Friday 21st January 2011
World Rowing Coaches Conference
Copthorne Hotel Slough-Windsor UK

Using performance based models to focus training; Practical examples from Cycling and Swimming

Scott Gardner Ph.D.

Beijing 2008

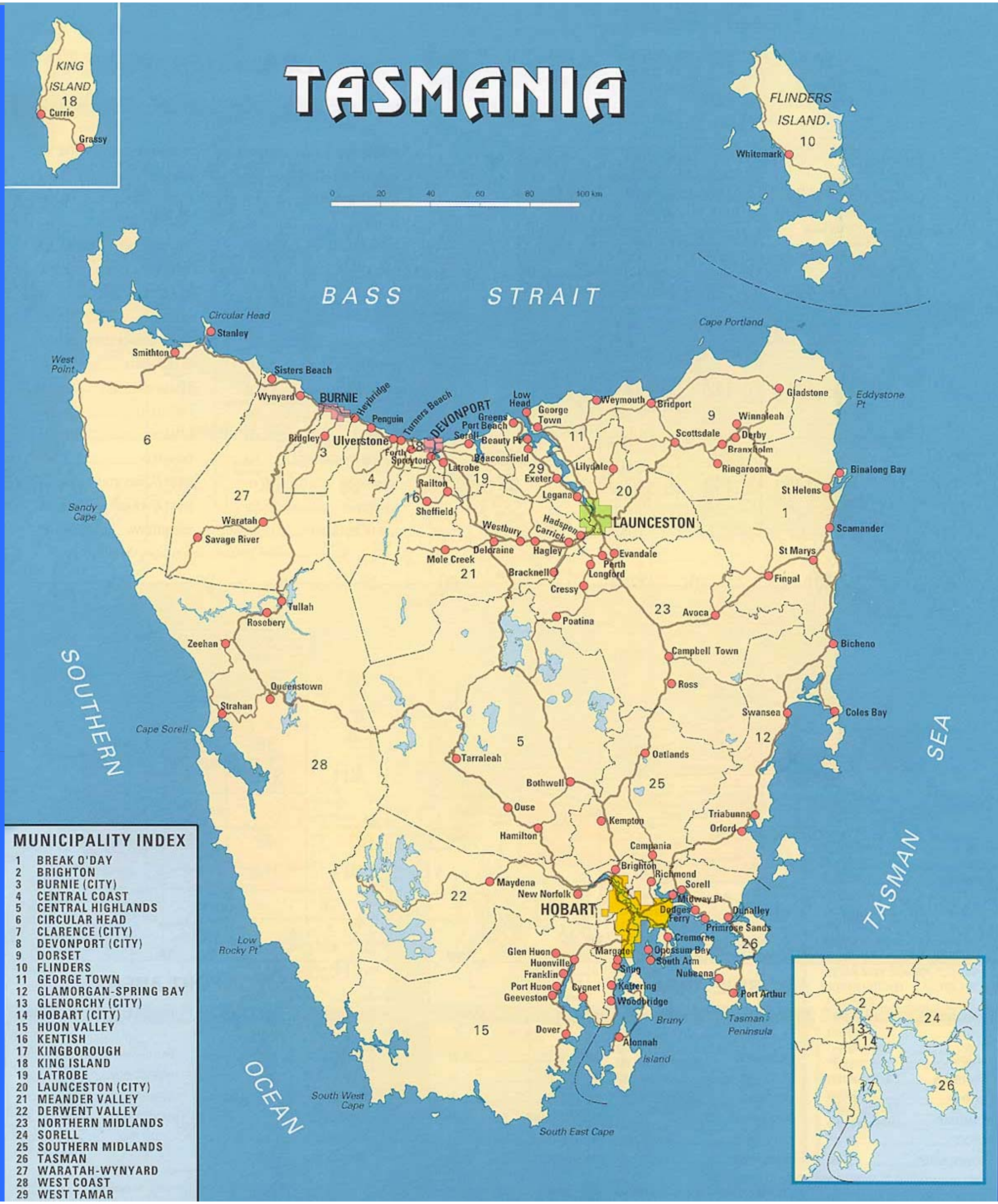
LONDON 2012

Acknowledgements

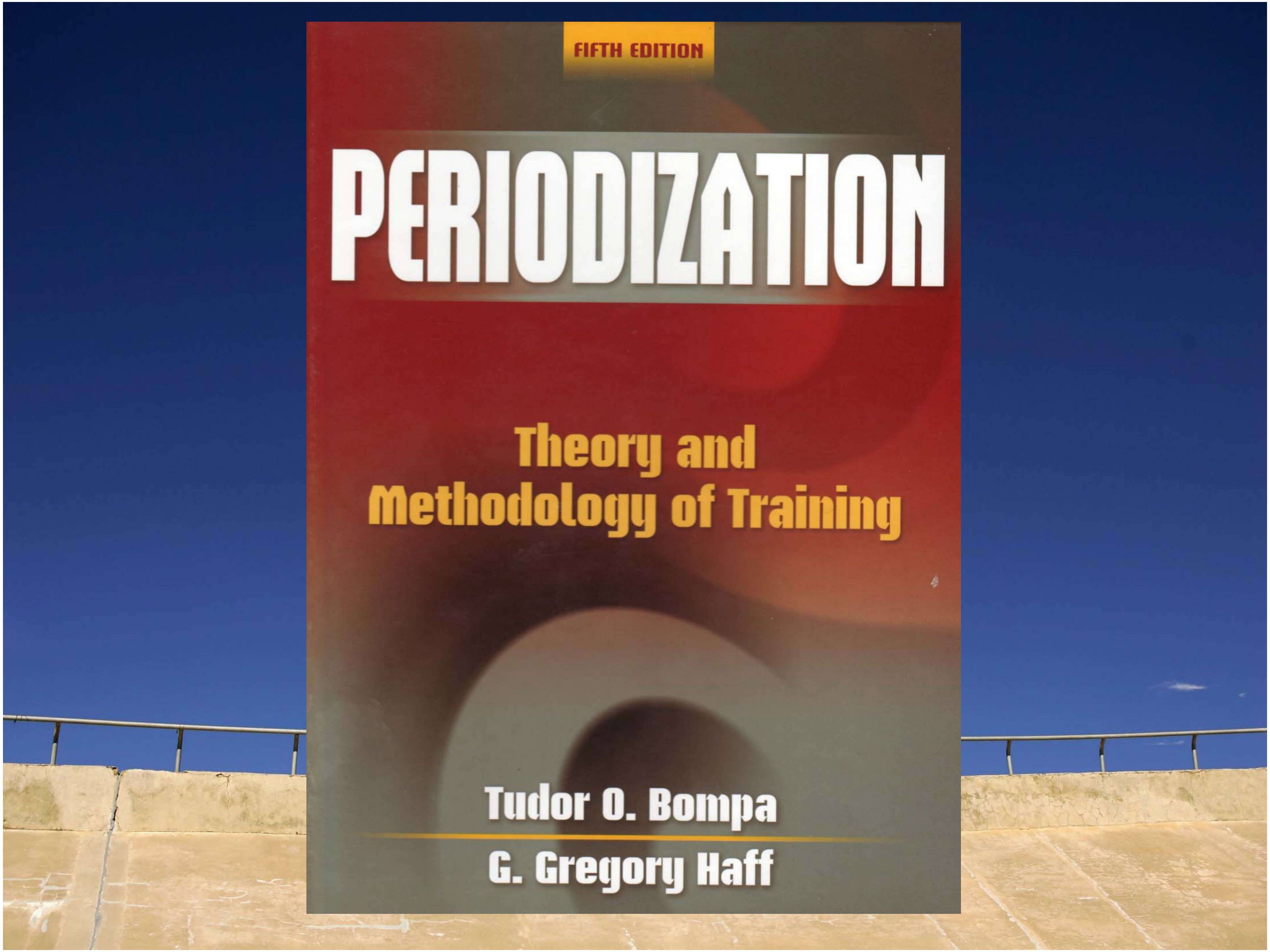
- GB and Aus Cycling Athletes
- British Swimming and Cycling
- EIS Sport Science (North West)
- UK Sport

- Dr Jim Martin
- Dr David T. Martin
- Dr Matthew Parker
- Tim Kerrison

- Conference Organisers and FISA



TASMANIA
KING ISLAND 18
Currie
Grassy
FLINDERS ISLAND 10
Whitemark
BASS STRAIT
TASMAN SEA
SOUTHERN OCEAN
Circular Head
Stanley
Smithton
West Point
Cape Portland
Sisters Beach
Wynyard
BURNIE
Penguin
Ulverstone
DEVONPORT
Low Head
George Town
Weymouth
Bridport
Gladstone
Eddystone Pt
Scottsdale
Winnaleah
Derby
Branxholm
Ringarooma
Binalong Bay
St Helens
Lilydale
Beaconsfield
Exeter
Latrobe
Railton
Sheffield
Legana
LAUNCESTON
Scamander
St Marys
Westbury
Hadspen
Carrick
Hagley
Evandale
Deloraine
Mole Creek
Perth
Longford
Bracknell
Cressy
Fingal
Avoca
Poatina
Sandy Cape
Waratah
Savage River
Tullah
Rosebery
Zeehan
Bicheno
Campbell Town
Ross
Queenstown
Strahan
Cape Sorell
Swansea
Coles Bay
Tarraleah
Oatlands
Bothwell
Ouse
Kempton
Hamilton
Triabunna
Orford
Campania
Brighton
Richmond
Sorell
Maydena
New Norfolk
HOBART
Midway Pt
Dodges Ferry
Dunalley
Primrose Sands
Cremorne
Low Rocky Pt
Glen Huon
Huonville
Franklin
Port Huon
Geeveston
Margate
Opossum Bay
South Arm
Nubeena
Port Arthur
Snug
Kettering
Cygnet
Woodbridge
Dover
Bruny Island
Alonnah
Tasman Peninsula
South West Cape
South East Cape
MUNICIPALITY INDEX
1 BREAK O'DAY
2 BRIGHTON
3 BURNIE (CITY)
4 CENTRAL COAST
5 CENTRAL HIGHLANDS
6 CIRCULAR HEAD
7 CLARENCE (CITY)
8 DEVONPORT (CITY)
9 DORSET
10 FLINDERS
11 GEORGE TOWN
12 GLAMORGAN-SPRING BAY
13 GLENORCHY (CITY)
14 HOBART (CITY)
15 HUON VALLEY
16 KENTISH
17 KINGBOROUGH
18 KING ISLAND
19 LATROBE
20 LAUNCESTON (CITY)
21 MEANDER VALLEY
22 DERWENT VALLEY
23 NORTHERN MIDLANDS
24 SORELL
25 SOUTHERN MIDLANDS
26 TASMAN
27 WARATAH-WYNYARD
28 WEST COAST
29 WEST TAMAR


FIFTH EDITION
PERIODIZATION
Theory and
Methodology of Training
Tudor O. Bompa
G. Gregory Haff

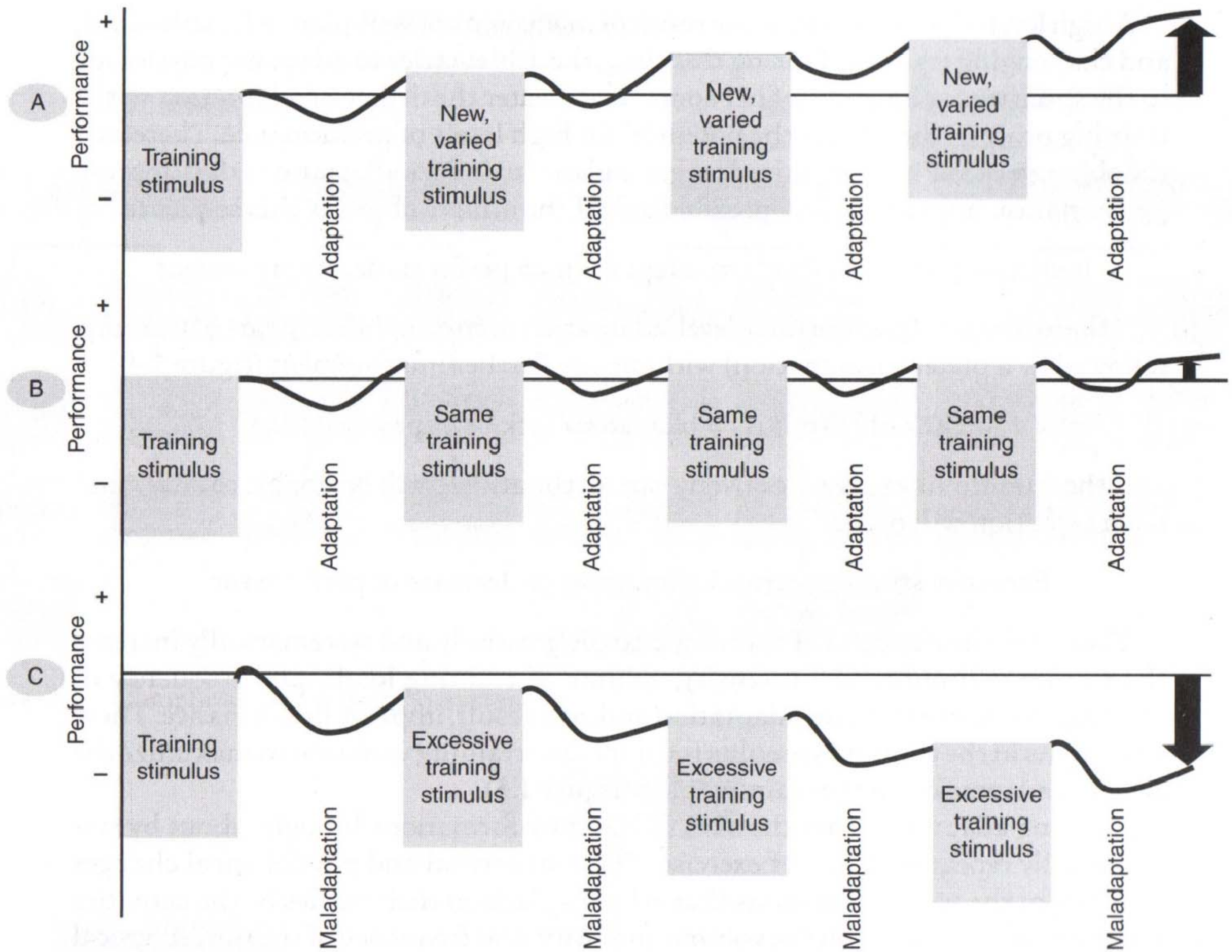


Figure 1.5 Training stimulus and adaptation.

(a) Increasing stimulus (load) ⇒ adaptation ⇒ performance improvement. *(b)* Lack of stimulus ⇒ plateau ⇒ lack of improvement. *(c)* Excessive stimulus ⇒ maladaptation ⇒ decrease in performance. ⬆ = increased performance; ⬇ = decreased performance.

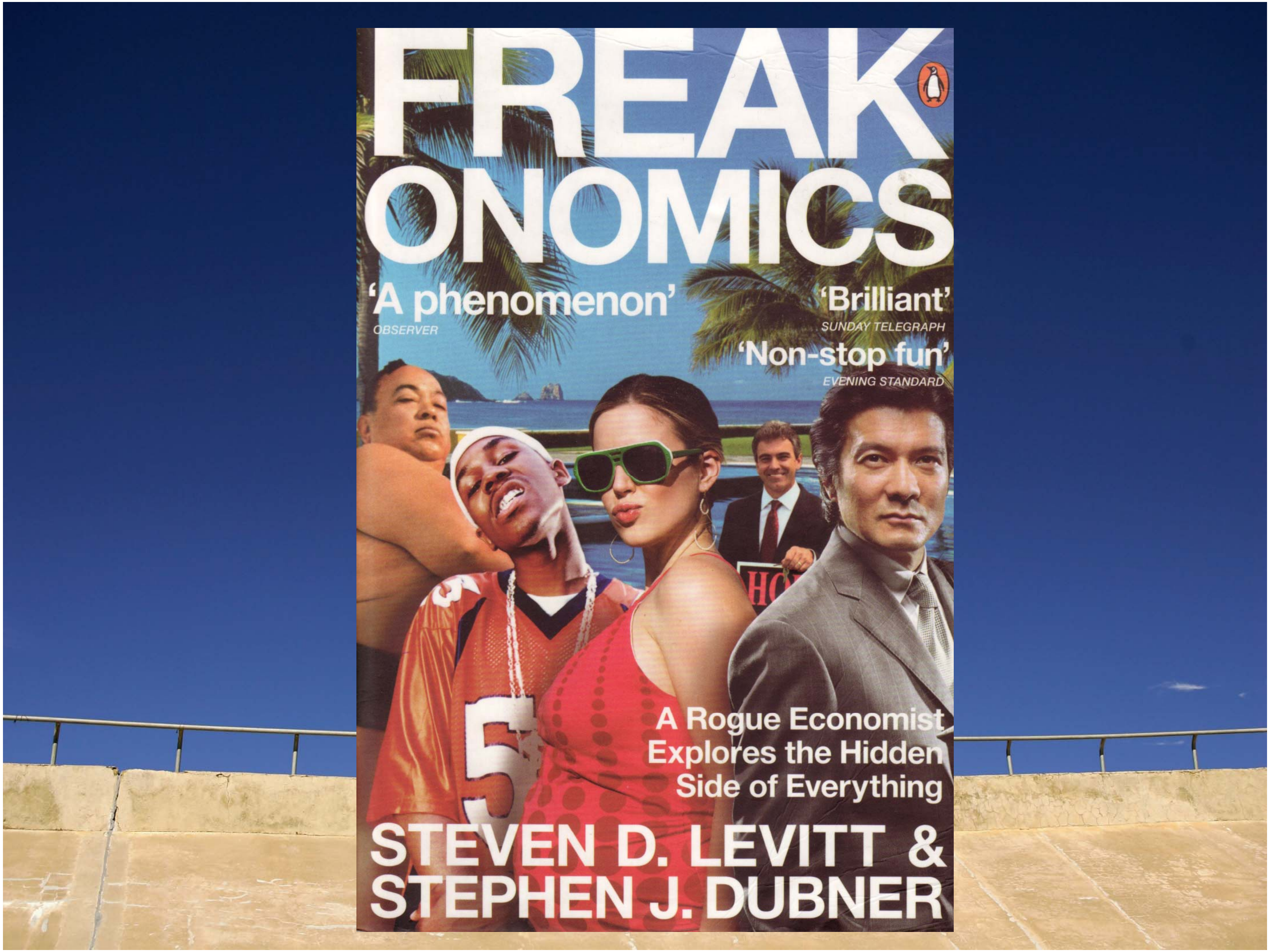
Todays outline

- First principal analysis of performance
- Relevant to Athlete and Coach
- Foundation of performance planning

Assumptions

- You are the experts and there is no magic bullet
- You will engage in order to advance your understanding because you want to grow as a coach
- You will let go of your sports conventional wisdom for 1 hour (i.e. throw out the rule book)

- I aim to be a little controversial today in order get you thinking about your sports performance requirements


FREAK
ONOMICS
'A phenomenon'
OBSERVER
'Brilliant'
SUNDAY TELEGRAPH
'Non-stop fun'
EVENING STANDARD
A Rogue Economist
Explores the Hidden
Side of Everything
STEVEN D. LEVITT &
STEPHEN J. DUBNER

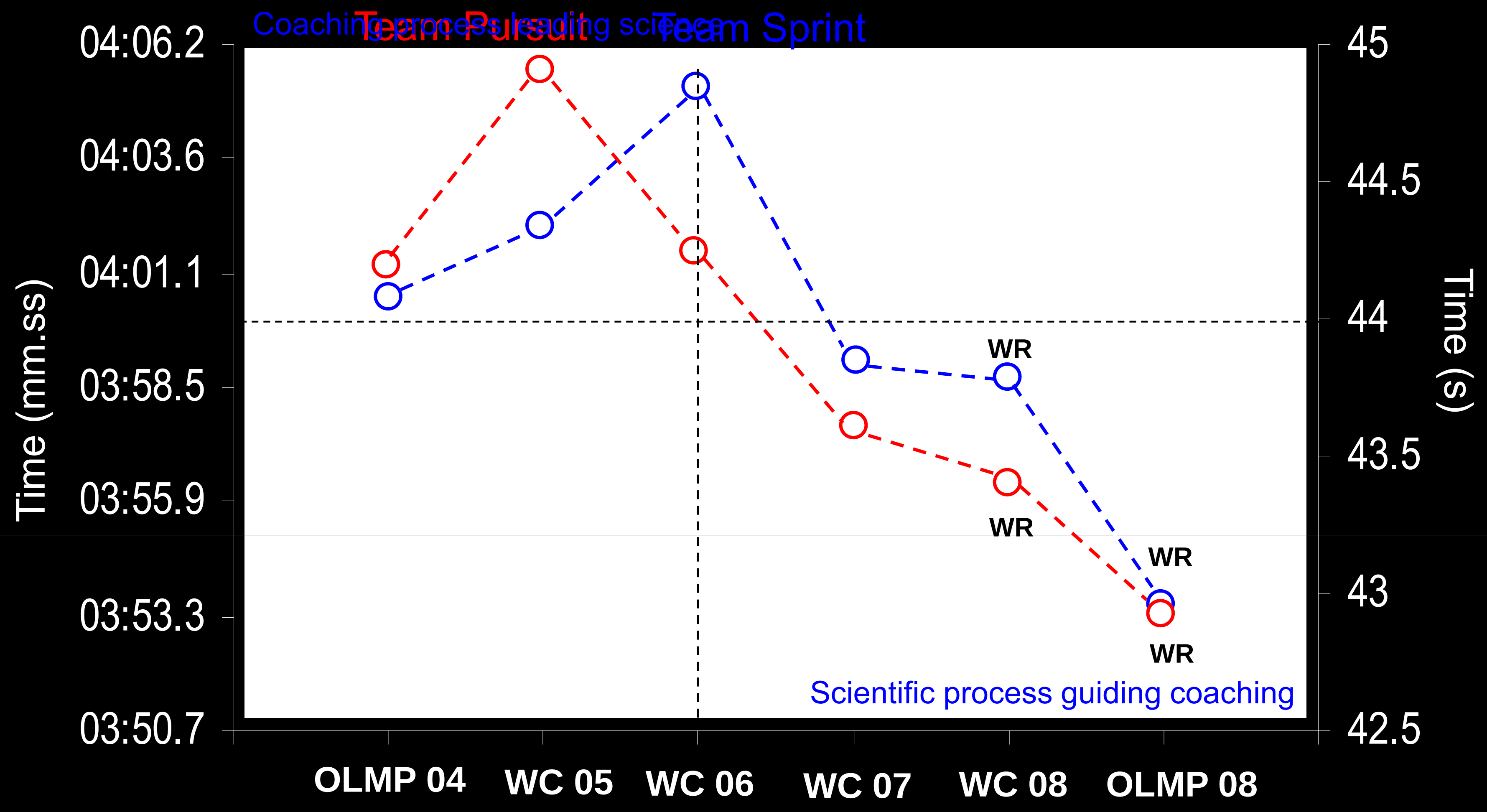
So the conventional wisdom in Galbraith's view must be simple, convenient, comfortable, and comforting—though not necessarily true. It would be silly to argue that the conventional wisdom is *never* true. But noticing where the conventional wisdom may be false—noticing, perhaps, the contrails of sloppy or self-interested thinking—is a nice place to start asking questions.

do a thing for your health. Conventional wisdom is often shoddily formed and devilishly difficult to see through, but it can be done.

Knowing what to measure and how to measure it makes a complicated world much less so. If you learn to look at data in the right way, you can explain riddles that otherwise might have seemed impossible. Because there is nothing like the sheer power of numbers to scrub away layers of confusion and contradiction.

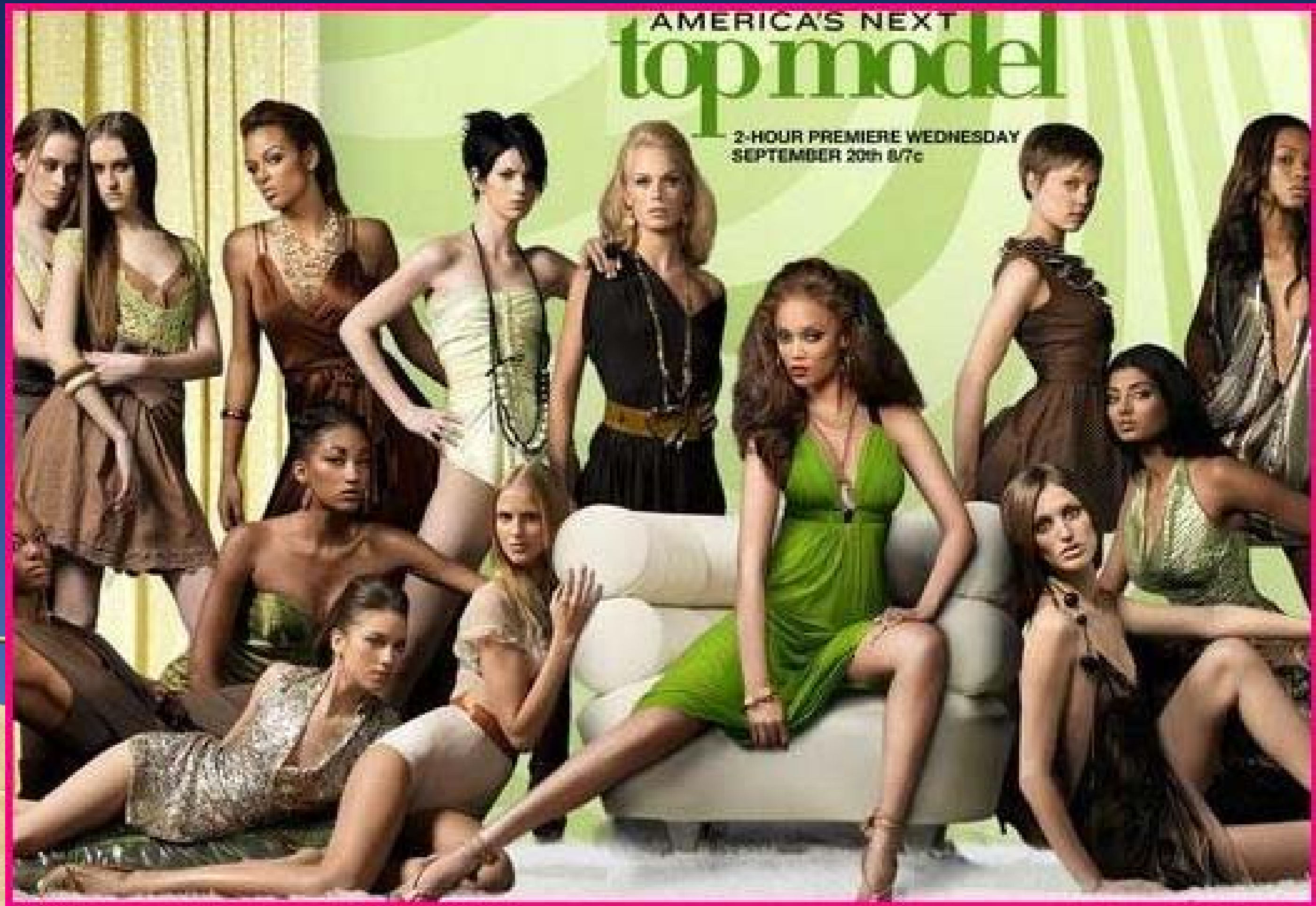
Evolution or Revolution?

Team Pursuit and Team Sprint



Dr M Parker British Cycling

Models mean different things to different people!



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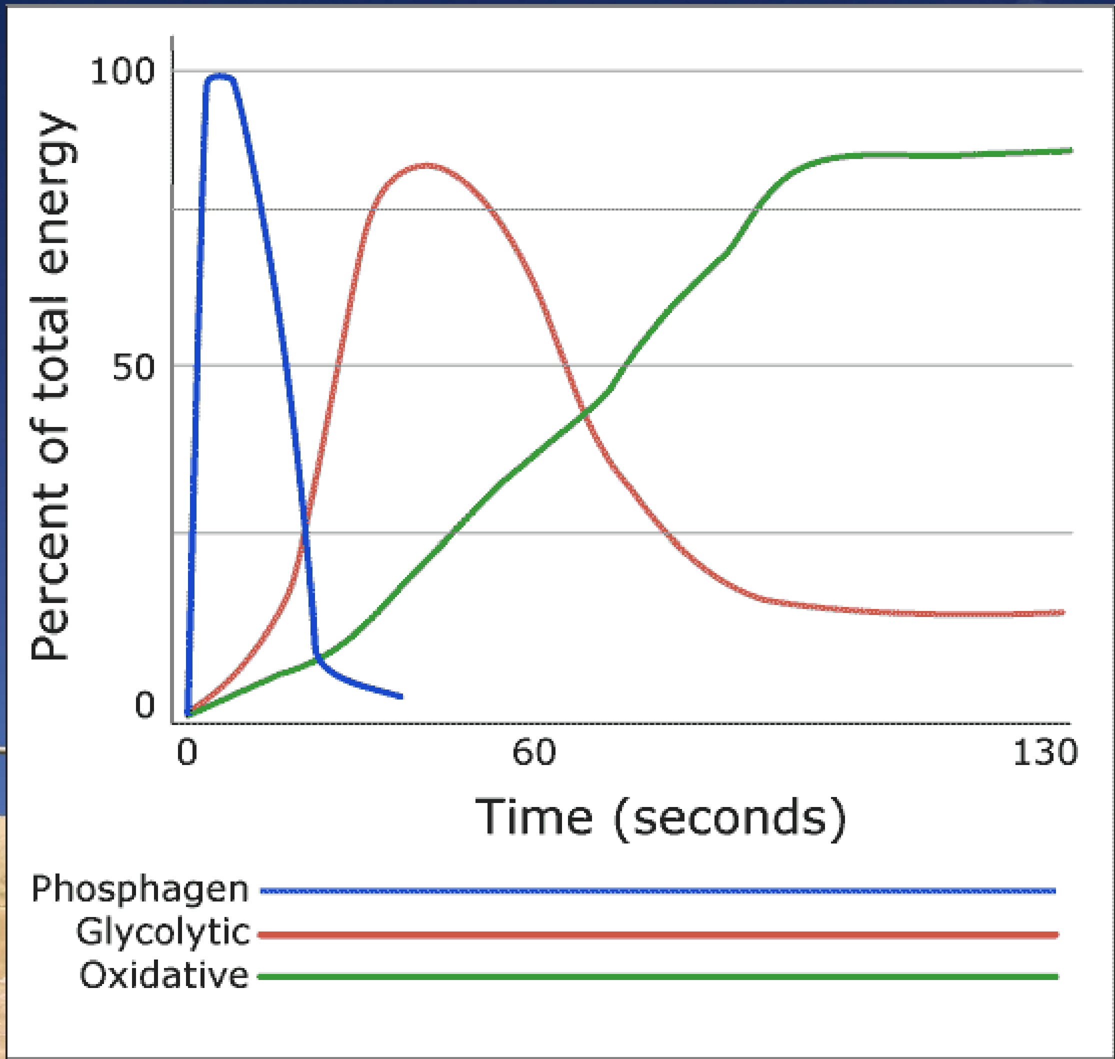
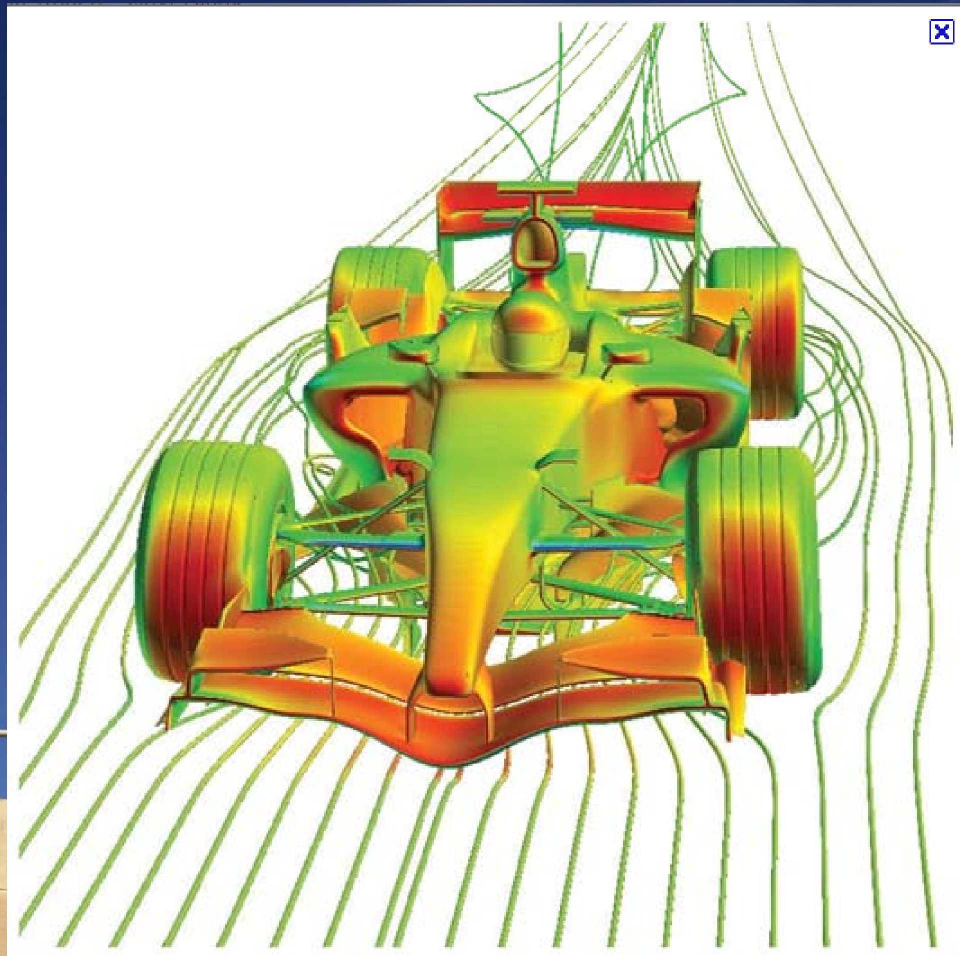
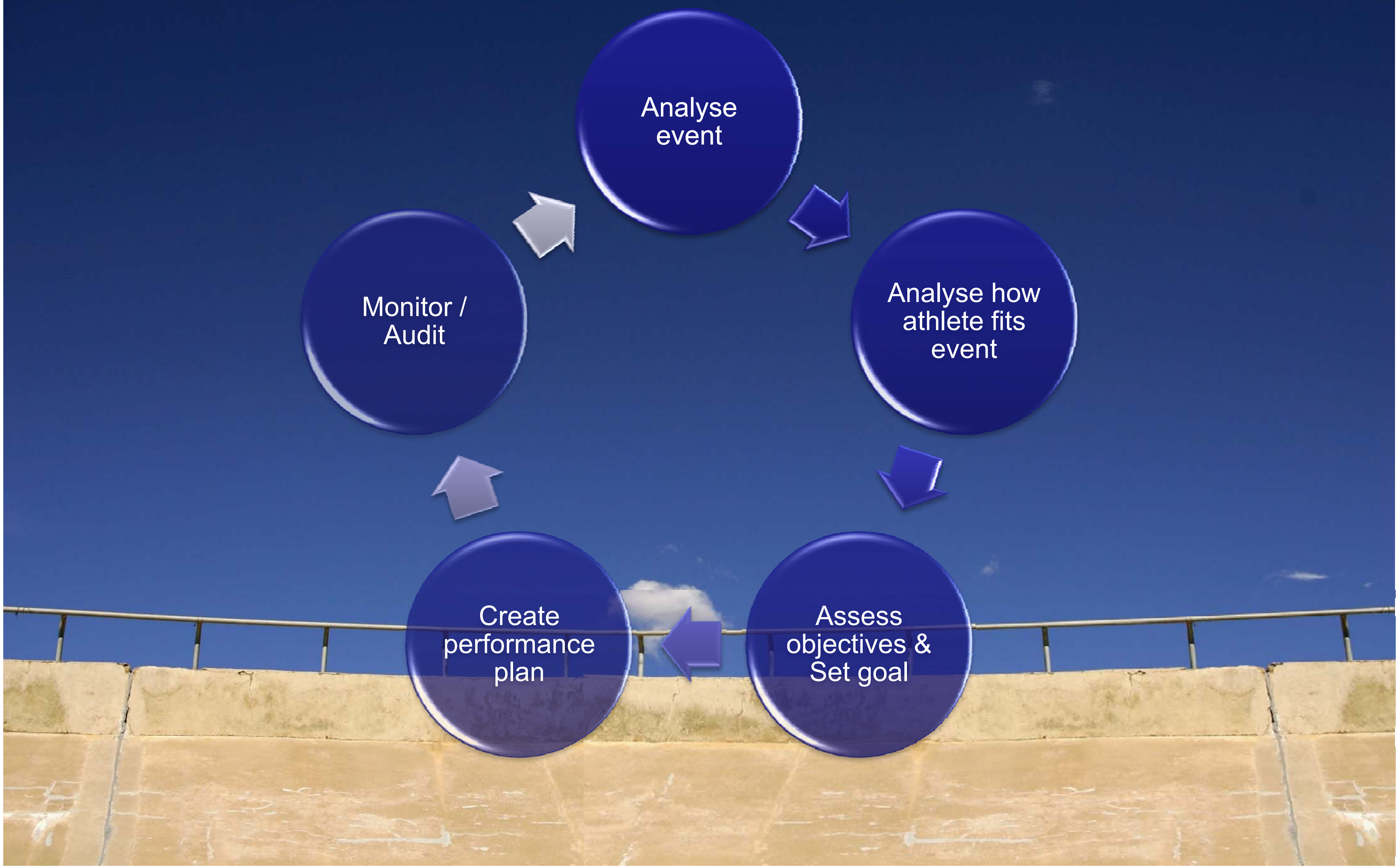


Models mean different things to different people!



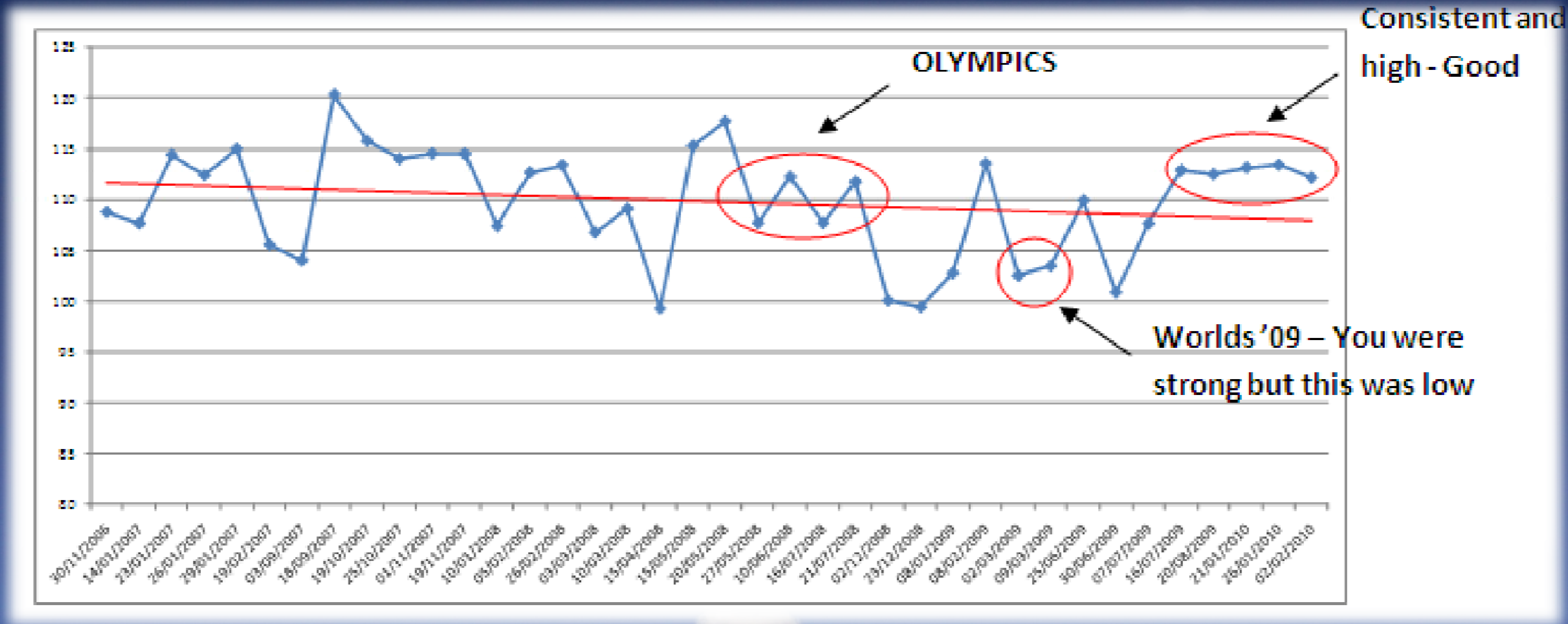
Model of Performance Support



Profile of a World Champion

Mass (kg):	98
Height (cm):	184
Sum 7 SF (mm):	36
Lab Peak Power (W):	2250 (1s)
Field Peak Power (W):	2490 (1s)
Vertical Jump (cm):	~55
VO_2 Peak ($L.min^{-1}$):	5.1
VO_2 Peak ($ml.kg^{-1}.min^{-1}$):	52
HR_{Max} (bpm):	184
Aerobic PPO (W):	370
MOD D_{MAX} (W):	280

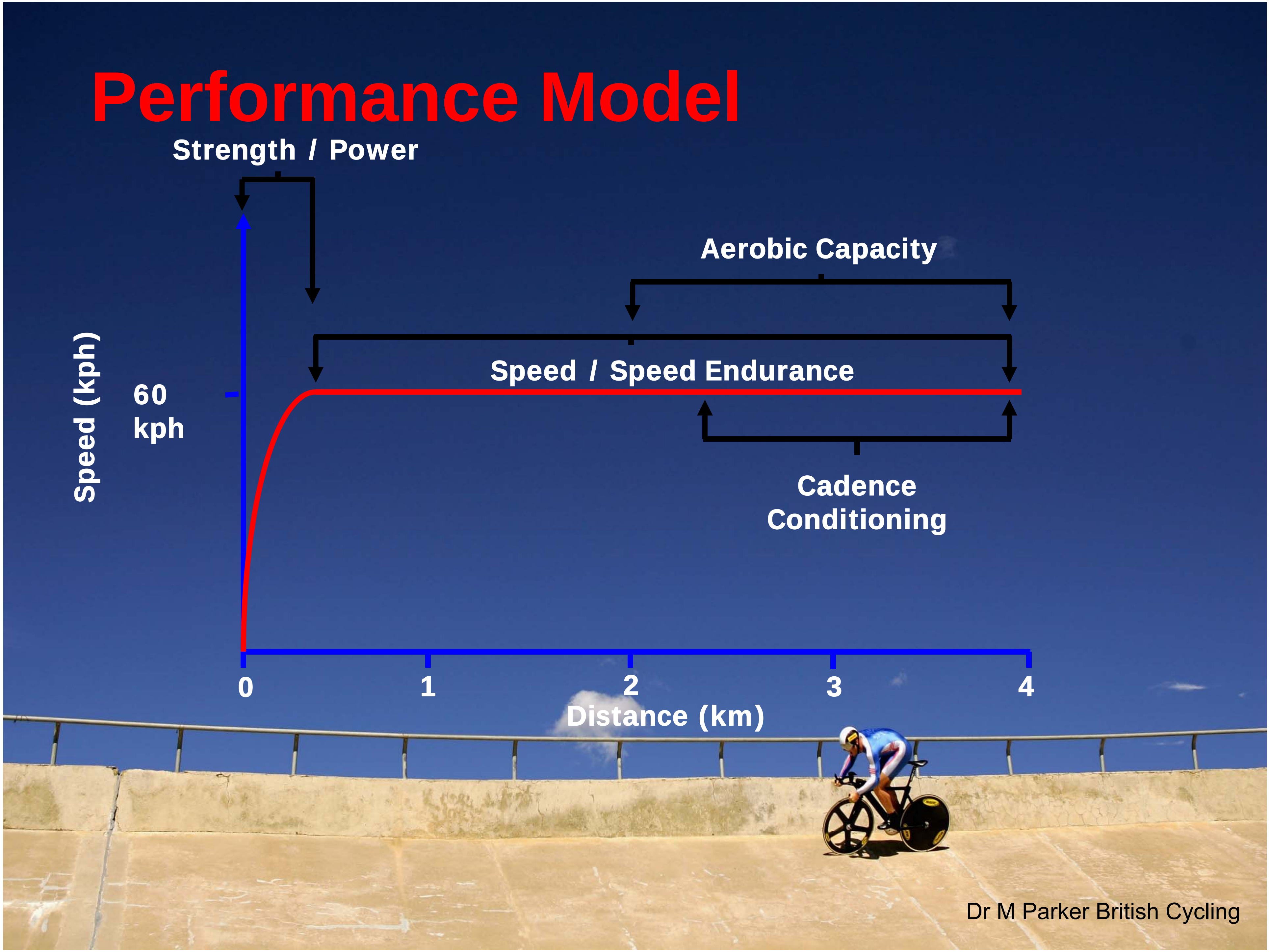
Training Monitoring



Race Power Profiles

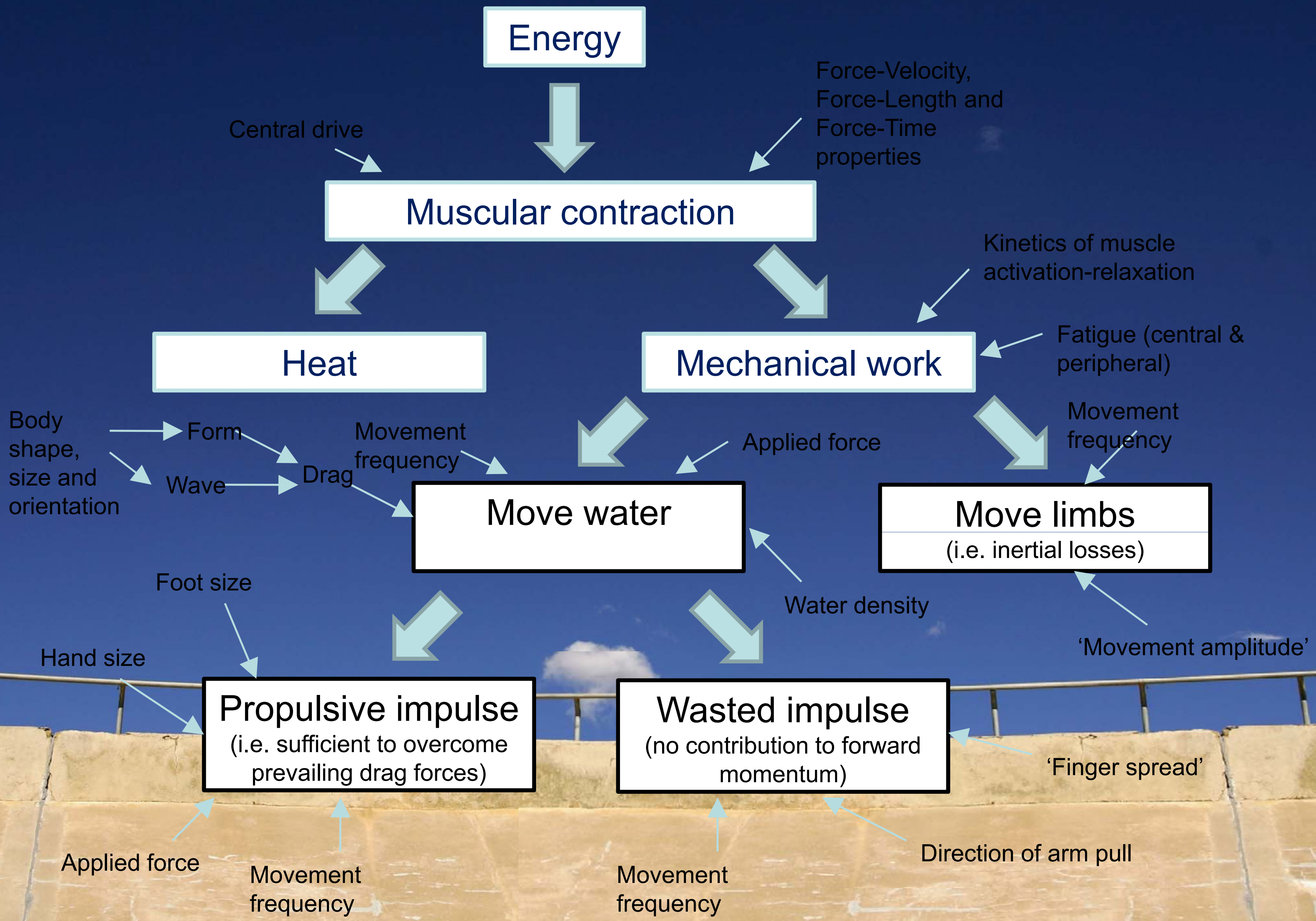
	International (n=18 races)	Domestic (n= 18 races)	DIFF	% DIFF
Avg Power (W)	559.3 ± 113.9	505 ± 76.3	-53.7	10.1
Avg Power ($W.kg^{-1}$)	6.4 ± 1.2	5.8 ± 0.9	-0.6	-9.7
Peak Power (W)	1898.9 ± 245.1	1968.8 ± 239.1	69.9	3.6
Peak Power ($W.kg^{-1}$)	21.7 ± 1.4	22.6 ± 2.0	0.9	4.1
Cadence @ Peak Power (rpm)	126.6 ± 9.9	133.4 ± 8.4	6.8	5.3
Peak Cadence (rpm)	160.3 ± 3.1	160.9 ± 3.8	0.6	0.4
MMP (5s) (W)	1668.3 ± 265.7	1696 ± 214.0	28.4	1.7
MMP (10s) (W)	1524 ± 226.4	1534.3 ± 193.1	10.4	0.7
MMP (15s) (W)	1438.5 ± 178.0	1459.6 ± 159.8	21.1	1.5

Model of Performance Support



Performance Model
Strength / Power
Aerobic Capacity
Speed / Speed Endurance
Cadence
Conditioning
Speed (kph)
60
kph
0
1
2
3
4
Distance (km)
Dr M Parker British Cycling

Considerations in Aquatic Propulsion



Knowns & Unknowns

Get out of the bubble and prioritise!!

Rider 1
- Reaction Time
- Acceleration
  - Power – Lower Cad
- Speed
  - Power – High Cad
    - Power Profile
  - Low C_dA
- Shortest Distance
  - esp. 1st Corner
- Delivery Speed
- Change-over position

Rider 2
- Effective drafting
- Speed
  - Power Profile
  - Power – High Cad
  - Low C_dA
- Shortest Distance
- Delivery Speed

Rider 3
- Effective drafting
- Speed
  - Power – High Cad
  - Power Profile
  - Low CdA
  - Speed Maint
- Shortest Distance
- Lunge for line?

Track and environmental conditions
- Same for everyone at event

A. Wylie ,Frazer-Nash Consultency

Aggregation of Marginal Gains

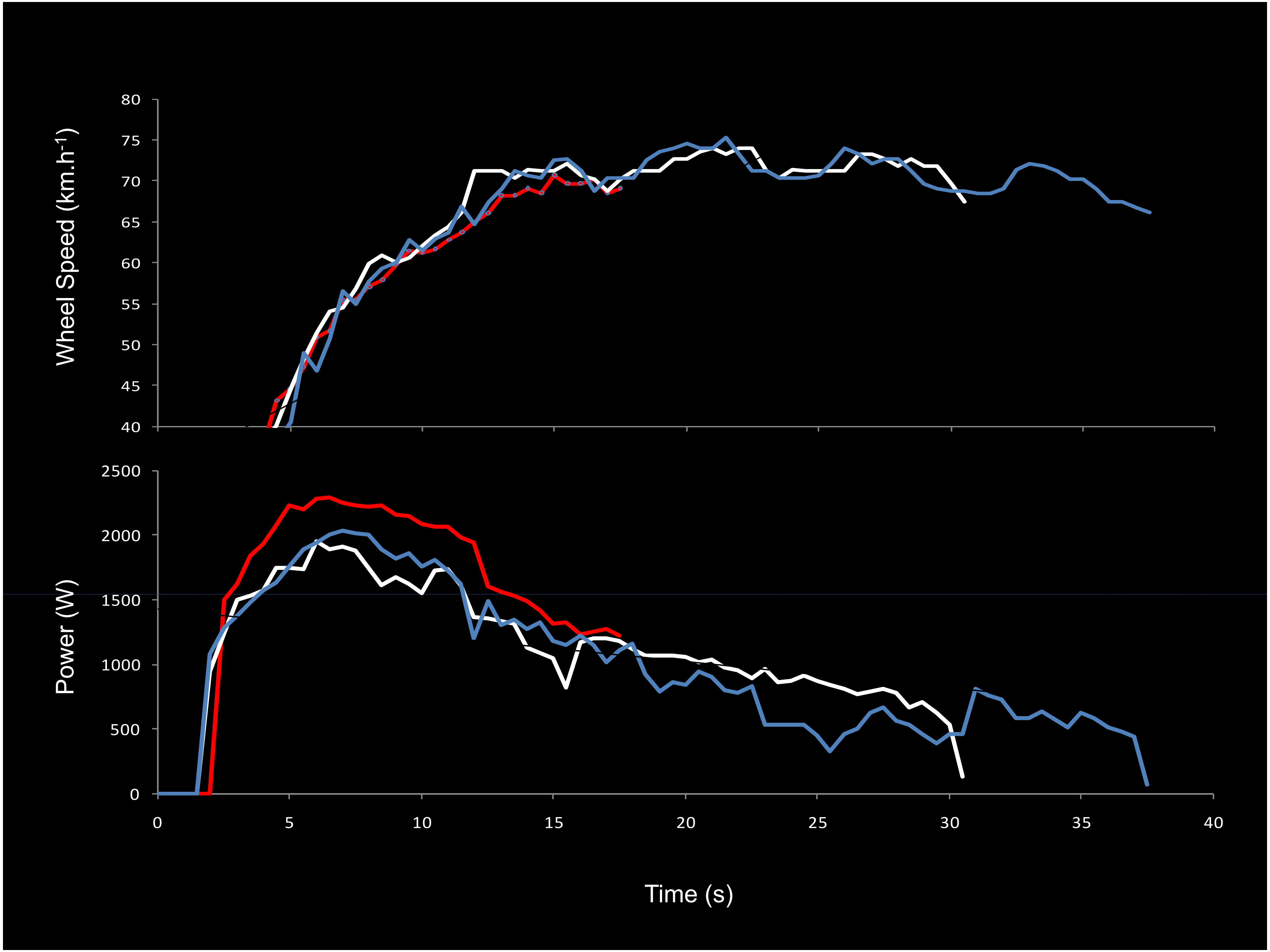
- Single big gains in elite sport are in frequent.

- Small gains in many areas – big gains in performance

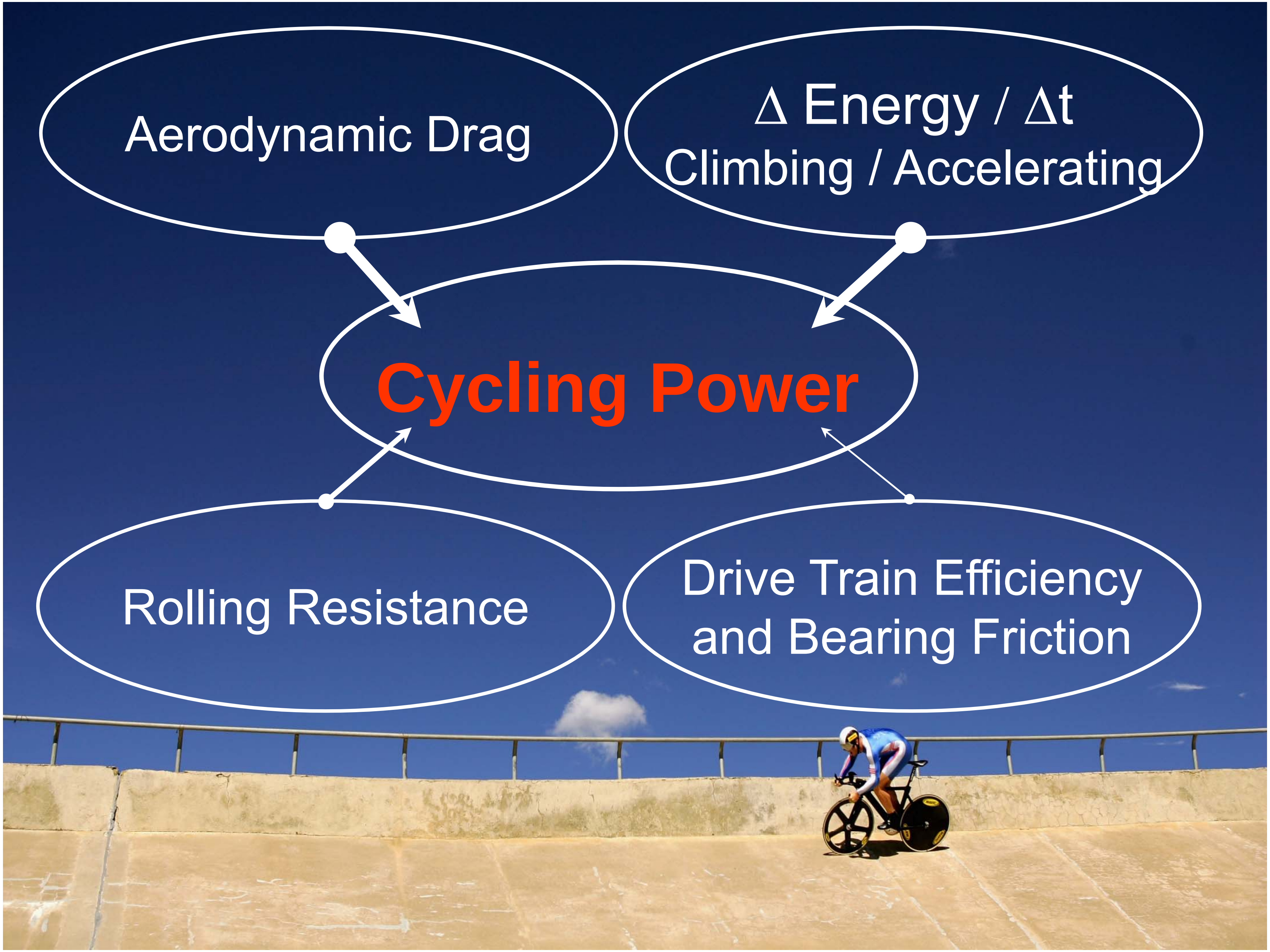
Model of Performance Support

Cycling Speed Power Models

- di Prampero et al., 1979 JAP
  - Towing to determine drag
- Davies 1980 EJAP
  - VO_2 in a wind tunnel
- Olds et al., 1993 JAP
  - Frontal area based on body surface area
- Olds et al., 1995 JAP
- Martin et al., 1998 JAB
- Martin et al., 2006 MSSE
  - Non steady state power



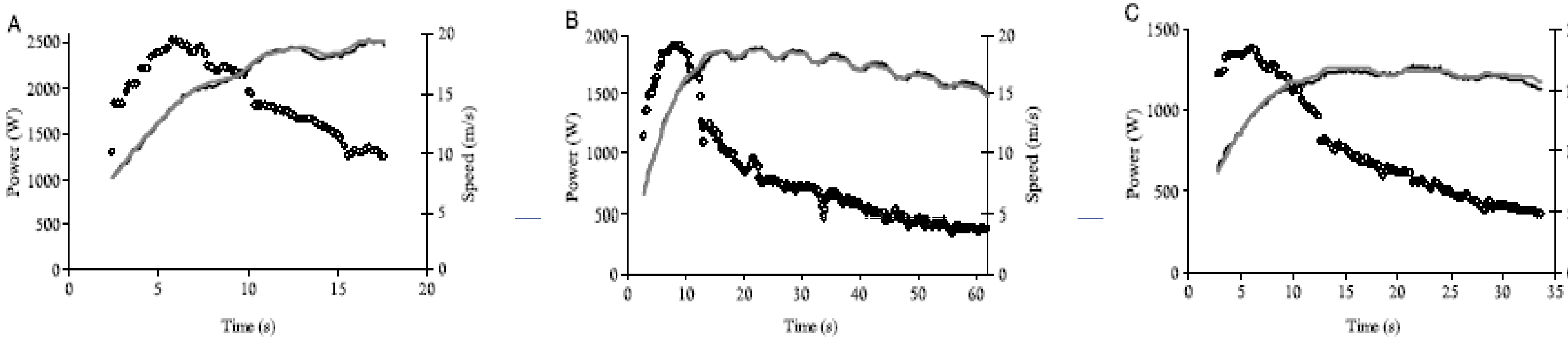
Wheel Speed (km.h-1)
80
75
70
65
60
55
50
45
40
Power (W)
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
35
40
Time (s)


Aerodynamic Drag
∆ Energy / ∆t
Climbing / Accelerating
Cycling Power
Rolling Resistance
Drive Train Efficiency
and Bearing Friction

Modeling Sprint Cycling Using Field-Derived Parameters and Forward Integration

JAMES C. MARTIN[1], A. SCOTT GARDNER[2,3], MARTIN BARRAS[2], and DAVID T. MARTIN[2]

[1]The University of Utah, Department of Exercise and Sport Science, Salt Lake City, UT; [2]Australian Institute of Sport, Canberra, Australian Capital Territory, AUSTRALIA; and [3]Queensland Academy of Sport, Brisbane, Queensland, AUSTRALIA



MARTIN, J. C., A. S. GARDNER, M. BARRAS, and D. T. MARTIN. Modeling Sprint Cycling Using Field-Derived Parameters and Forward Integration. *Med. Sci. Sports Exerc.*,Vol. 38, No. 3, pp. 592–597, 2006.

TABLE 3. Modeled scenarios.

Predicted Time Changes (s)	Reduced Mass	Reduced Drag	Reduced Mass and Drag	Reduced Mass and Power
Subject 1 250 m	−0.061	−0.030	−0.091	+0.031
Subject 2 1000 m	−0.140	−0.314	−0.456	+0.320
Subject 3 500 m	−0.093	−0.120	−0.214	+0.123

Predicted time changes (s) for each time trial for four scenarios: 2% decrease in mass, 2% decrease in aerodynamic drag, 2% reduction in both drag and mass, and 2% reductions in both mass and power. For each subject, the time changes are specific to her or his competition distance. A negative sign indicates reduction in performance time (improved performance), and a positive sign indicates increased performance time (decreased performance).

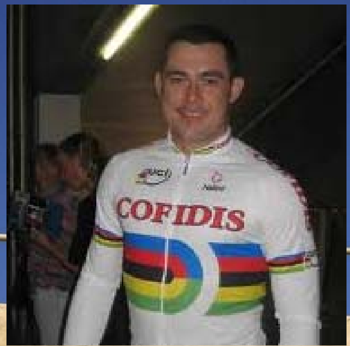
Coach Question?

What is the power required to ride a world record in the Team Sprint?

World Record

17.21
(0-68 kph)
Gregory Bauge
1st Lap – Worlds ‘08 Qualifying

12.72
(70.8 kph)
Kévin Sireau
2nd Lap – Worlds ‘08 Qualifying



13.34
(67.5 kph)
Arnaud Tournant
3rd Lap – Worlds ‘08 Qualifying

43.271

Power requirement for WR

Distance m	Cum s	Split s	Ave Speed $Km.hr^{-1}$	Power Achieved W	Power Required W	Delta W
62.5	6.82		33.0			
125.0	10.62	3.80	59.2			
187.5	14.00	3.38	66.6			
250.0	17.28	3.28	68.6			

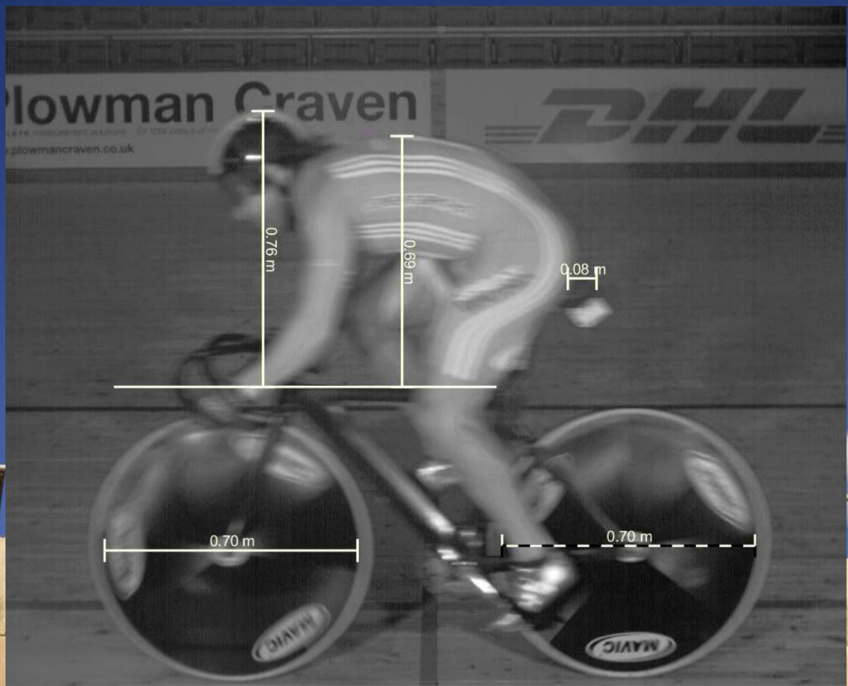
Power requirement for WR

Measured average speed, environmental conditions and inertial load
Assumed acceleration/deceleration ($\Delta s.t^{-1}$)

Distance m	Cum s	Split s	Ave Speed $Km.hr^{-1}$	Power Achieved W	Power Required W	Delta W
62.5	6.82		33.0			
125.0	10.62	3.80	59.2			
187.5	14.00	3.38	66.6			
250.0	17.28	3.28	68.6			

Speed Power Trials

- Established individual CdA using 6 speeds
  - 25,35,45,55,65,70 $km.hr^{-1}$ (6.9-19.4 $m.s^{-1}$)
  - n = 6 riders x 6 trials



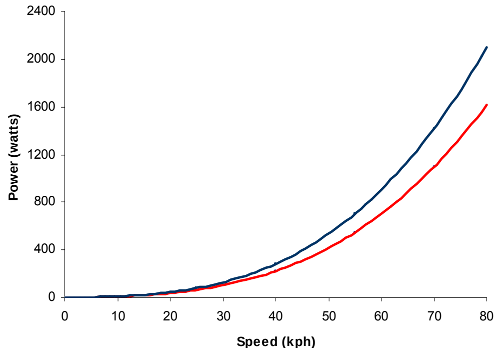
Individual Rider CdA

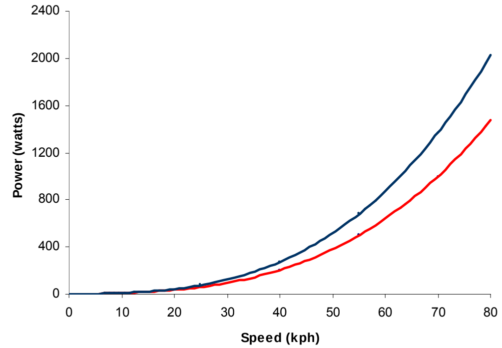
Larger 92.0 ± 3.3 kg
0.237 ± 0.008 m^2

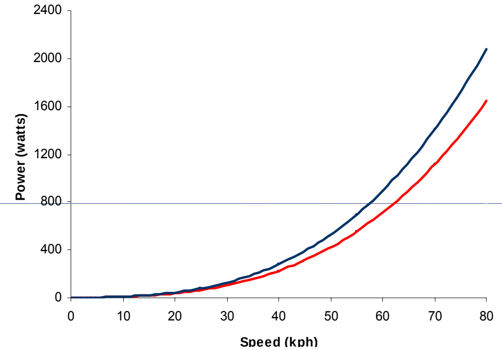
Smaller 80.7 ± 8.1 kg
0.220 ± 0.005 m^2

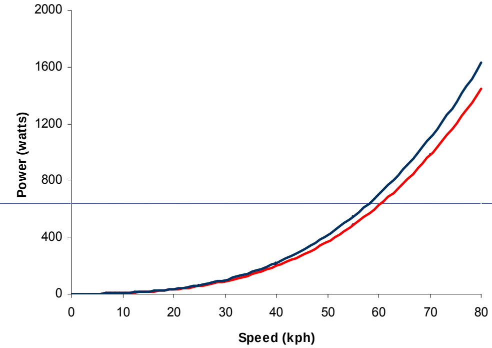
----- Seated

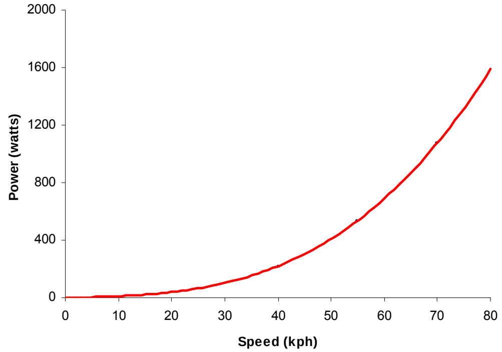
----- Standing

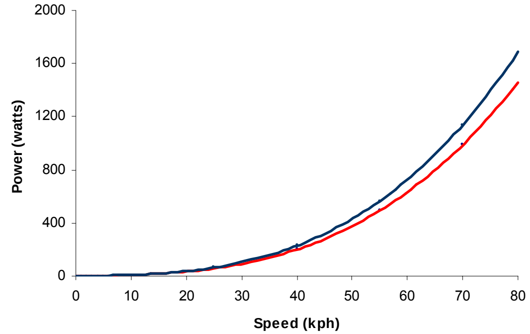












Power requirement for WR

Distance m	Cum s	Split s	Ave Speed Km.hr^{-1}	Power Achieved W	Power Required W	Delta W
62.5	6.82		33.0	1414		
125.0	10.62	3.80	59.2	1994		
187.5	14.00	3.38	66.6	1420		
250.0	17.28	3.28	68.6	1221		

Power requirement for WR

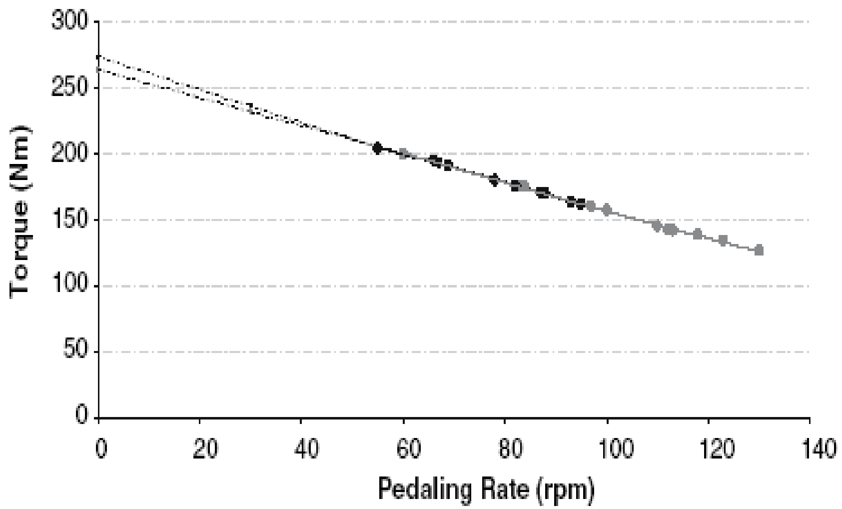
Distance m	Cum s	Split s	Ave Speed Km.hr^{-1}	Power Achieved W	Power Required W	Delta W
62.5	6.82		33.0	1414	1424	-10
125.0	10.62	3.80	59.2	1994	1984	10
187.5	14.00	3.38	66.6	1420	1444	-24
250.0	17.28	3.28	68.6	1221	1263	-42

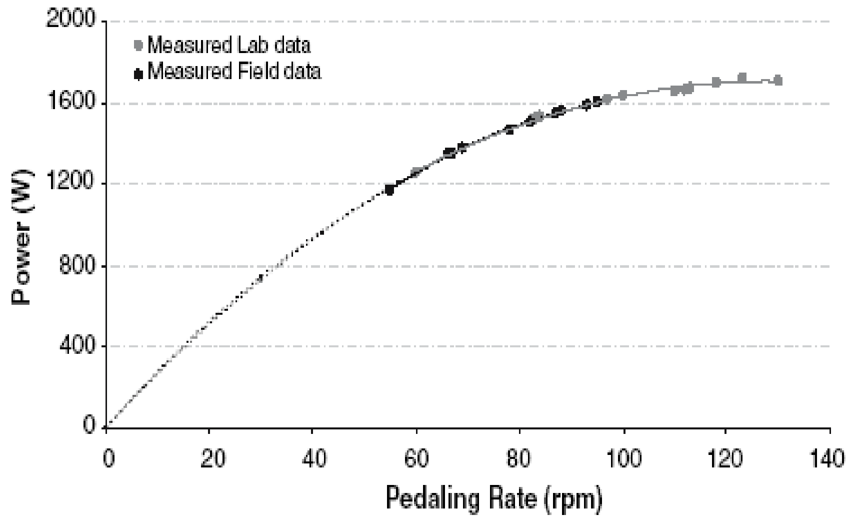
Eur J Appl Physiol
DOI 10.1007/s00421-007-0498-4

ORIGINAL ARTICLE

Maximal torque- and power-pedaling rate relationships for elite sprint cyclists in laboratory and field tests

A. Scott Gardner · James C. Martin · David T. Martin · Martin Barras · David G. Jenkins

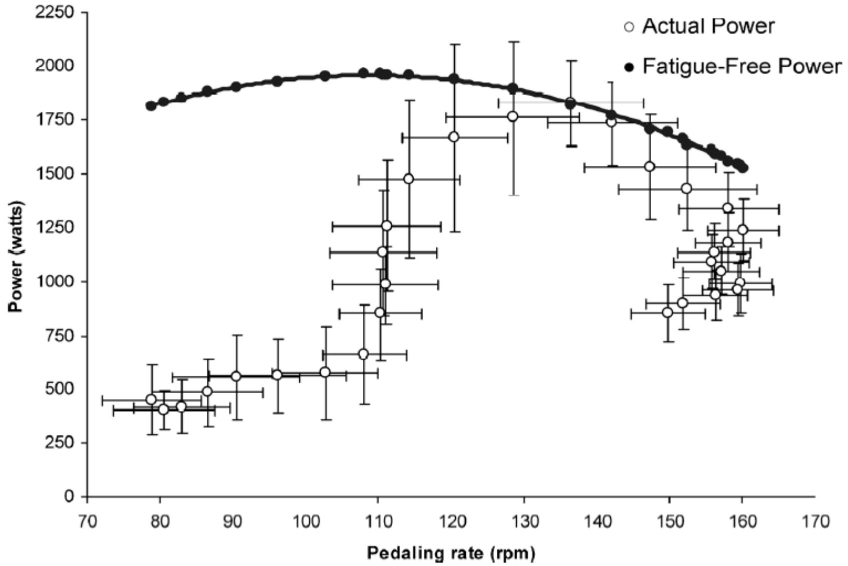


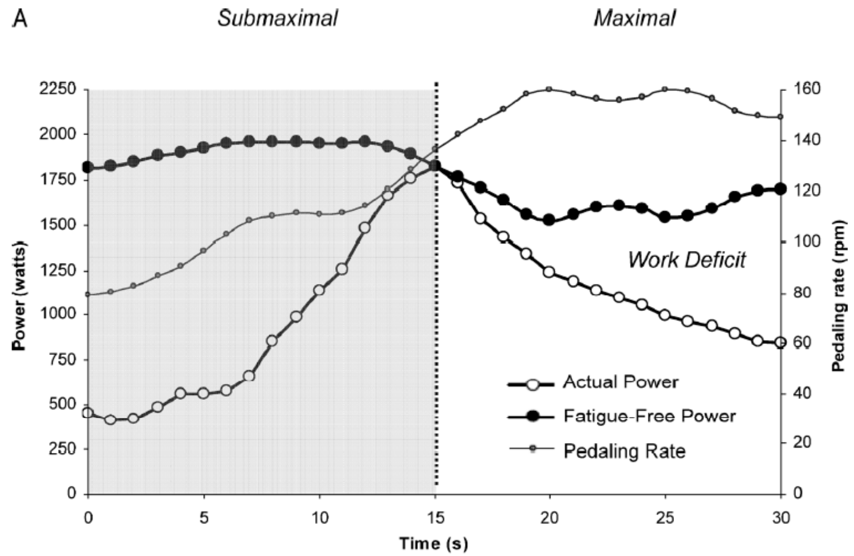


Velocity-Specific Fatigue: Quantifying Fatigue during Variable Velocity Cycling

A. SCOTT GARDNER[1], DAVID T. MARTIN[2], DAVID G. JENKINS[3], IAIN DYER[4], JAN VAN EIDEN[4], MARTIN BARRAS[5], and JAMES C. MARTIN[6]

[1]Department of Physiology, English Institute of Sport, Manchester, UNITED KINGDOM; [2]Department of Physiology, Australian Institute of Sport, Bruce, AUSTRALIA; [3]School of Human Movement Studies, The University of Queensland, Brisbane, AUSTRALIA; [4]High Performance Unit, Great Britain Cycling, UNITED KINGDOM; [5]Cycling Program, Australian Institute of Sport, Bruce, AUSTRALIA; and [6]Department of Exercise and Sport Science, The University of Utah, Salt Lake City, UT





GARDNER, A. S., D. T. MARTIN, D. G. JENKINS, I. DYER, J. VAN EIDEN, M. BARRAS, and J. C. MARTIN. Velocity-Specific Fatigue: Quantifying Fatigue during Variable Velocity Cycling. *Med. Sci. Sports Exerc.*, Vol. 41, No. 4, pp. 904–911, 2009.

International Journal of Sports Physiology and Performance, 2007;2:5-21

Understanding Sprint-Cycling Performance: The Integration of Muscle Power, Resistance, and Modeling

James C. Martin, Christopher J. Davidson, and Eric R. Pardyjak

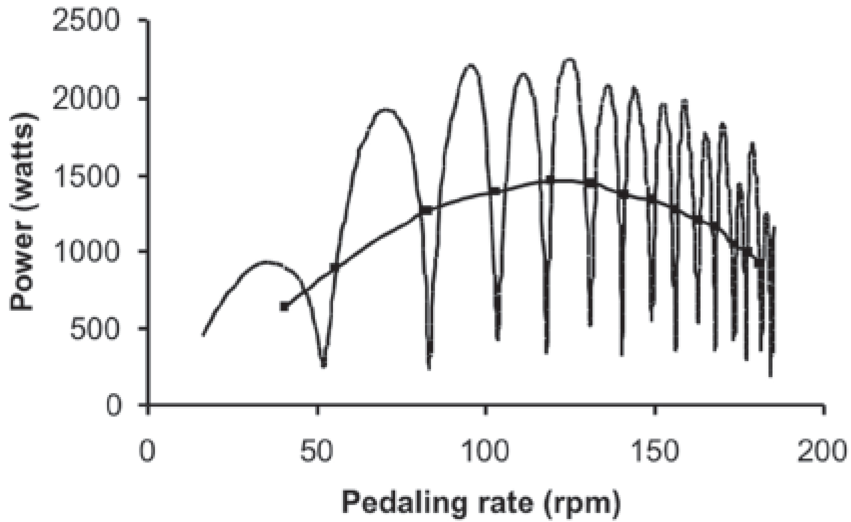


Figure 1 — Power–pedaling rate relationship. Data from a representative subject performing an inertial-load power test show instantaneous power (P_I —) and power averaged over each complete revolution of the pedal cranks (P_{REV} –ν–) in relation to pedaling rate (rpm). The pedaling rate at which subjects reach a maximum value for P_{REV} is defined as optimal pedaling rate. Note that P_I varies within each pedal revolution and reaches values up to 85% greater than P_{REV}.

Coach Question?

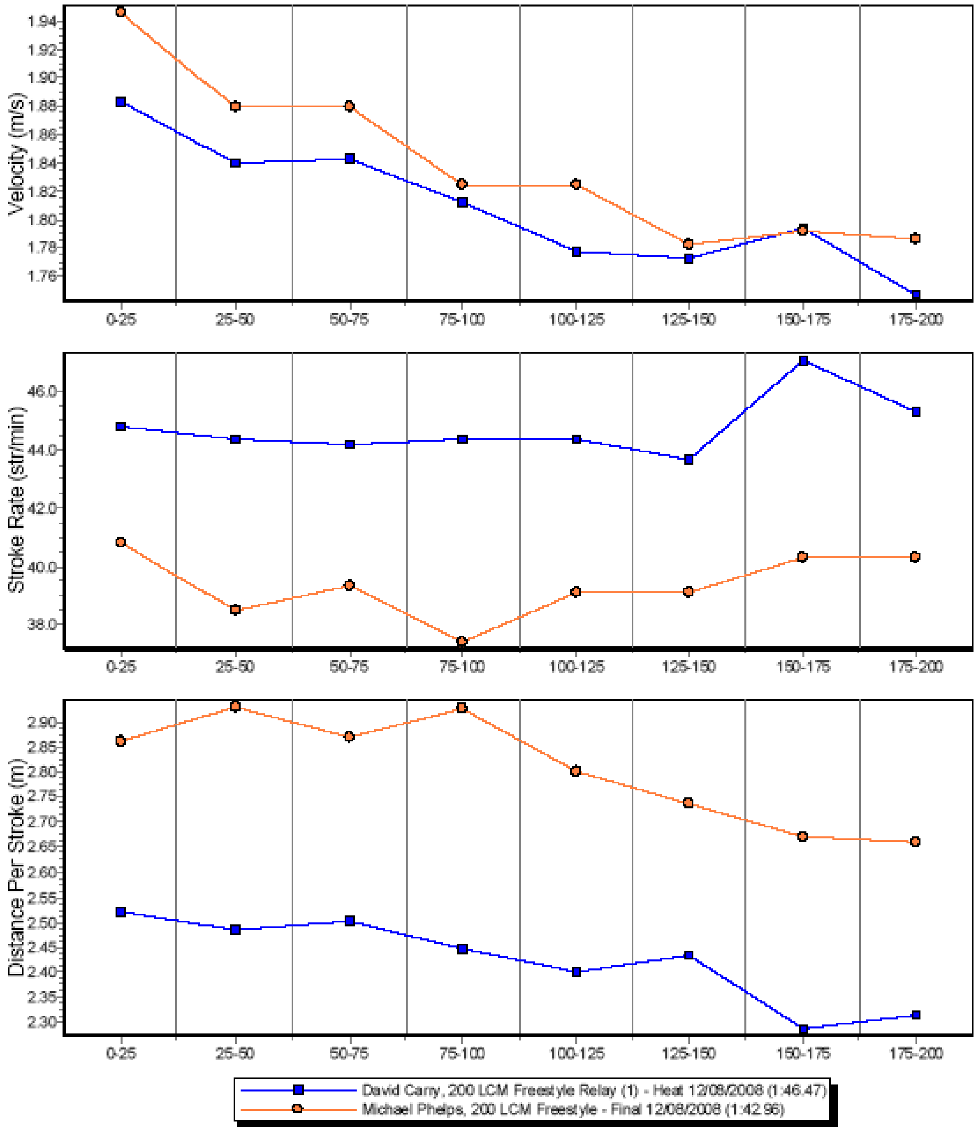
How can David Carry be a contender in the 200m Freestyle?

SwIMS Race Analysis
Comparison Report
Page 1

David Carry

200 LCM Freestyle Relay (1) - Heat

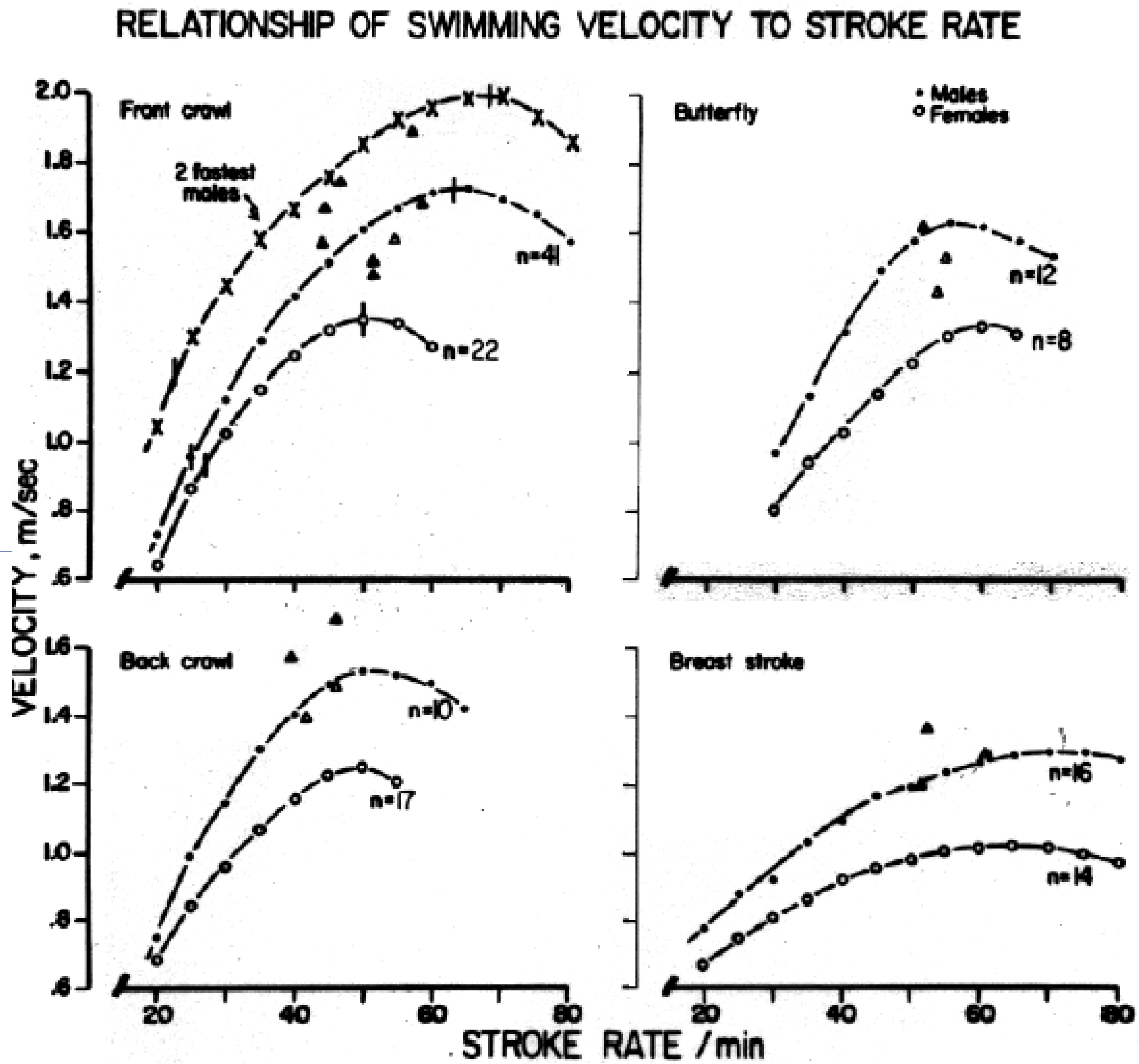
Olympic Games
Beijing
12/08/2008



MEDICINE AND SCIENCE IN SPORTS
Vol. 11, No. 3, pp. 278-283, 1979

Relationships of stroke rate, distance per stroke, and velocity in competitive swimming

ALBERT B. CRAIG, JR. and DAVID R. PENDERGAST



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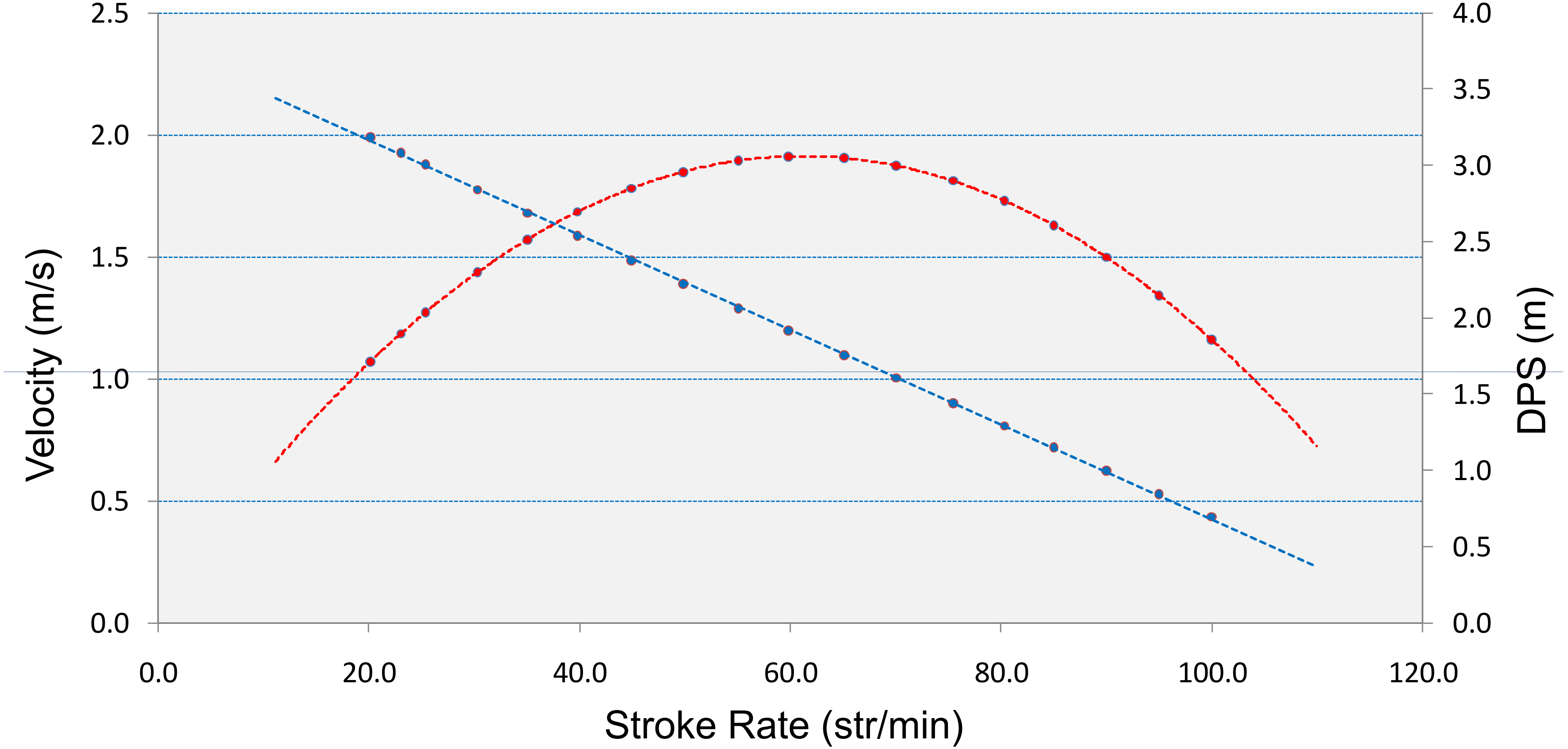
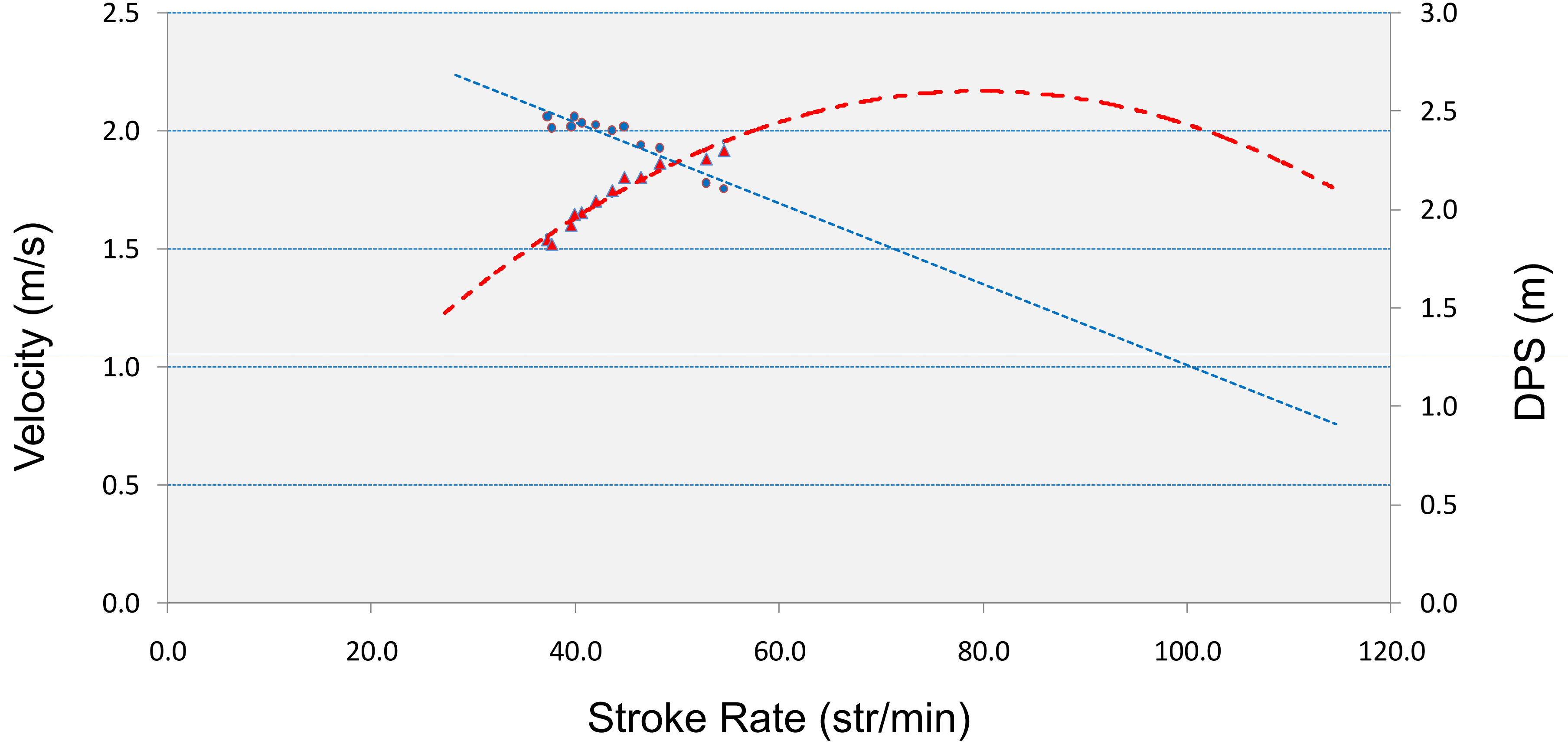


Stroke Efficiency
David Carry



200m Race Analysis Model

Input Measured Swim 1.46.47 s — Swimmers Height 2.00 m

Segment	Velocity (m/s)	SR (str/min)	DPS (m)	15m (s)	Turn (s)	Finish (s)	Split (s)	Cum (s)	50m (s)	100m (s)
0-25	1.88	44.8	2.52	6.29			11.60			
25-50	1.84	44.4	2.49		2.89		13.74	25.35	25.35	
50-75	1.84	44.2	2.50		4.53		12.67	38.02		
75-100	1.81	44.4	2.45		2.99		14.02	52.05	26.70	52.05
100-125	1.78	44.4	2.40		4.57		13.02	65.06		
125-150	1.77	43.7	2.43		3.04		14.34	79.40	27.36	
150-175	1.80	47.1	2.29		4.73		13.07	92.48		
175-200	1.74	45.3	2.31			2.54	14.01	106.48	27.08	54.44
	1.81	44.79	2.42		22.75				1 : 46.48	

200m Race Analysis Model

Stockport

Input Measured Swim		1.46.47	s	Swimmers Height		2.00	m			
Segment	Velocity	SR	DPS	15m	Turn	Finish	Split	Cum	50m	100m
	m/s	str/min	m	s	s	s	s	s	s	s
0-25	1.88	44.8	2.52	6.29			11.60			
25-50	1.84	44.4	2.49		2.89		13.74	25.35	25.35	
50-75	1.84	44.2	2.50		4.53		12.67	38.02		
75-100	1.81	44.4	2.45		2.99		14.02	52.05	26.70	52.05
100-125	1.78	44.4	2.40		4.57		13.02	65.06		
125-150	1.77	43.7	2.43		3.04		14.34	79.40	27.36	
150-175	1.80	47.1	2.29		4.73		13.07	92.48		
175-200	1.74	45.3	2.31			2.54	14.01	106.48	27.08	54.44
	1.81	44.79	2.42		22.75				1 : 46.48	

Improve 15m time	0.00 %		Change DPS 1st 50	0.00 %		Change SR 1st 50	0.00 %
Improve rel speed into turn	0.00 %		Change DPS 2nd 50	0.00 %		Change SR 2nd 50	0.00 %
Improve turn push off	0.00 %		Change DPS 3rd 50	0.00 %		Change SR 3rd 50	0.00 %
Improve rel finish speed	0.00 %		Change DPS 4th 50	0.00 %		Change SR 4th 50	0.00 %

200m Race Analysis Model

Stockport

Input Measured Swim 1.46.47 s — Swimmers Height 2.00 m

Segment	Velocity	SR	DPS	15m	Turn	Finish	Split	Cum	50m	100m
	m/s	str/min	m	s	s	s	s	s	s	s
0-25	1.88	44.8	2.52	6.29			11.60			
25-50	1.84	44.4	2.49		2.89		13.74	25.35	25.35	
50-75	1.84	44.2	2.50		4.53		12.67	38.02		
75-100	1.81	44.4	2.45		2.99		14.02	52.05	26.70	52.05
100-125	1.78	44.4	2.40		4.57		13.02	65.06		
125-150	1.77	43.7	2.43		3.04		14.34	79.40	27.36	
150-175	1.80	47.1	2.29		4.73		13.07	92.48		
175-200	1.74	45.3	2.31			2.54	14.01	106.48	27.08	54.44
	1.81	44.79	2.42		22.75				1 : 46.48	

Improve 15m time	0.00	%	Change DPS 1st 50	0.00	%	Change SR 1st 50	0.00	%
Improve rel speed into turn	0.00	%	Change DPS 2nd 50	0.00	%	Change SR 2nd 50	0.00	%
Improve turn push off	0.00	%	Change DPS 3rd 50	0.00	%	Change SR 3rd 50	0.00	%
Improve rel finish speed	0.00	%	Change DPS 4th 50	0.00	%	Change SR 4th 50	0.00	%

OUTCOME

Segment	Velocity			SR	DPS	15m	Turn	Finish	Split	Cum	lap	
	m/s			str/min	m	s	s	s	s	s	s	
0-25	1.88	0.00	%	44.8	2.52	6.3			11.60			
25-50	1.84	0.00	%	44.4	2.49		2.89		13.74	131.83	25.35	
50-75	1.84	0.00	%	44.2	2.50		4.53		12.67	144.51		
75-100	1.81	0.00	%	44.4	2.45		2.99		14.02	158.53	26.70	52.05
100-125	1.78	0.00	%	44.4	2.40		4.57		13.02	171.54		
125-150	1.77	0.00	%	43.7	2.43		3.04		14.34	185.88	27.36	
150-175	1.80	0.00	%	47.1	2.29		4.73		13.07	198.96		
175-200	1.74	0.00	%	45.3	2.31			2.54	14.01	212.97	27.08	54.44
	1.81			44.79	2.42		22.75	0.00%			1 : 46.48	0.00%

200m Race Analysis Model

Input Measured Swim 1.46.47 s Swimmers Height 2.00 m

Segment	Velocity	SR	DPS	15m	Turn	Finish	Split	Cum	50m	100m
	m/s	str/min	m	s	s	s	s	s	s	s
0-25	1.88	44.8	2.52	6.29			11.60			
25-50	1.84	44.4	2.49		2.89		13.74	25.35	25.35	
50-75	1.84	44.2	2.50		4.53		12.67	38.02		
75-100	1.81	44.4	2.45		2.99		14.02	52.05	26.70	52.05
100-125	1.78	44.4	2.40		4.57		13.02	65.06		
125-150	1.77	43.7	2.43		3.04		14.34	79.40	27.36	
150-175	1.80	47.1	2.29		4.73		13.07	92.48		
175-200	1.74	45.3	2.31			2.54	14.01	106.48	27.08	54.44
	1.81	44.79	2.42		22.75				1 : 46.48	

Improve 15m time	0.00	%	Change DPS 1st 50	0.00	%	Change SR 1st 50	2.00	%
Improve rel speed into turn	0.00	%	Change DPS 2nd 50	0.00	%	Change SR 2nd 50	2.00	%
Improve turn push off	0.00	%	Change DPS 3rd 50	0.00	%	Change SR 3rd 50	2.00	%
Improve rel finish speed	0.00	%	Change DPS 4th 50	0.00	%	Change SR 4th 50	2.00	%

OUTCOME

Segment	Velocity			SR	DPS	15m	Turn	Finish	Split	Cum	lap	
	m/s			str/min	m	s	s	s	s	s	s	
0-25	1.92	0.07	%	45.7	2.52	6.3			11.50			
25-50	1.88	0.07	%	45.3	2.49		2.83		13.47	131.46	24.98	
50-75	1.88	0.07	%	45.1	2.50		4.53		12.52	143.97		
75-100	1.85	0.07	%	45.3	2.45		2.93		13.75	157.72	26.26	51.24
100-125	1.81	0.06	%	45.3	2.40		4.57		12.85	170.57		
125-150	1.81	0.06	%	44.6	2.43		2.98		14.06	184.63	26.91	
150-175	1.83	0.06	%	48.0	2.29		4.73		12.91	197.54		
175-200	1.78	0.06	%	46.2	2.31			2.49	13.73	211.27	26.64	53.55
	1.84			45.68	2.42		22.58	0.77%			1 : 44.79	1.59%

200m Race Analysis Model

Input Measured Swim 1.46.47 s — Swimmers Height 2.00 m

Segment	Velocity	SR	DPS	15m	Turn	Finish	Split	Cum	50m	100m
	m/s	str/min	m	s	s	s	s	s	s	s
0-25	1.88	44.8	2.52	6.29			11.60			
25-50	1.84	44.4	2.49		2.89		13.74	25.35	25.35	
50-75	1.84	44.2	2.50		4.53		12.67	38.02		
75-100	1.81	44.4	2.45		2.99		14.02	52.05	26.70	52.05
100-125	1.78	44.4	2.40		4.57		13.02	65.06		
125-150	1.77	43.7	2.43		3.04		14.34	79.40	27.36	
150-175	1.80	47.1	2.29		4.73		13.07	92.48		
175-200	1.74	45.3	2.31			2.54	14.01	106.48	27.08	54.44
	1.81	44.79	2.42		22.75				1 : 46.48	

Improve 15m time	0.00 %	Change DPS 1st 50	2.00 %	Change SR 1st 50	0.00 %
Improve rel speed into turn	0.00 %	Change DPS 2nd 50	2.00 %	Change SR 2nd 50	0.00 %
Improve turn push off	0.00 %	Change DPS 3rd 50	2.00 %	Change SR 3rd 50	0.00 %
Improve rel finish speed	0.00 %	Change DPS 4th 50	2.00 %	Change SR 4th 50	0.00 %

OUTCOME

Segment	Velocity			SR	DPS	15m	Turn	Finish	Split	Cum	lap	
	m/s			str/min	m	s	s	s	s	s	s	
0-25	1.92	0.07	%	44.8	2.57	6.3			11.50			
25-50	1.88	0.07	%	44.4	2.54		2.83		13.47	131.46	24.98	
50-75	1.88	0.07	%	44.2	2.55		4.53		12.52	143.97		
75-100	1.85	0.07	%	44.4	2.50		2.93		13.75	157.72	26.26	51.24
100-125	1.81	0.06	%	44.4	2.45		4.57		12.85	170.57		
125-150	1.81	0.06	%	43.7	2.48		2.98		14.06	184.63	26.91	
150-175	1.83	0.06	%	47.1	2.34		4.73		12.91	197.54		
175-200	1.78	0.06	%	45.3	2.36			2.49	13.73	211.27	26.64	53.55
	1.84			44.79	2.47		22.58	0.77%			1 : 44.79	1.59%

Aggregation of Marginal Gains

- Single big gains in elite sport are in frequent.
- Improve everything

200m Race Analysis Model

Input Measured Swim

Input Measured Swim		1.46.47	s	Swimmers Height		2.00	m			
Segment	**Velocity**	**SR**	**DPS**	**15m**	**Turn**	**Finish**	**Split**	**Cum**	**50m**	**100m**
	m/s	str/min	m	s	s	s	s	s	s	s
0-25	1.88	44.8	2.52	6.29			11.60			
25-50	1.84	44.4	2.49		2.89		13.74	25.35	25.35	
50-75	1.84	44.2	2.50		4.53		12.67	38.02		
75-100	1.81	44.4	2.45		2.99		14.02	52.05	26.70	52.05
100-125	1.78	44.4	2.40		4.57		13.02	65.06		
125-150	1.77	43.7	2.43		3.04		14.34	79.40	27.36	
150-175	1.80	47.1	2.29		4.73		13.07	92.48		
175-200	1.74	45.3	2.31			2.54	14.01	106.48	27.08	54.44
	1.81	44.79	2.42		22.75				1 : 46.48	

Improve 15m time	2.00	%	Change DPS 1st 50	2.00	%	Change SR 1st 50	2.00 %
Improve rel speed into turn	2.00	%	Change DPS 2nd 50	2.00	%	Change SR 2nd 50	2.00 %
Improve turn push off	2.00	%	Change DPS 3rd 50	2.00	%	Change SR 3rd 50	2.00 %
Improve rel finish speed	2.00	%	Change DPS 4th 50	2.00	%	Change SR 4th 50	2.00 %

OUTCOME

Segment	**Velocity**			**SR**	**DPS**	**15m**	**Turn**	**Finish**	**Split**	**Cum**	**lap**	
	m/s			str/min	m	s	s	s	s	s	s	
0-25	1.96	0.14	%	45.7	2.57	6.2			11.27			
25-50	1.92	0.14	%	45.3	2.54		2.72		13.15	130.91	24.43	
50-75	1.92	0.14	%	45.1	2.55		4.44		12.27	143.18		
75-100	1.89	0.13	%	45.3	2.50		2.82		13.42	156.60	25.69	50.11
100-125	1.85	0.13	%	45.3	2.45		4.48		12.60	169.19		
125-150	1.84	0.13	%	44.6	2.48		2.86		13.73	182.92	26.32	
150-175	1.87	0.13	%	48.0	2.34		4.64		12.66	195.58		
175-200	1.81	0.12	%	46.2	2.36			2.39	13.41	208.99	26.07	52.39
	1.88			45.68	2.47		21.96	3.49%			1 : 42.51	3.73%

Model of Performance Support

Model of Performance Support

Performance Planning

1. List Known's and Unknown's – Prioritise understanding of relevant and important unknowns
   - Optimum - DPS, SR, fatigue rates, pacing strategy, warm-up, mental preparation, skills, diet, decision making, boat size, rigging/gear ratios, paddle dimensions...
2. Understand and Integrate knowledge of the Individuals performance (responders, non-responders)
   - Profiling, Training Response, Race Analysis, Race Modeling
3. Determine Goal Performance (History)
   - What does success look like? Run a needs analysis!
   - Think like a systems analyst outside of the conventional wisdom
4. Develop a performance plan (not just a training plan) based on your performance model
   - Integrate training philosophy
   - Integrate race requirements (specificity)
   - Accommodate individuals
   - Integrate specialists through specific projects (team or individuals)

Service providers and family can't help but be time stealers, how do we expect to make an impact!

Senior ITC Swimming Coach

Full-time podium athletes	5
Part-time ITC athletes	7
Assistant and Pathway coaches	3
Club and Facilities management	3
Performance director	1
Head Coach	1
Administrative team	5+
Service Providers	9
Family	3
Dog	1

38

Model of Performance Support

New World Record

17.198
(0-71kph)
Jamie Staff
1st Lap – Olympics '08 Qualifying

12.555 (on the back of 17.198)
(71.7kph)
Jason Kenny
2nd Lap – Olympics '08 Qualifying

13.197 (on the back of 12.555 and 17.198)
(68.2kph)
Chris Hoy
3rd Lap – Olympics '08 Qualifying

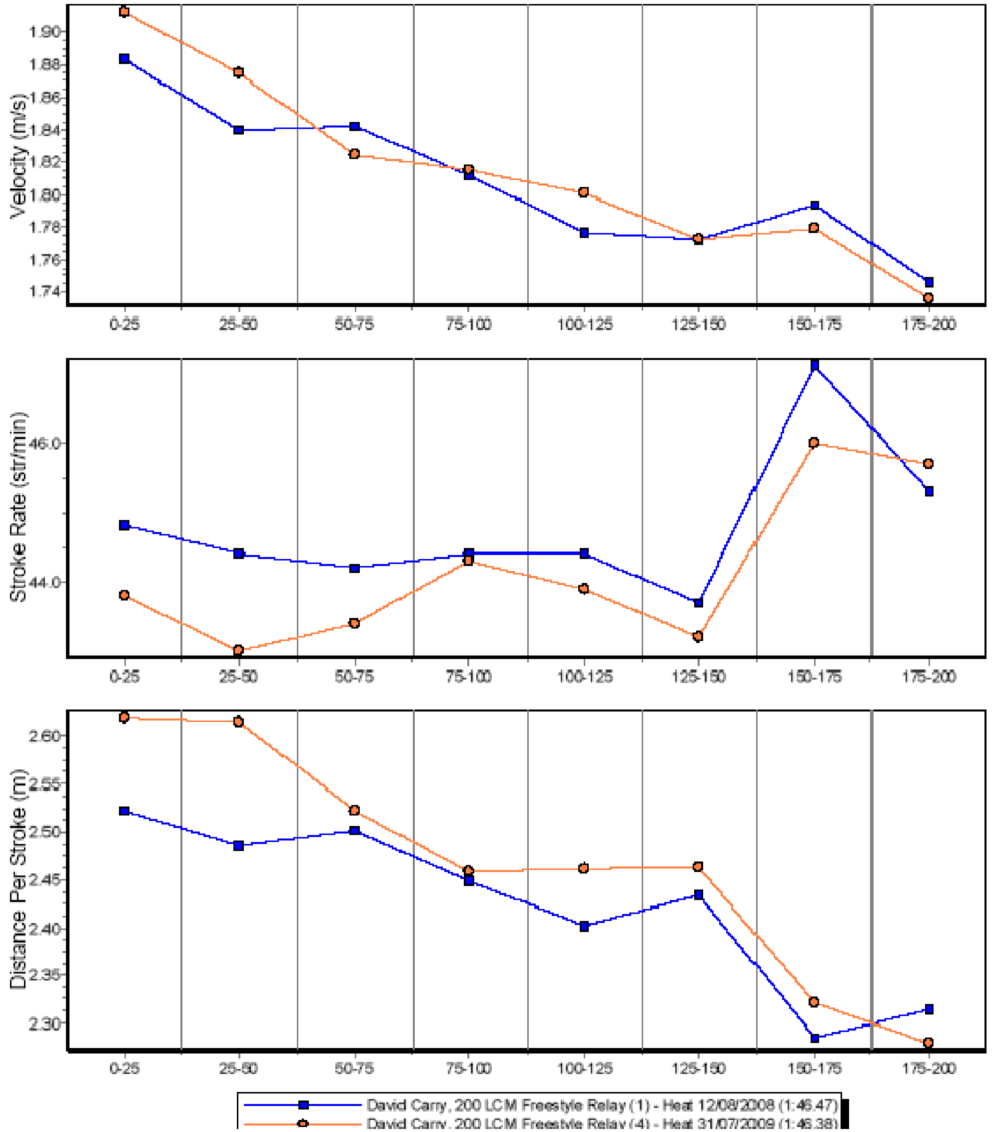
42.950

SwIMS Race Analysis
Comparison Report
Page 1

David Carry

200 LCM Freestyle Relay (1) - Heat

Olympic Games
Beijing
12/08/2008



200m Race Analysis Model

Stockport

Input Measured Swim		1.46.47 s		Swimmers Height		2.00 m				
Segment	**Velocity**	**SR**	**DPS**	**15m**	**Turn**	**Finish**	**Split**	**Cum**	**50m**	**100m**
	m/s	str/min	m	s	s	s	s	s	s	s
0-25	1.88	44.8	2.52	6.29			11.60			
25-50	1.84	44.4	2.49		2.89		13.74	25.35	25.35	
50-75	1.84	44.2	2.50		4.53		12.67	38.02		
75-100	1.81	44.4	2.45		2.99		14.02	52.05	26.70	52.05
100-125	1.78	44.4	2.40		4.57		13.02	65.06		
125-150	1.77	43.7	2.43		3.04		14.34	79.40	27.36	
150-175	1.80	47.1	2.29		4.73		13.07	92.48		
175-200	1.74	45.3	2.31			2.54	14.01	106.48	27.08	54.44
	1.81	44.79	2.42		22.75				1 : 46.48	

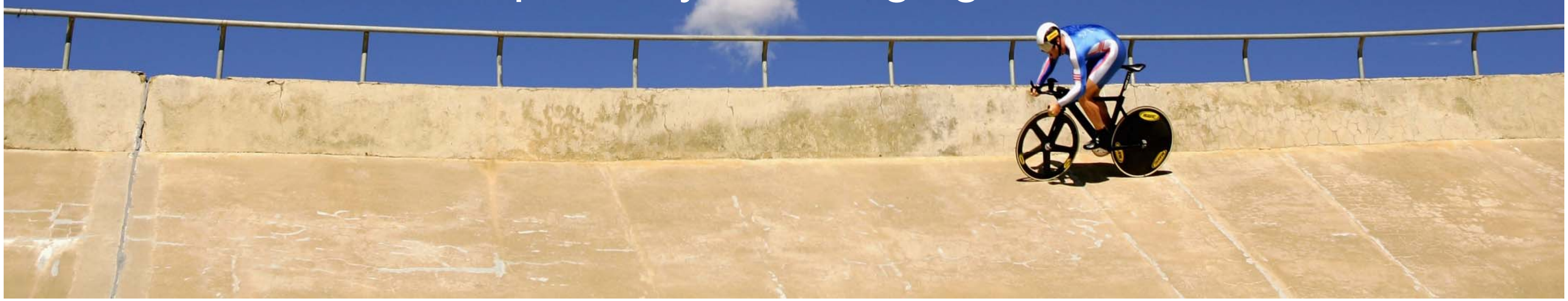
Improve 15m time	11.00 %	Change DPS 1st 50	4.70 %	Change SR 1st 50	-3.30 %
Improve rel speed into turn	-0.50 %	Change DPS 2nd 50	0.60 %	Change SR 2nd 50	-1.10 %
Improve turn push off	-4.00 %	Change DPS 3rd 50	1.10 %	Change SR 3rd 50	-0.60 %
Improve rel finish speed	0.50 %	Change DPS 4th 50	0.00 %	Change SR 4th 50	-0.80 %

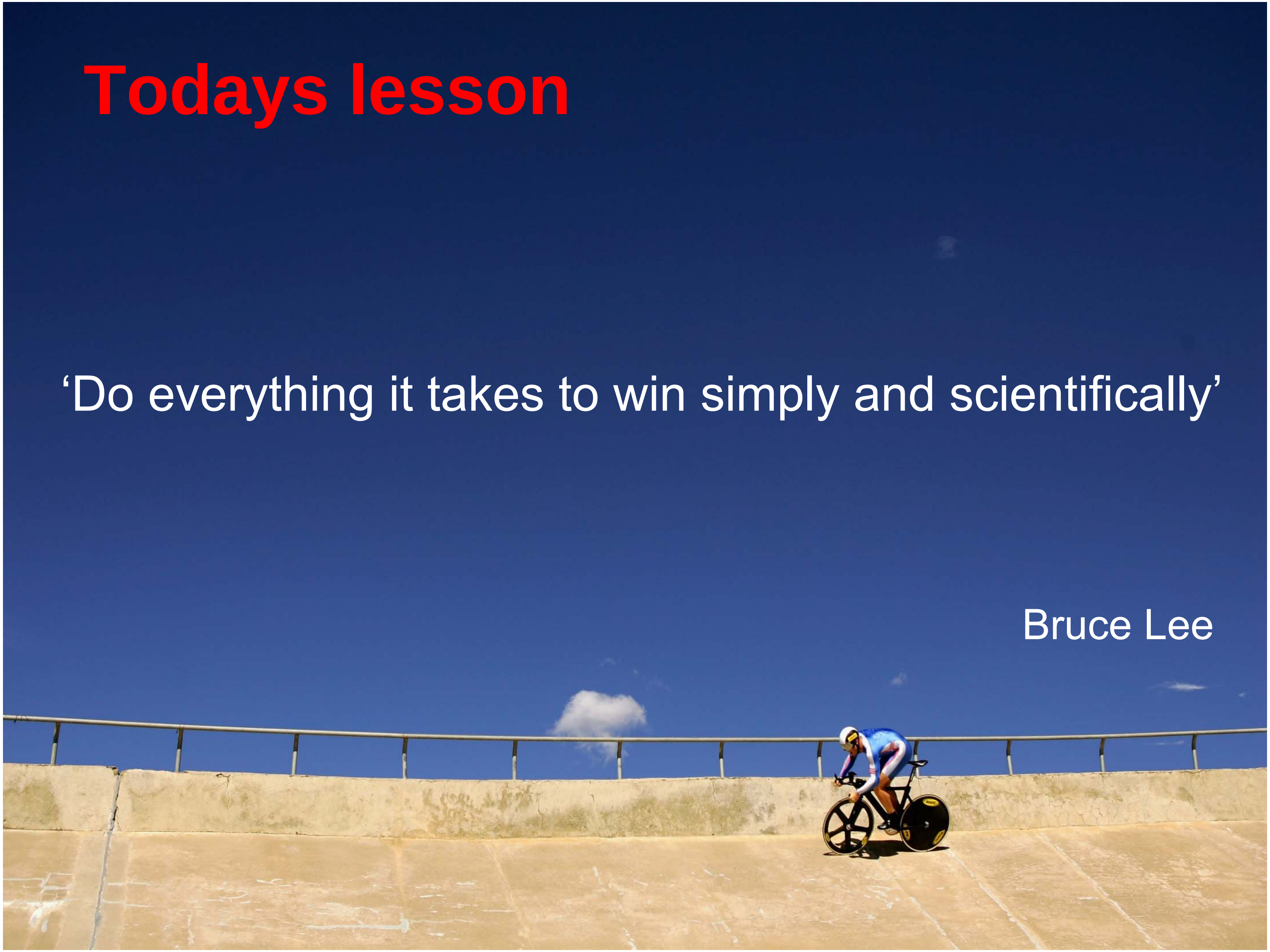
OUTCOME

Segment	**Velocity**		**SR**	**DPS**	**15m**	**Turn**	**Finish**	**Split**	**Cum**	**lap**	
	m/s		str/min	m	s	s	s	s	s	s	
0-25	1.91	0.04 %	43.3	2.64	5.6			10.85			
25-50	1.87	0.04 %	42.9	2.61		2.87		13.59	130.92	24.44	
50-75	1.83	-0.02 %	43.7	2.52		4.71		12.90	143.82		
75-100	1.80	-0.02 %	43.9	2.46		3.02		14.11	157.93	27.01	51.44
100-125	1.78	0.02 %	44.1	2.43		4.75		13.16	171.08		
125-150	1.78	0.02 %	43.4	2.46		3.04		14.29	185.37	27.44	
150-175	1.78	-0.03 %	46.7	2.29		4.92		13.33	198.70		
175-200	1.73	-0.02 %	44.9	2.31			2.55	14.11	212.81	27.44	54.88
	1.81		44.14	2.46		23.31	-2.47%			1 : 46.32	0.15%

Summary

- Performance driven by the details
- Requires specialists
- Deliver good science / scientific thinking ….
- …. Exceptionally challenging environment.




Todays lesson
‘Do everything it takes to win simply and scientifically’
Bruce Lee