The reliability and validity of the 3-minute critical power test in linear and isokinetic mode

James Wright

Southampton SOLENT University

THE UNIVERSITY OF WINCHESTER

Exercise Testing
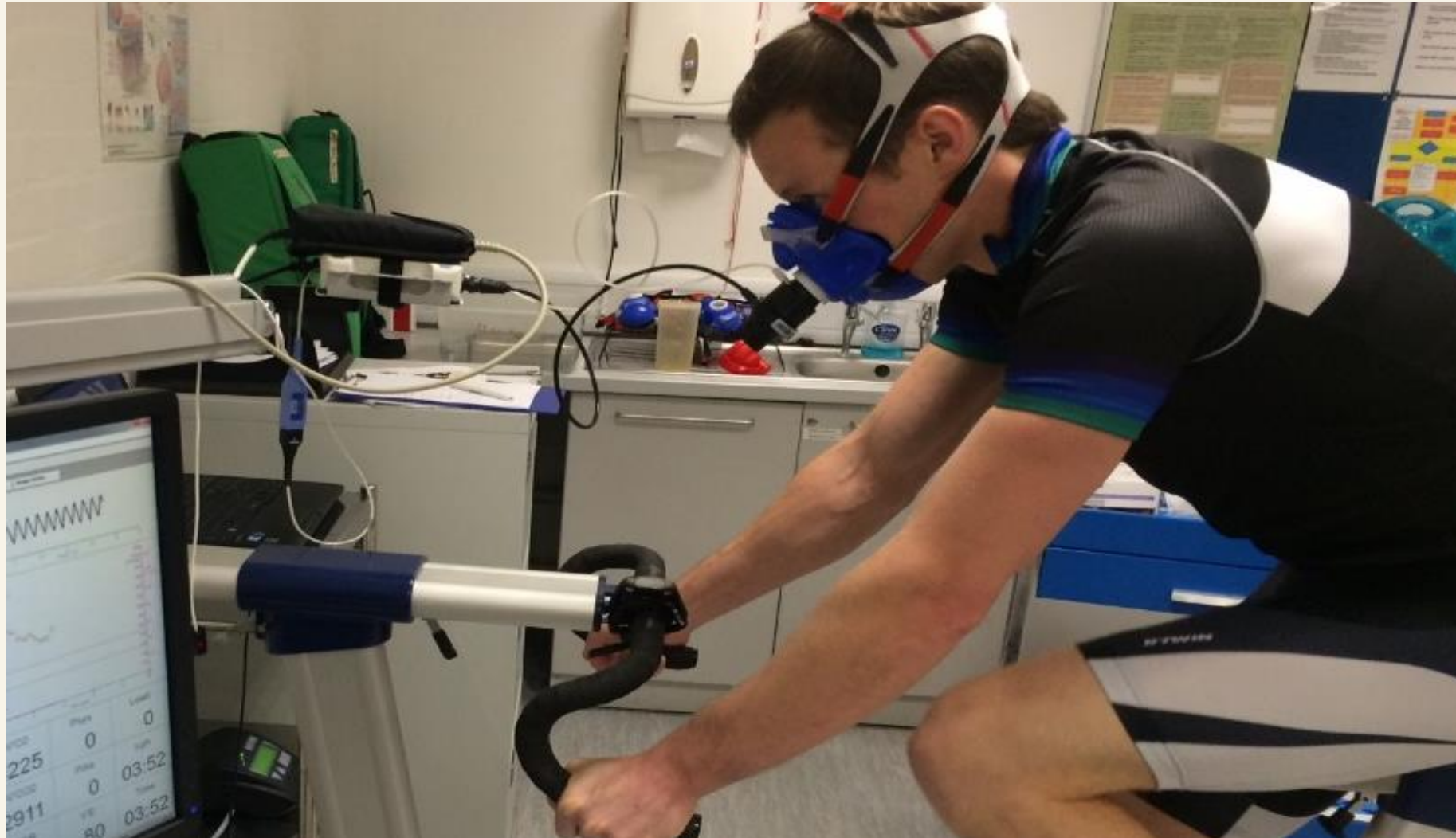
Critical Power

- Critical Power has been defined as the highest sustainable rate of aerobic metabolism

  (Hill, 1993)

- It has been used to provide an estimation of the heavy-severe exercise boundary

  (Jones et al, 2010)

- How is it normally measured?
  - Multiple time to exhaustion trials
  - Power-time relationship

Critical Power
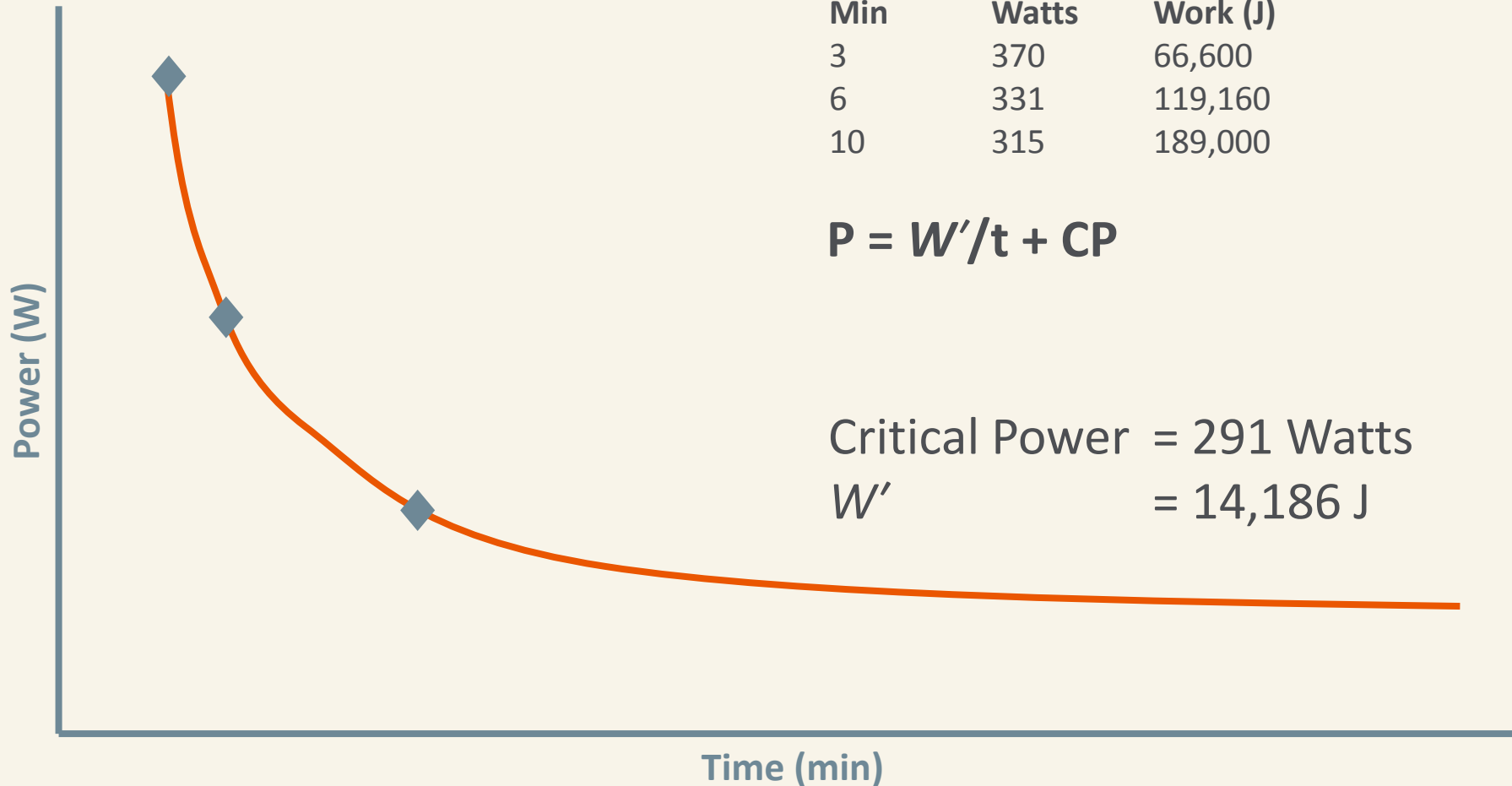
Min	Watts	Work (J)
3	370	66,600
6	331	119,160
10	315	189,000

$$P = W'/t + CP$$

Critical Power = 291 Watts
W' = 14,186 J

Power (W) (y-axis)

Time (min) (x-axis)

Projected best power for duration:

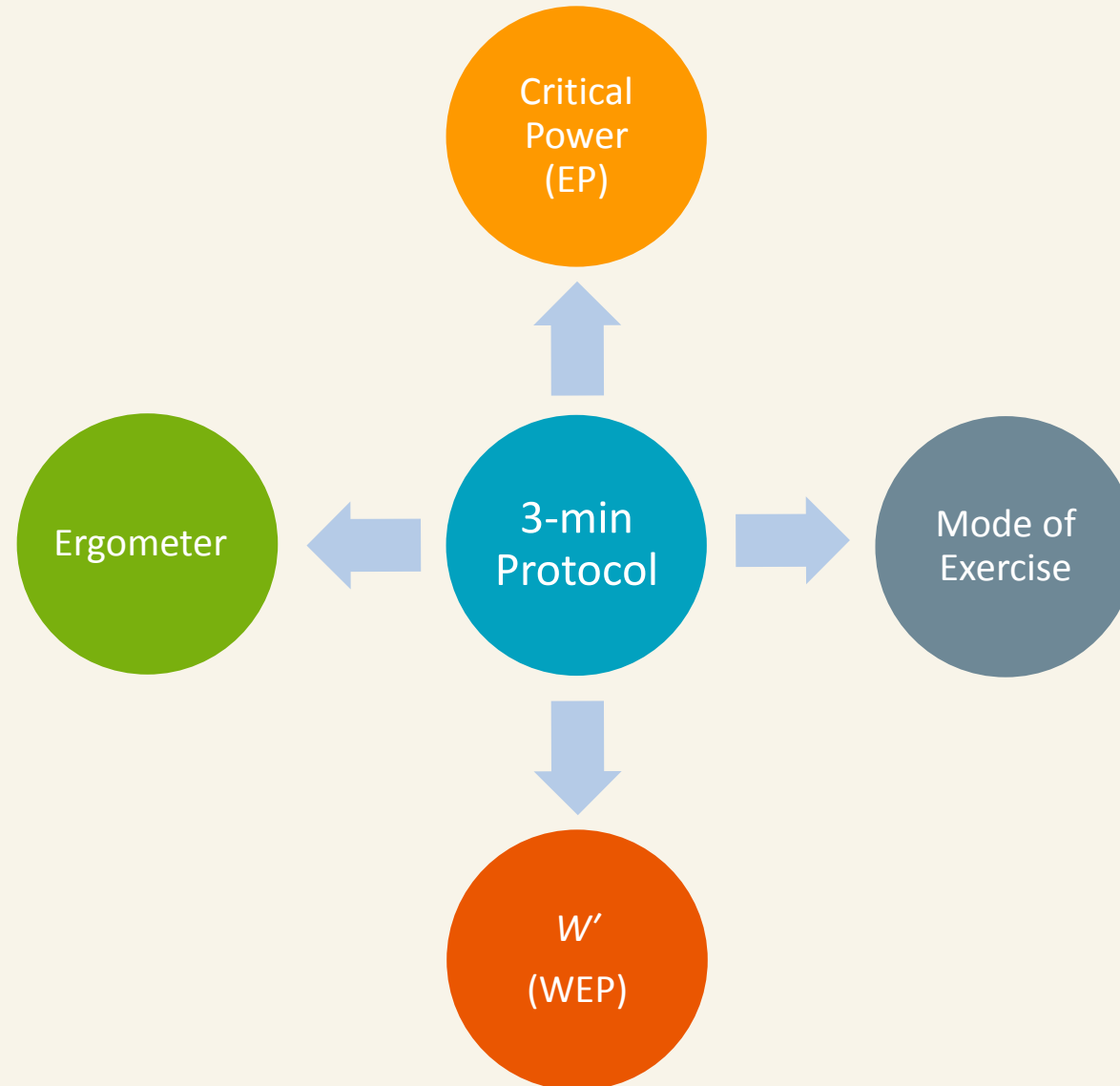| Min	Watts
3	370
5	339
11	313
14	308
17	305
20	303
23	302
26	300
29	300
32	299
35	298
38	298
41	297
44	297
47	296
50	296
53	296
56	296
59	295
62	295

3-minute Protocol

- P = W'/t + CP

- If W' was 100% depleted during exercise…..

- P = ~~0/t~~ + CP

- **P = CP**

3-minute Protocol
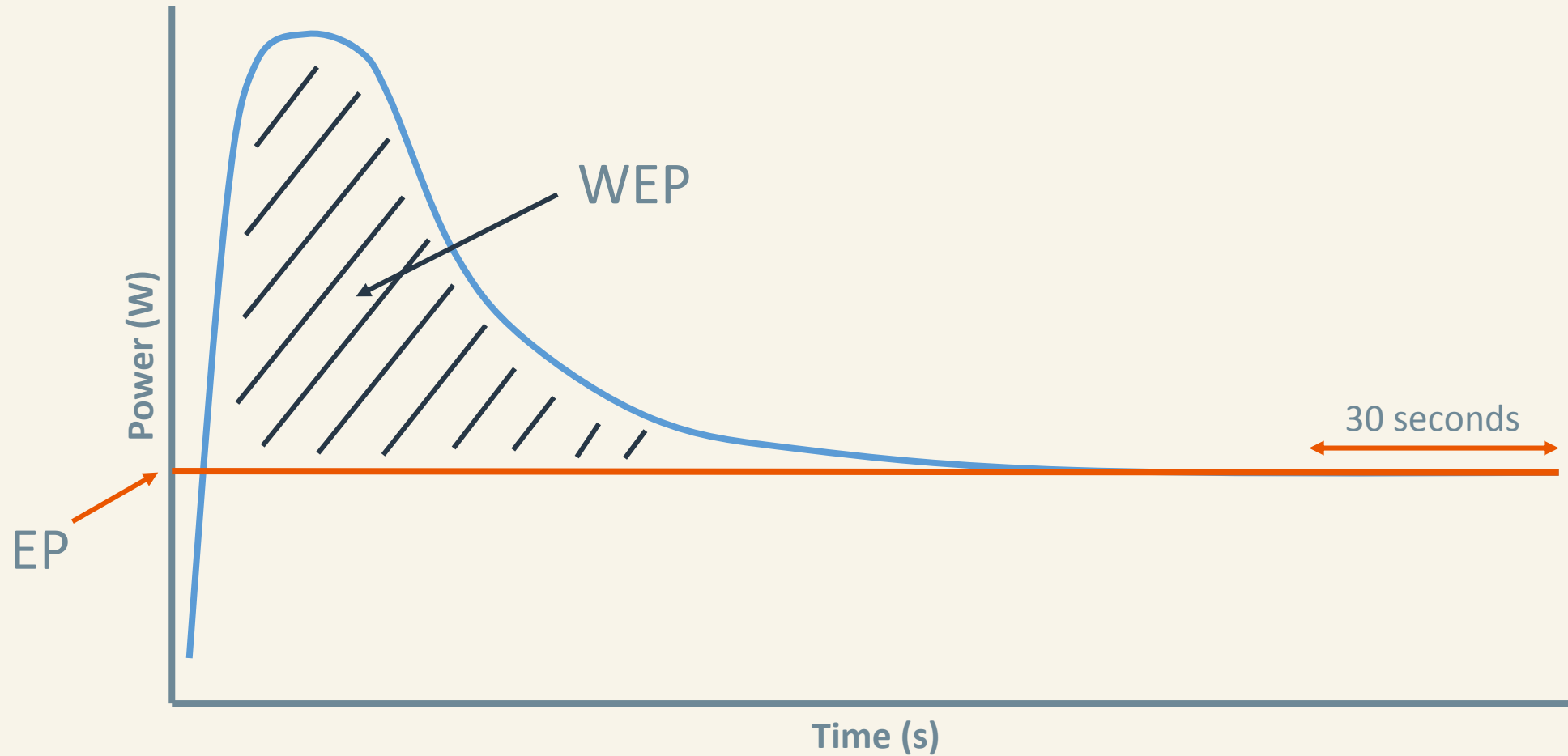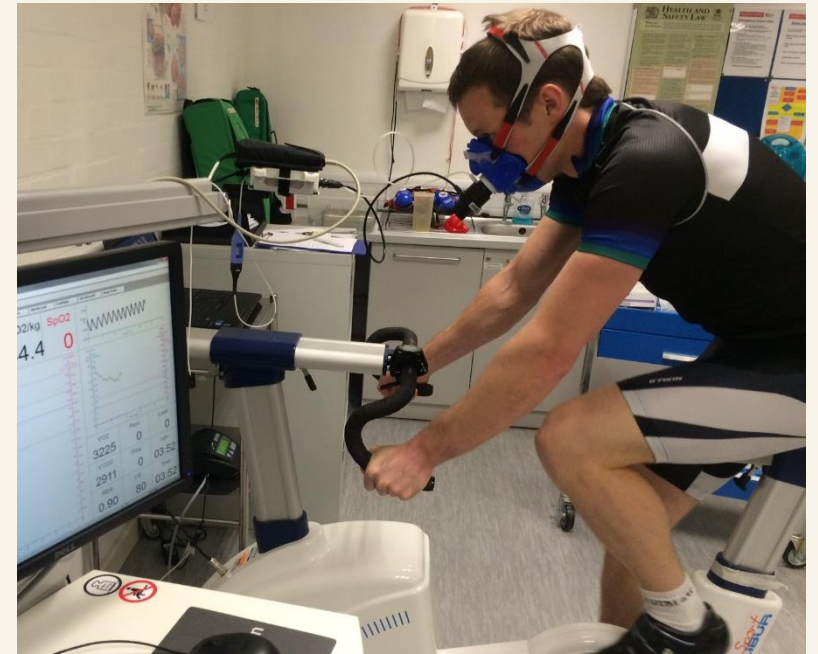
3-minute Protocol

Purpose

To investigate the reliability and validity of the 3-minute critical power test in both isokinetic and linear modes

Method

- 12 male cyclists

- 8 trials
  - Calculation of GET, MAP, $\dot{V}O_{2peak}$

  - 3 Trials to exhaustion to calculate CP and *W'*

  - 2 x 3-minute 'all-out' trials in isokinetic mode

  - 2 x 3-minute 'all-out' trials in linear mode

Analysis

- CP and *W'* were calculated from the 1/time (CP1 and *W'*1) and work/time (CP2 and *W'*2) equations:

  - 1/time: P = *W'* / (1/t) + CP
  - Work/time: W = *W'* + CP*t*

- EP was calculated as the average power observed during the final 30 seconds of each 3-minute trial

- WEP was calculated as the power-time integral above EP

Results

Repeated Measures ANOVA

	EP-Isokinetic	EP-Linear
CP1	+3.4 W p=0.38	+30.9 W p=0.004
CP2	+0.8 W p=0.97	+35.1 W p=0.003

	WEP-Isokinetic	WEP-Linear
W'1	+8.2 kJ p<0.000	+10.4 kJ p<0.000
W'2	+10.0 kJ p<0.000	+12.2 kJ p<0.000

Results

Coefficient of Variation

- EP-Isokinetic = 1.93%

- EP-Linear = 2.05%

- WEP-Isokinetic = 8.44%

- WEP-Linear = 5.39%

Conclusions

- The 3-minute isokinetic test provides a reliable measure of EP and a valid estimate of CP

- The 3-minute linear test provides a reliable measure of EP but it does not provide a valid estimate of CP

- Neither the isokinetic or linear mode provide a reliable measure of WEP or a valid estimate of W'

- The 3-minute isokinetic test can be used to estimate critical power

What is the future?

Thank you

Professor Simon Jobson

Professor Stewart Bruce-Low

Dr David Jessop