses above and below the CP mean training can be tailored to underlying physiology

What are Mean Maximal Power (MMP) Outputs?

'...the highest average power output for a given period, recorded during a single session.... For example, 20min MMP would be the highest average power recorded over 20 mins during a training session....'



Fundamental issues with MMP data?

'... MMP data is only indicative of what a cyclist did but not to what the cyclist is capable of ...'

Were the efforts maximal in nature?
In applied setting it's what we have!



Arbitrary durations?
The important question:

Part of a longer / shorter effort?
Given these limitations is MMP data useful?

Often stochastic power output

Why would we want to estimate CP from MMP?

'Why not just do formal testing?!'

- Formal testing takes time!
 - ! Often requires multiple days of testing
 - ! Athletes need to perform a taper beforehand
 - ! Athletes need to recover afterwards
- Athletes (sometimes) don't like testing!
- Validity
 - ? Where better to 'test' than in the race

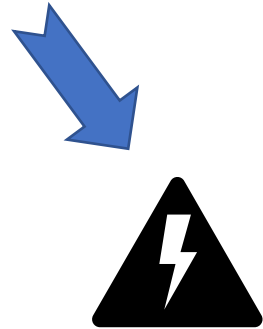
Participants and Protocol

Participants:

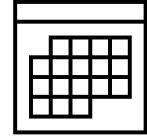
'11 professional U23 Cyclists (mean \pm SD, age 21.3 ± 1.1 y, body mass 70.8 ± 7 kg, height 182.1 ± 5.4 cm, VO_2 max 74.2 ± 3.1 ml \cdot kg \cdot min $^{-1}$)'



3 x performance trials
in 2 days:
2 min, 5 min, 12 min
(random order)



Derive CP &
 W' _{test}



Record MMP data in every session for
subsequent 3 months



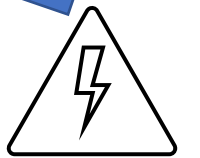
training

racing

best values



Derive CP_{race} and
 W' _{race}

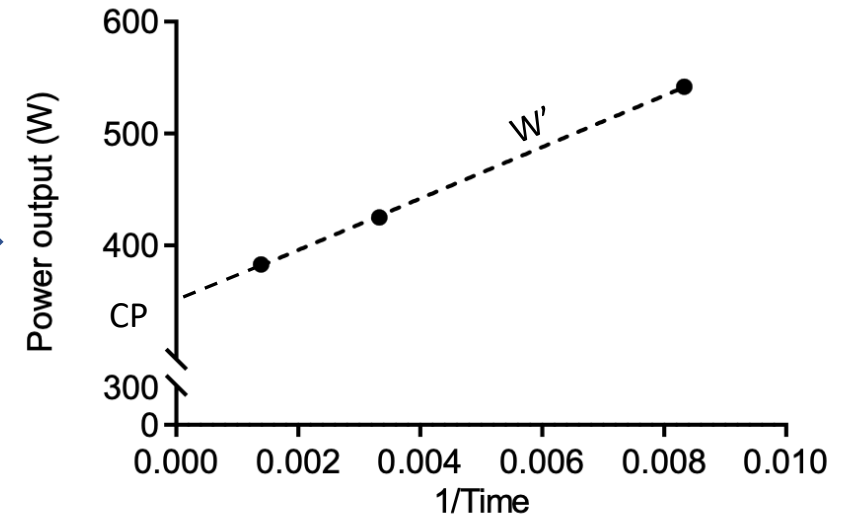
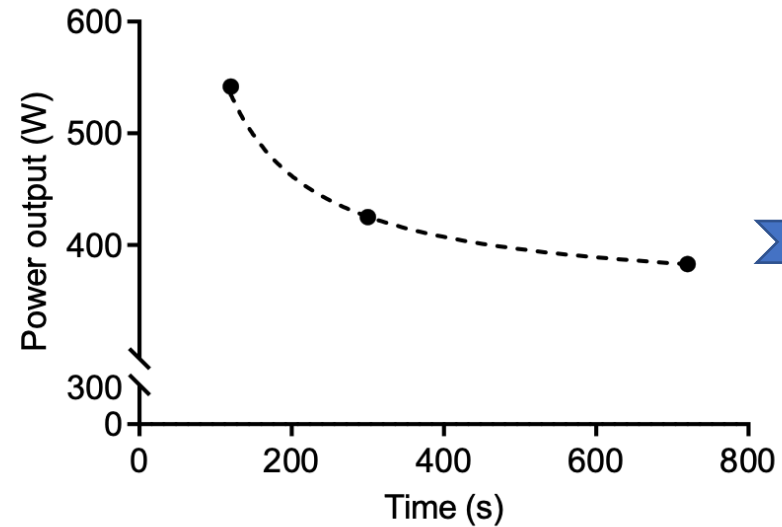


CP_{training} and
 W' _{training}



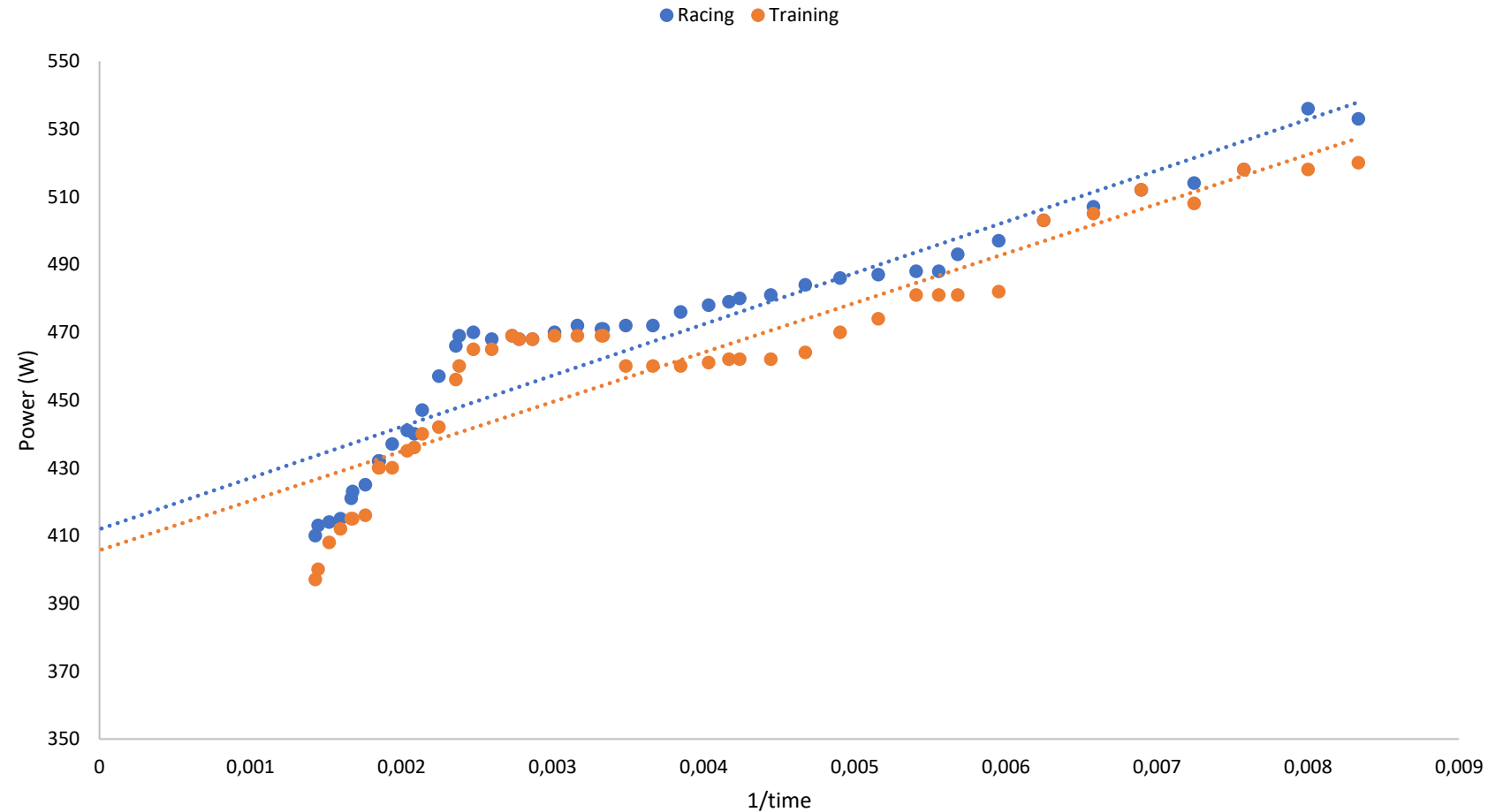
Estimating CP Estimate from Performance Trials

'Participants performed 3 performance trials (2, 5 and 12 minutes). Critical Power (CP_{test}) and W' (W'_{test}) were interpolated from these performance trials



Deriving CP Estimates from MMP values

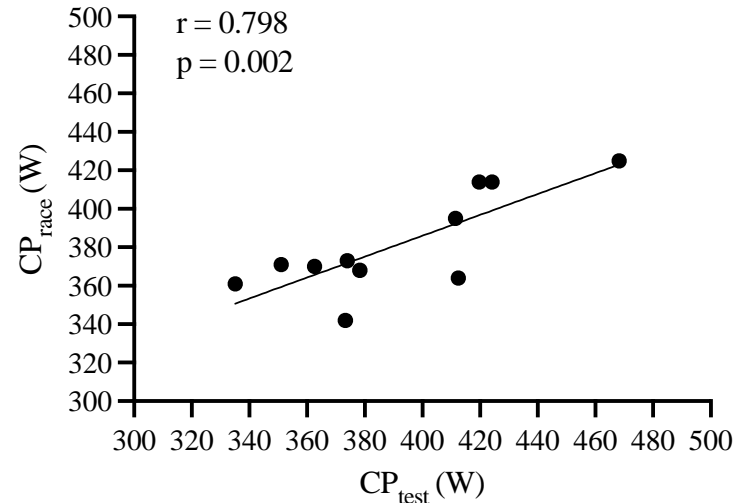
'MMP values for the duration of 120-720s were collected from both racing and training in the 3 months post CP_{test} . Critical Power and W' estimates were interpolated exclusively from racing data (CP_{race} , W'_{race}) or training data ($CP_{training}$ and $W'_{training}$)'



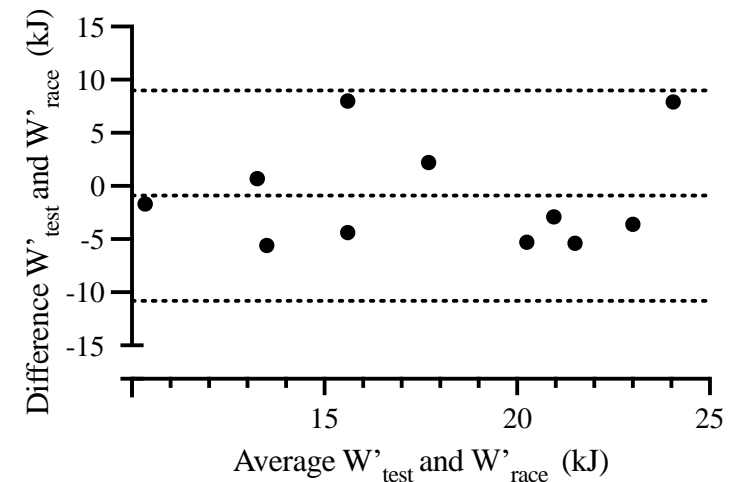
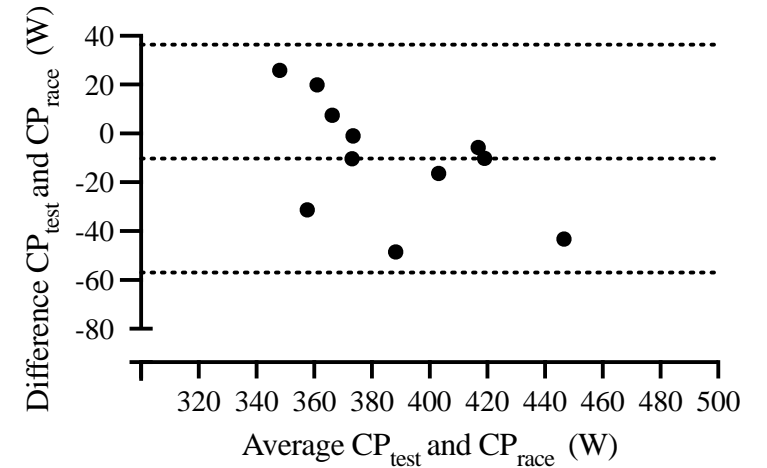
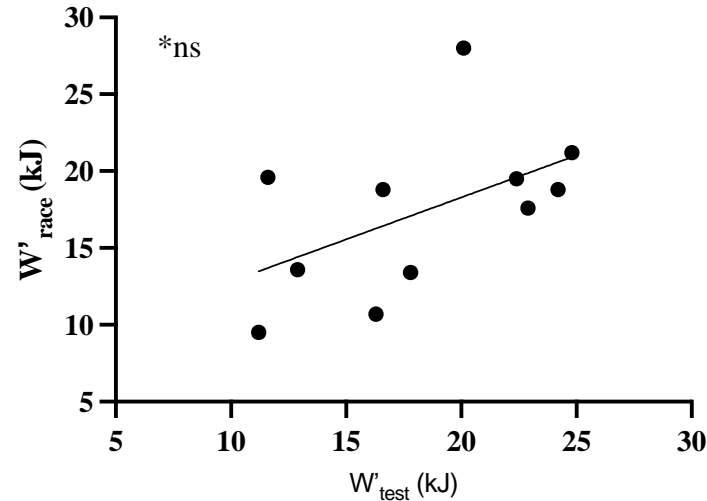
*simplified data for clarity of illustration purposes

Comparing CP and W' estimates...from race data

'No significant differences between CP_{test} and CP_{race} '

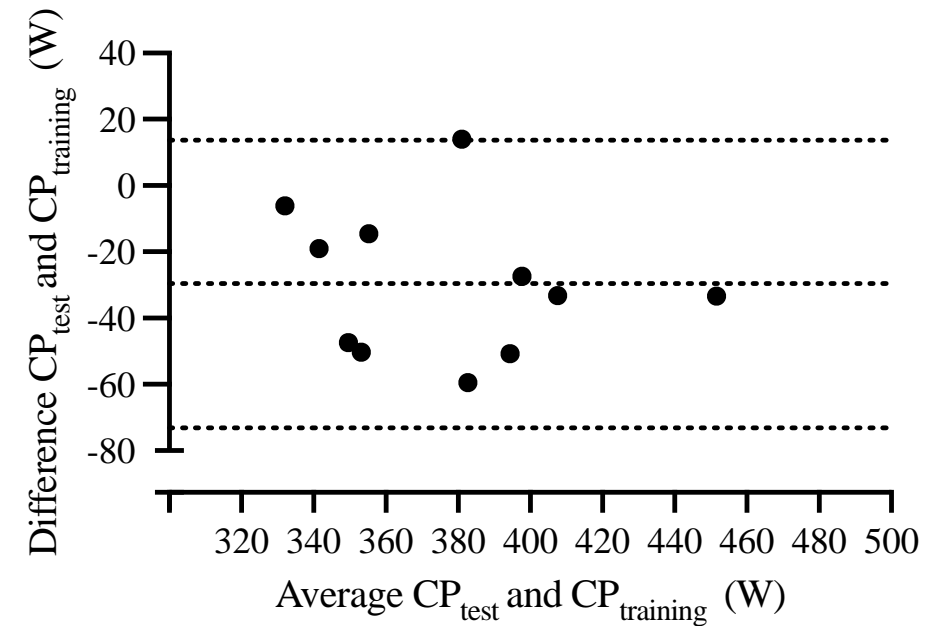
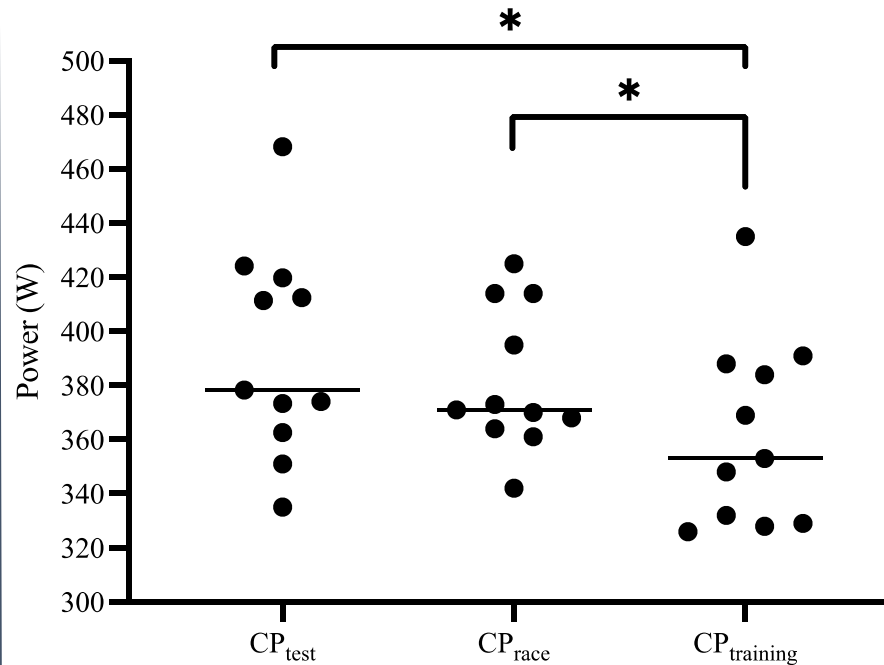


'No significant differences between W'_{test} and W'_{race} '



Comparing CP and W' estimates...from training data

'Significant differences between CP_{test} and $CP_{training}$ ($p < 0.001$)'



What does this tell us...?

'...the 'but so what' slide...'



We can derive valid CP estimates to good accuracy from race data!



MMP data from races (despite its flaws) can be used to gain insights into the underlying physiology



Professional cyclists DO produce maximal efforts in races (or at least very very close to maximal efforts)!

What doesn't this tell us...?

'...the 'but so what' slide...part 2.....'



We CANNOT use training data to derive CP estimates – you need race or formal test data to do that!



Efforts in training are NOT maximal in nature possibly due to...

- cumulative fatigue
- you don't need maximal efforts to get a training benefit



Efforts in training are NOT indicative of maximal performance potential



No correlations between W' estimates tell us we cannot W' derived W' from MMP, at least at an individual level

Conclusion

'... the take home message...'

Critical Power CAN be Estimated from
Racing Data using Mean Maximal Power
Outputs but NOT from Training Data