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Mountain, Sport & Health

CeRiSM research center sport mountain health

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Laboratory- derived measures of critical intensity: what's new?

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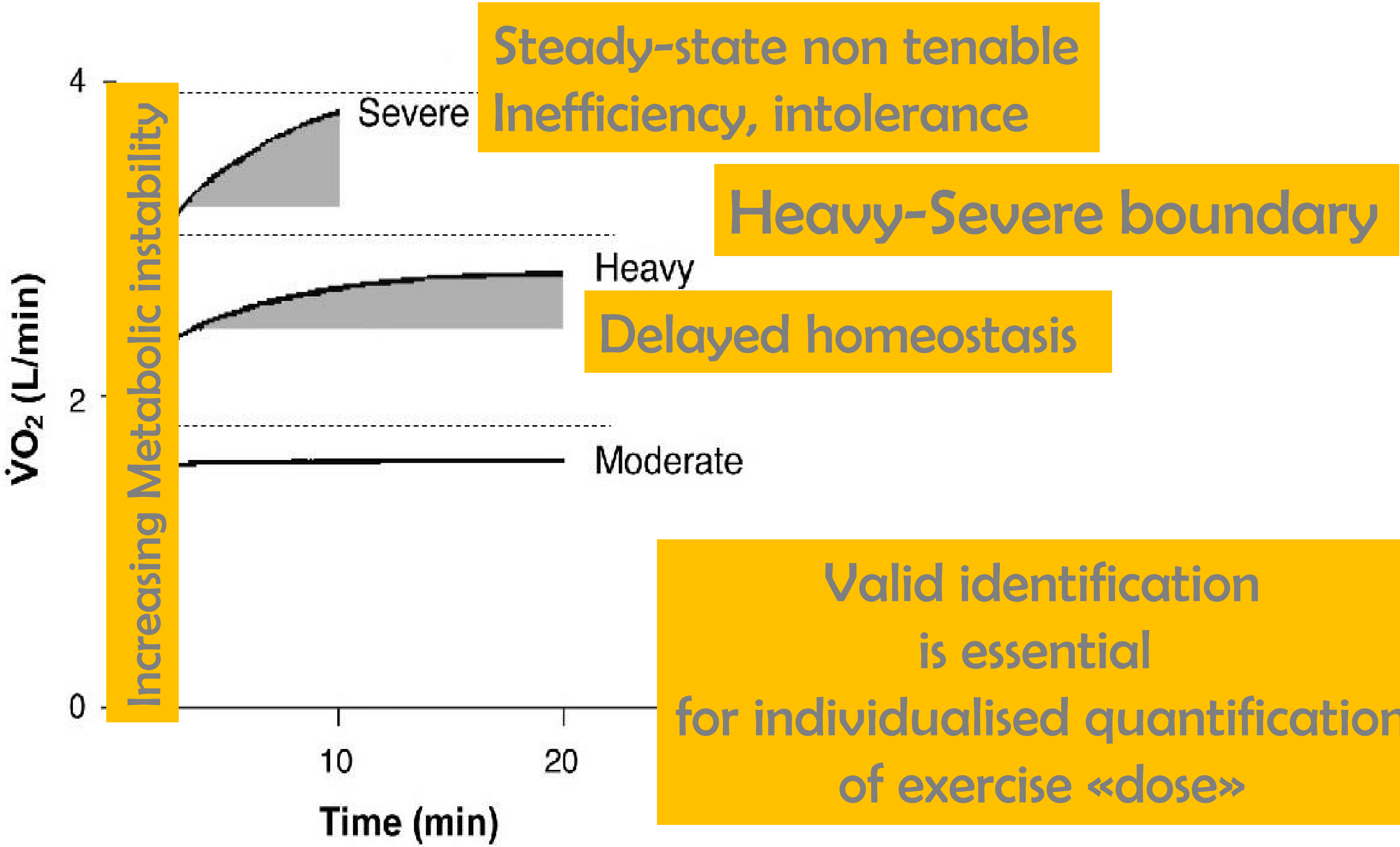
Exercise-intensity domains:

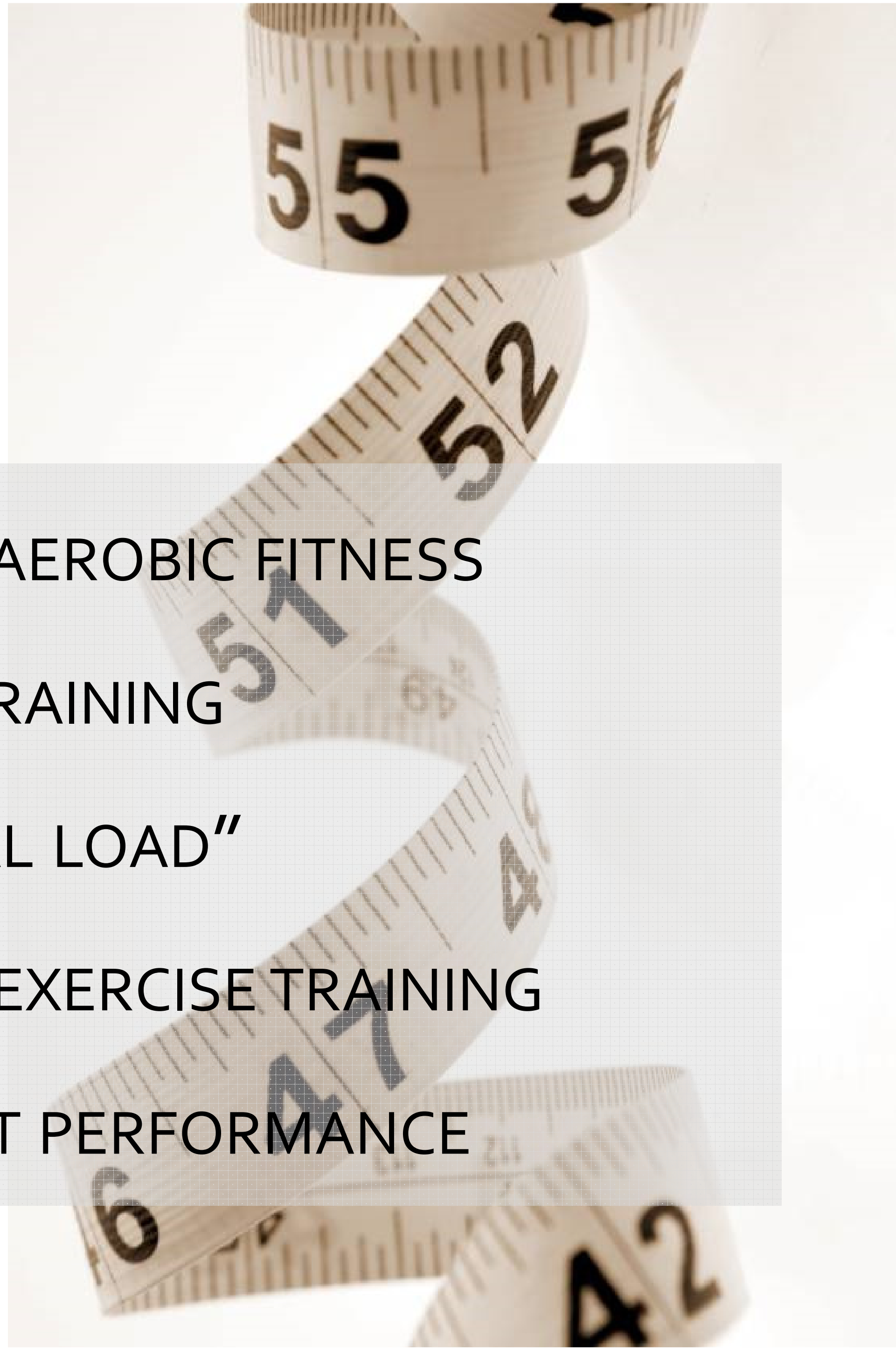
Exercise duration, VO2 profile, change in intracellular composition



Valid identification
is essential
for individualised quantification
of exercise «dose»

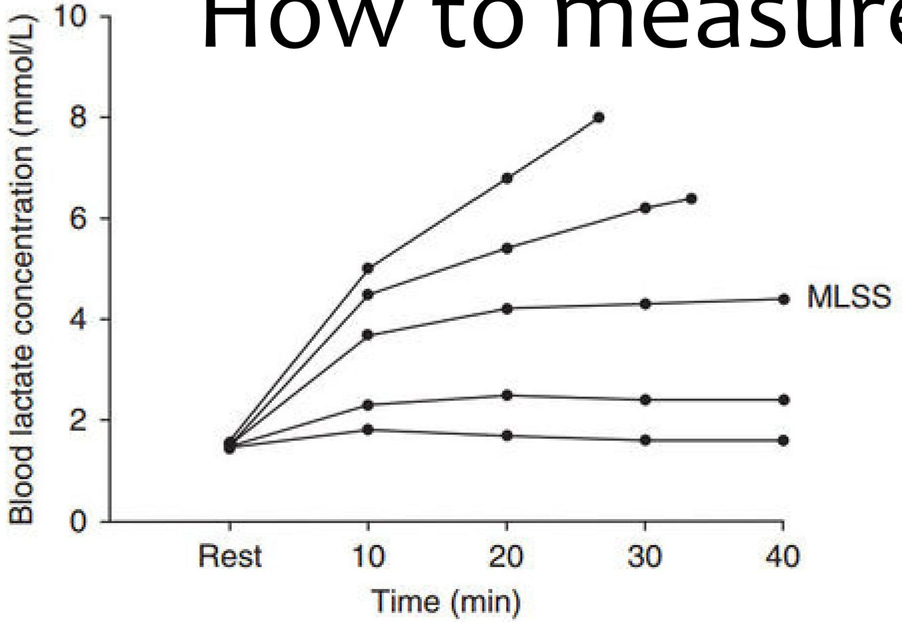
Jones AM and Poole DC, 2005

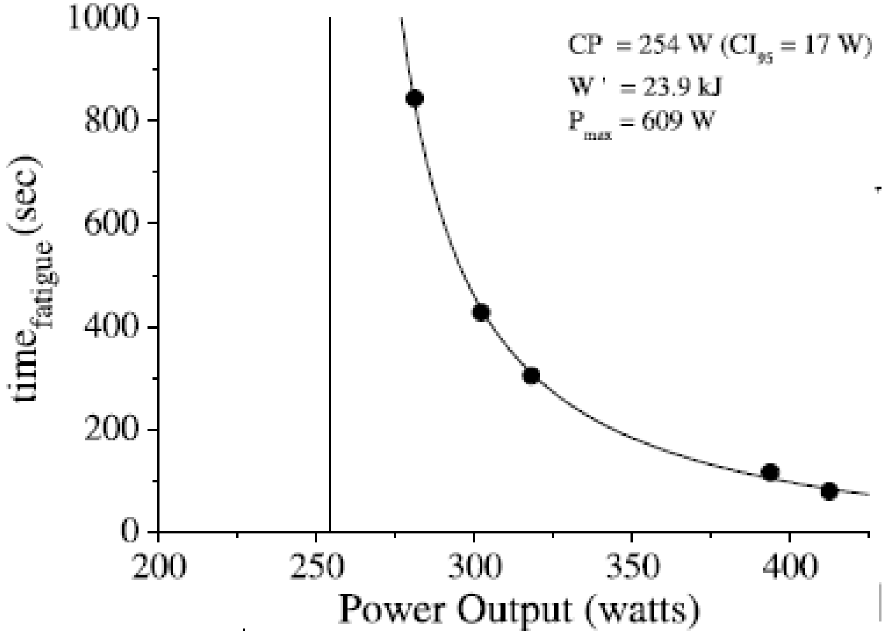
Why measure heavy-severe boundary?

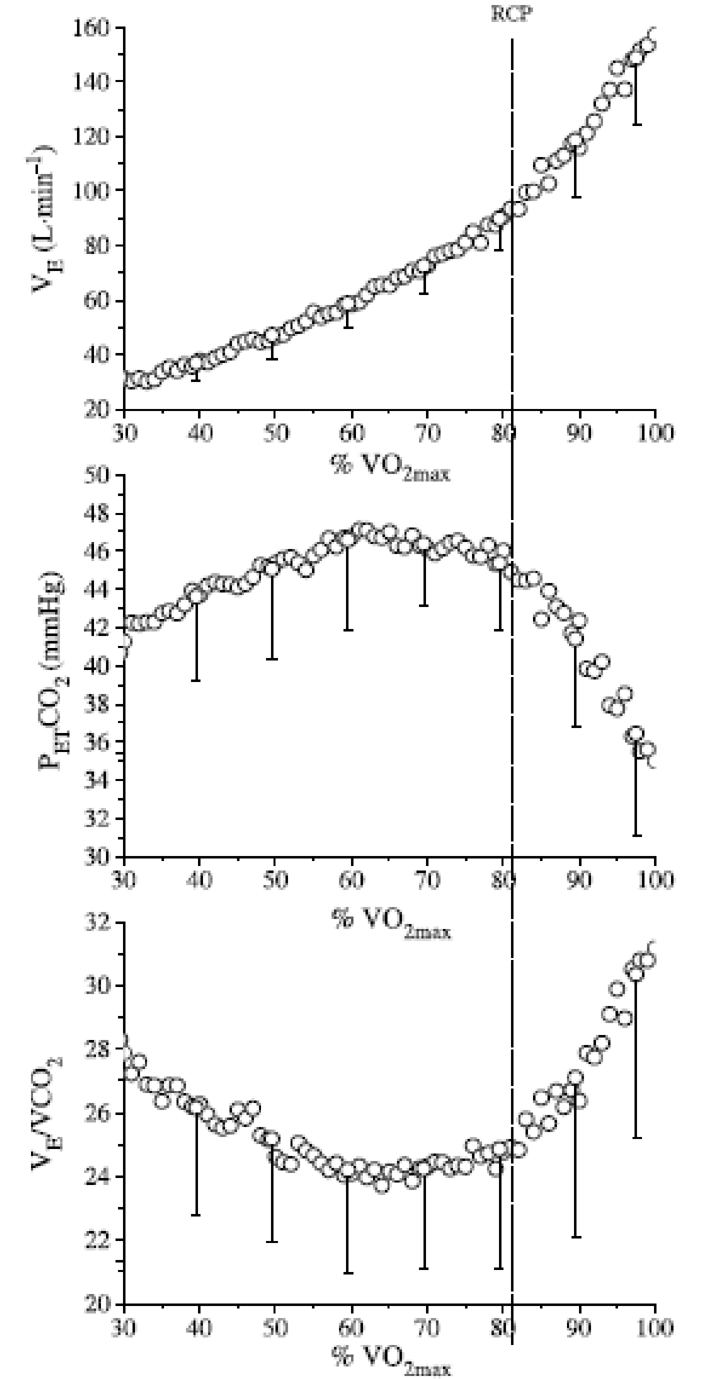


- ✓ SUBMAXIMAL INDEX OF AEROBIC FITNESS
- ✓ SENSITIVE TO AEROBIC TRAINING
- ✓ INDICATOR OF "INTERNAL LOAD"
- ✓ TARGET INTENSITY FOR EXERCISE TRAINING
- ✓ DETERMINANT OF SPORT PERFORMANCE

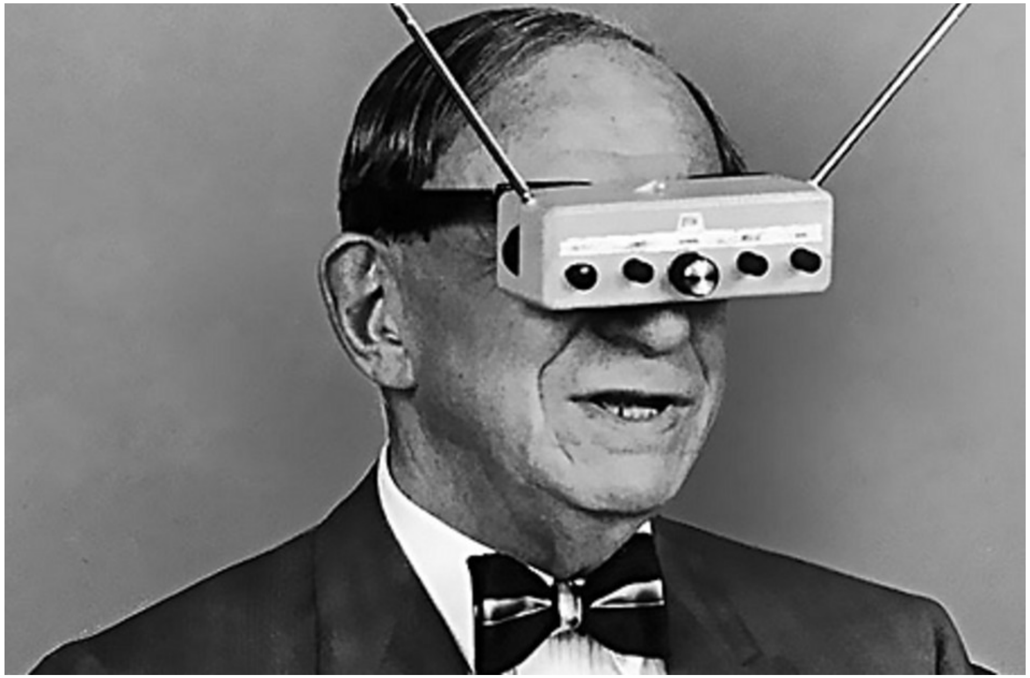
How to measure?







How to measure?



VT_2

VAM

MLSS

D_{max}

CP

RCP

IAT

VT

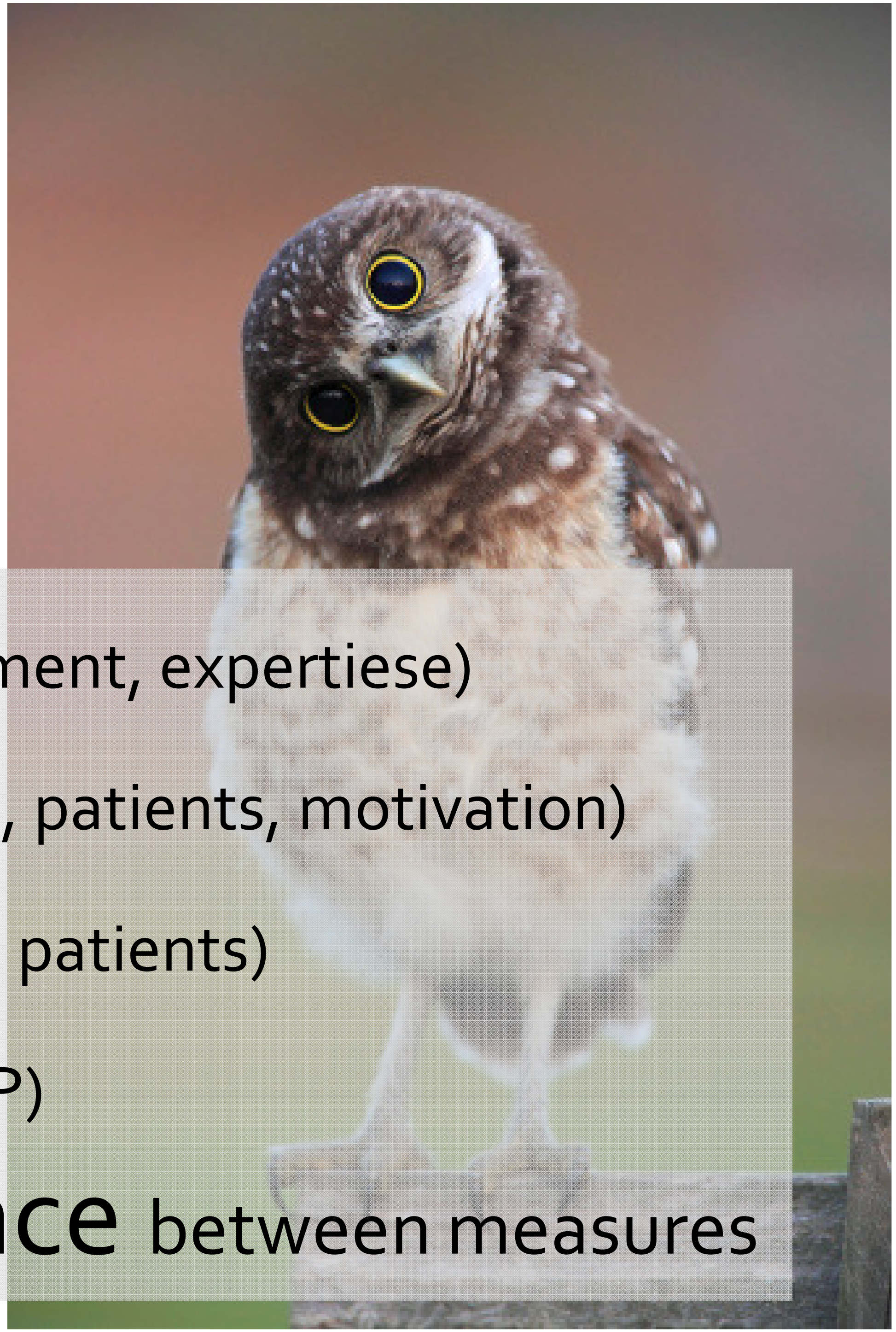
OBLA

LT_2

HR_{DP}

AT

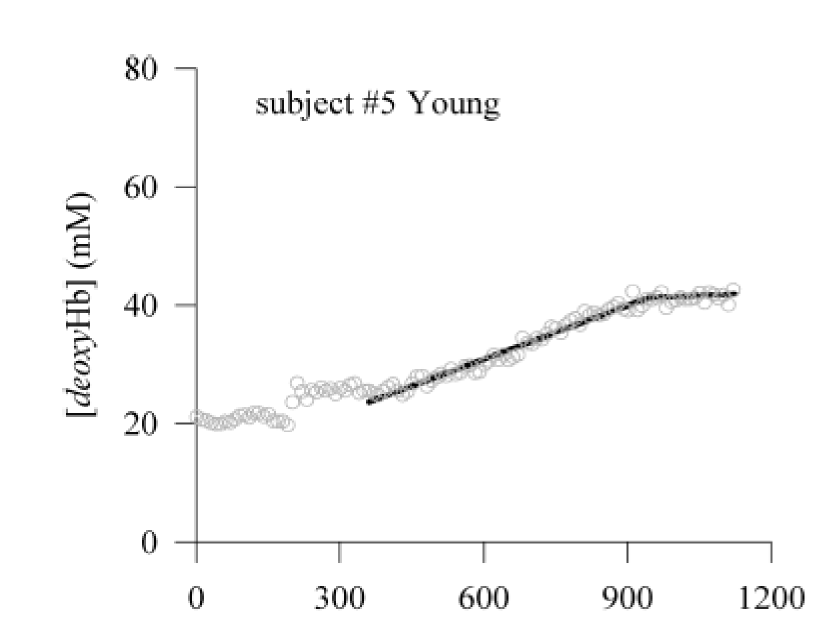
Alternatives? What’s new?

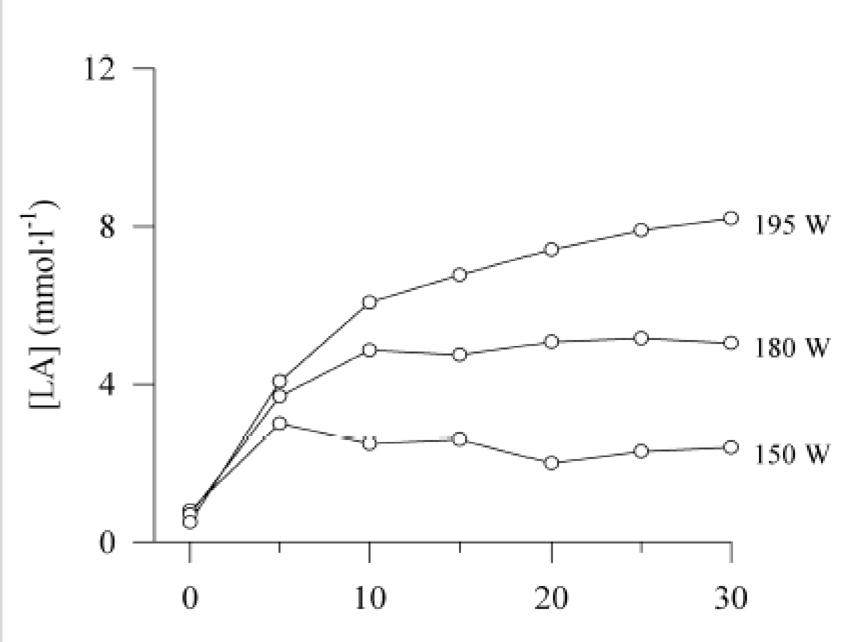


- ✓ COST (time, equipment, expertiese)
- ✓ EFFORT (children, patients, motivation)
- ✓ RISK (<u>older adults</u>, patients)
- ✓ Objectivity (RCP)
- ✓ Correspondance between measures

	#	Age (yrs)	Weight (kg)	Stature (m)	BMI	VO_{2max} ($mL \cdot kg^{-1} \cdot min^{-1}$)
Mean ± SD Range	32	48±17 23-74	76 ± 8 62-98	1.75±0.09 1.56-1.90	25±3 20-31	39.4 ± 11.4 21.8-59.8

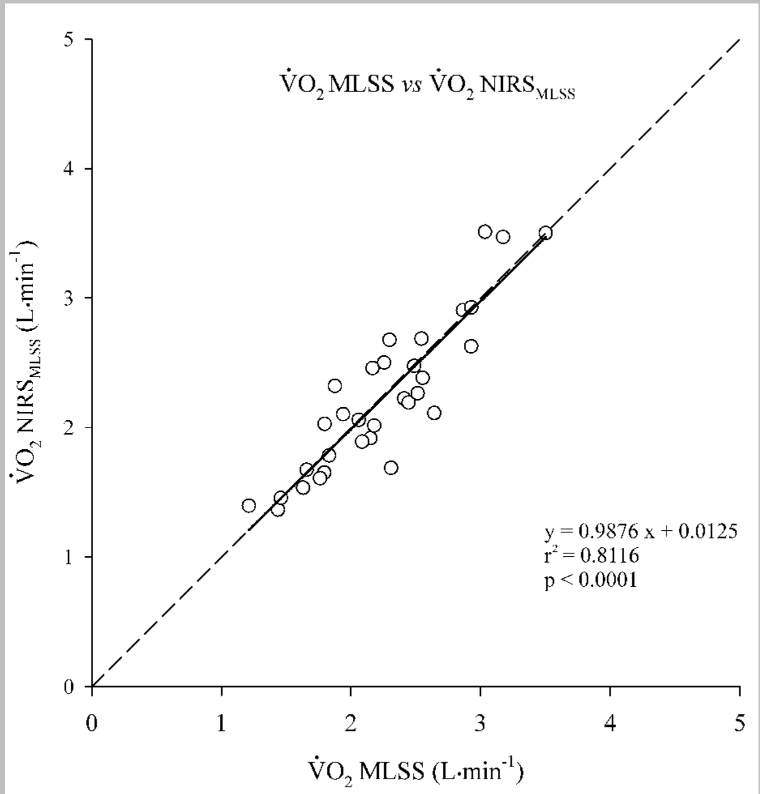
Can we determine critical intensity from deoxyHb profile? Correspondence with gold standard

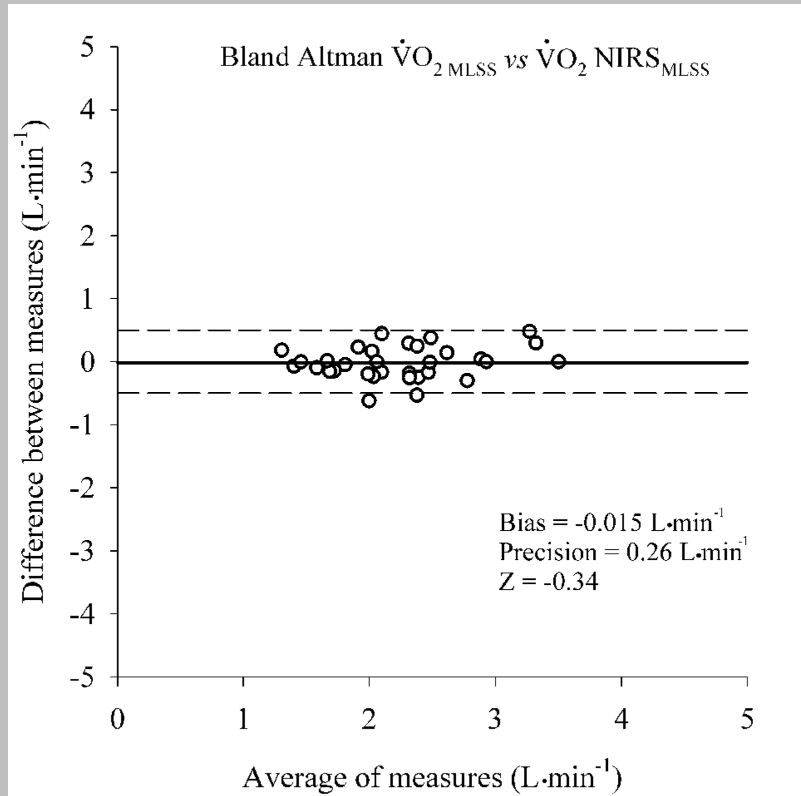




Bellotti C, MSSE 2013

	MLSS	$deoxyHb_{BP}$
VO_2 (L·min^{-1})	2.25 ± 0.54	2.23 ± 0.59





Bellotti C, MSSE 2013

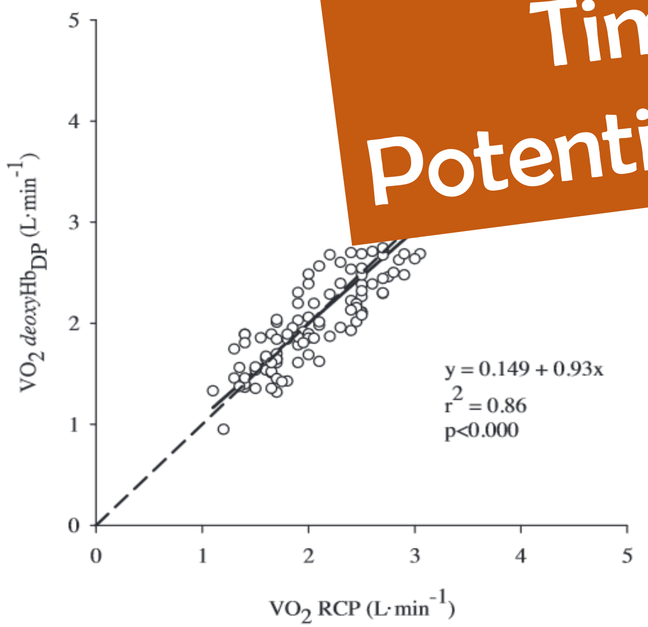
deoxyHb$_{BP}$ and RCP

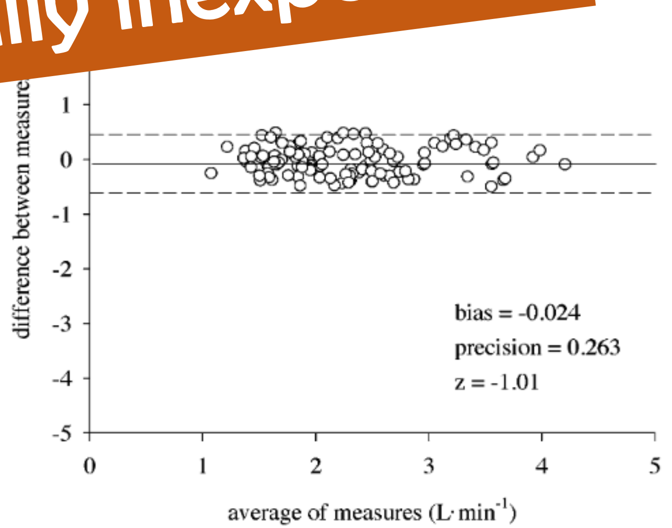
Table 1
Ramp increm...

Murias JM, RPNB 2013

	...	Women
RCP	...	2.6 ± 0.4*
Δ[HHb]-*BP*	...	2.4 ± 0.4*

Accurate and precise
Non-invasive
Objective
Time-efficient
Potentially inexpensive



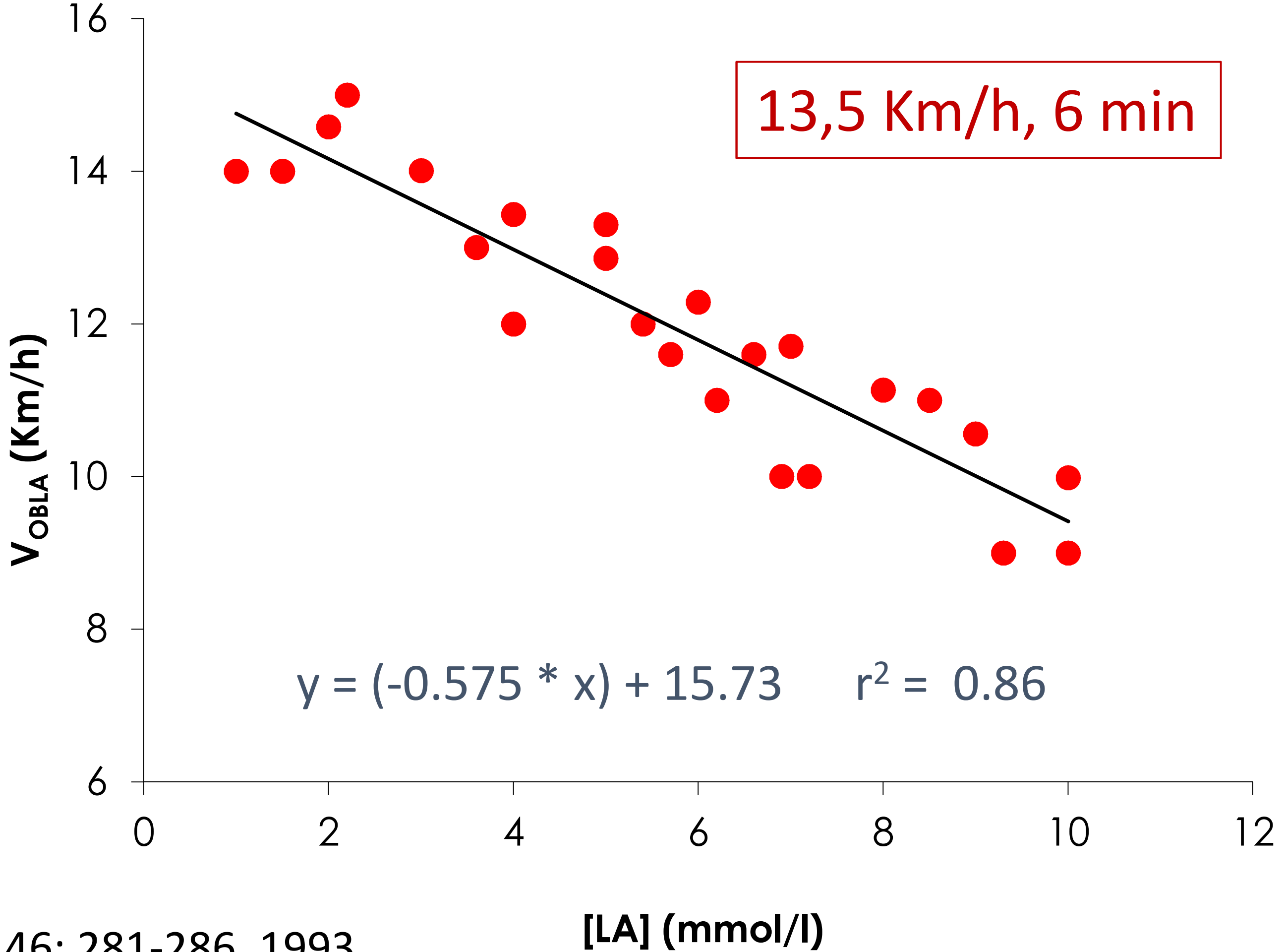


N=118

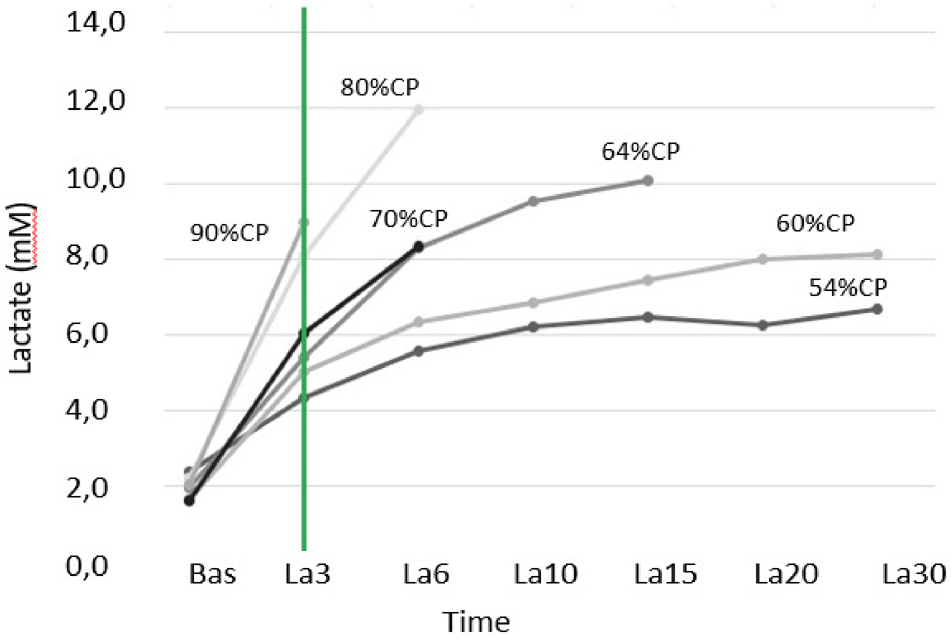
Fontana FY, JSMC 2015

Can maximal effort be spared?

- ✓EFFORT
- ✓RISK
- ✓ COST



Sirtori M.D. e coll. Med.Sport 46: 281-286, 1993



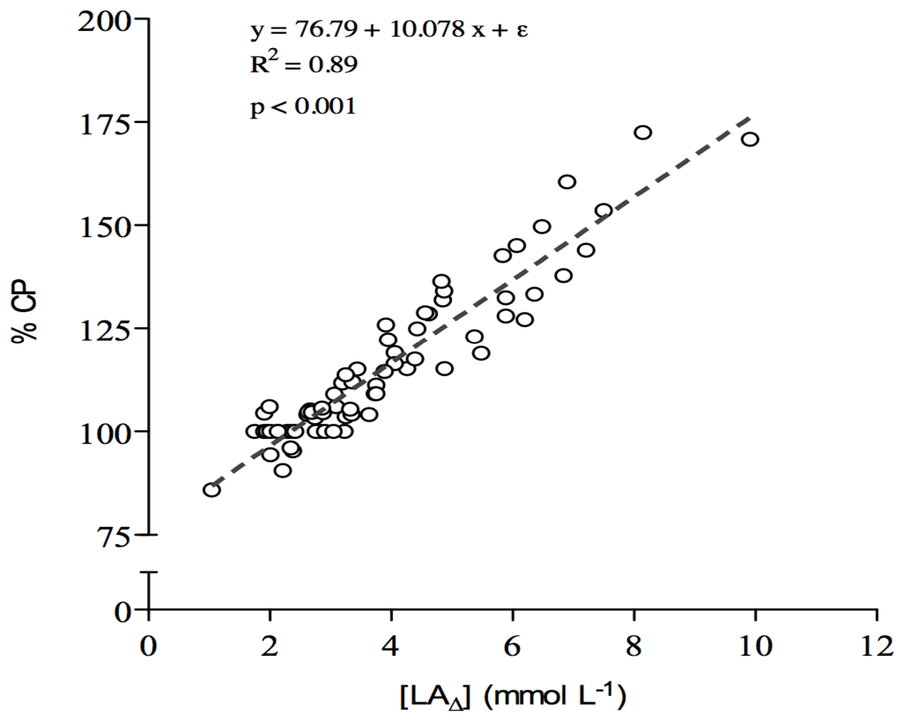
14 ♂

31 ± 7 yrs

(range 23-44)

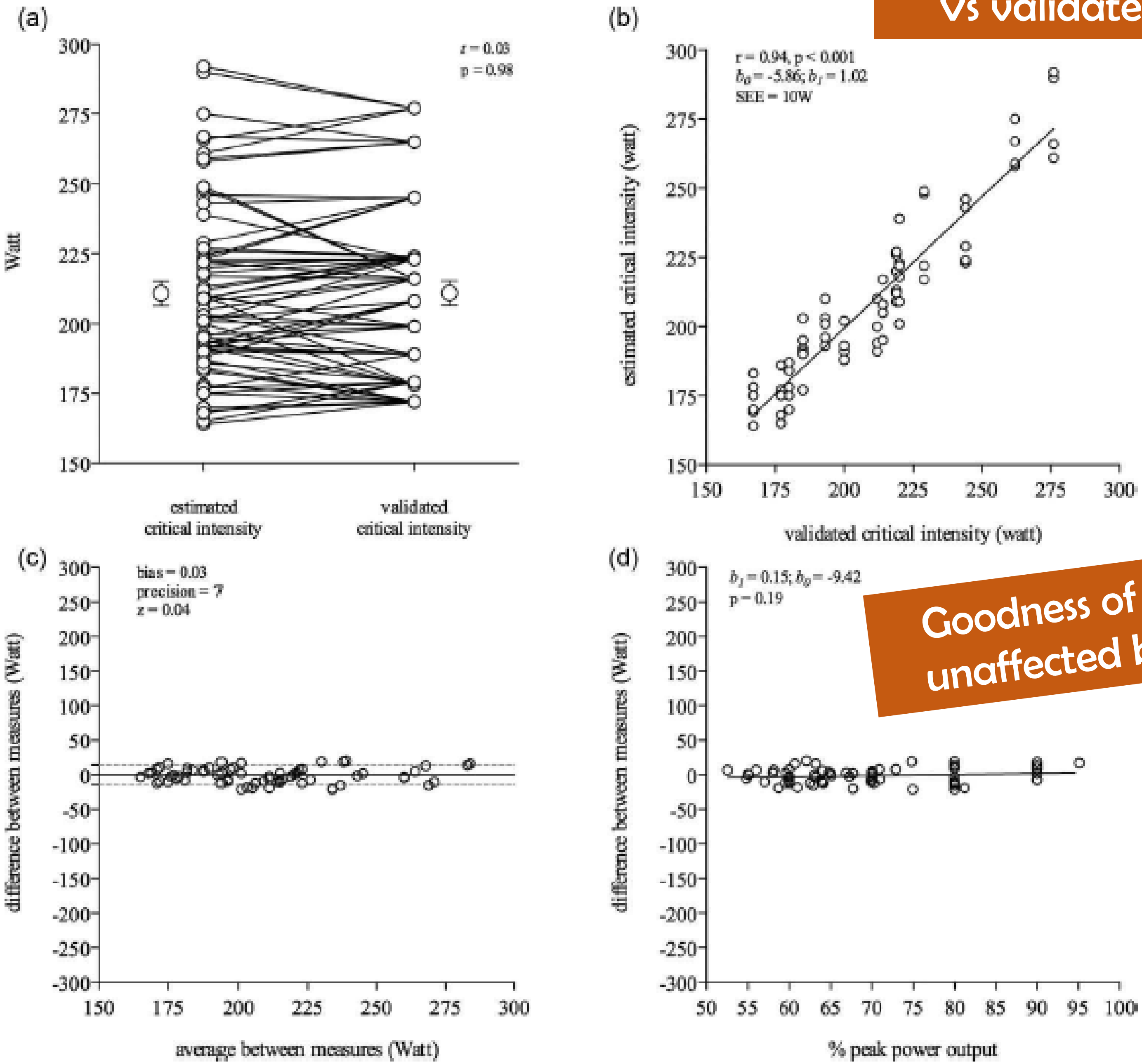
49 ± 7 ml*Kg^{-1}*min^{-1}

(range 44-65)



Fontana FY, JSS 2016

Vs validated intensity

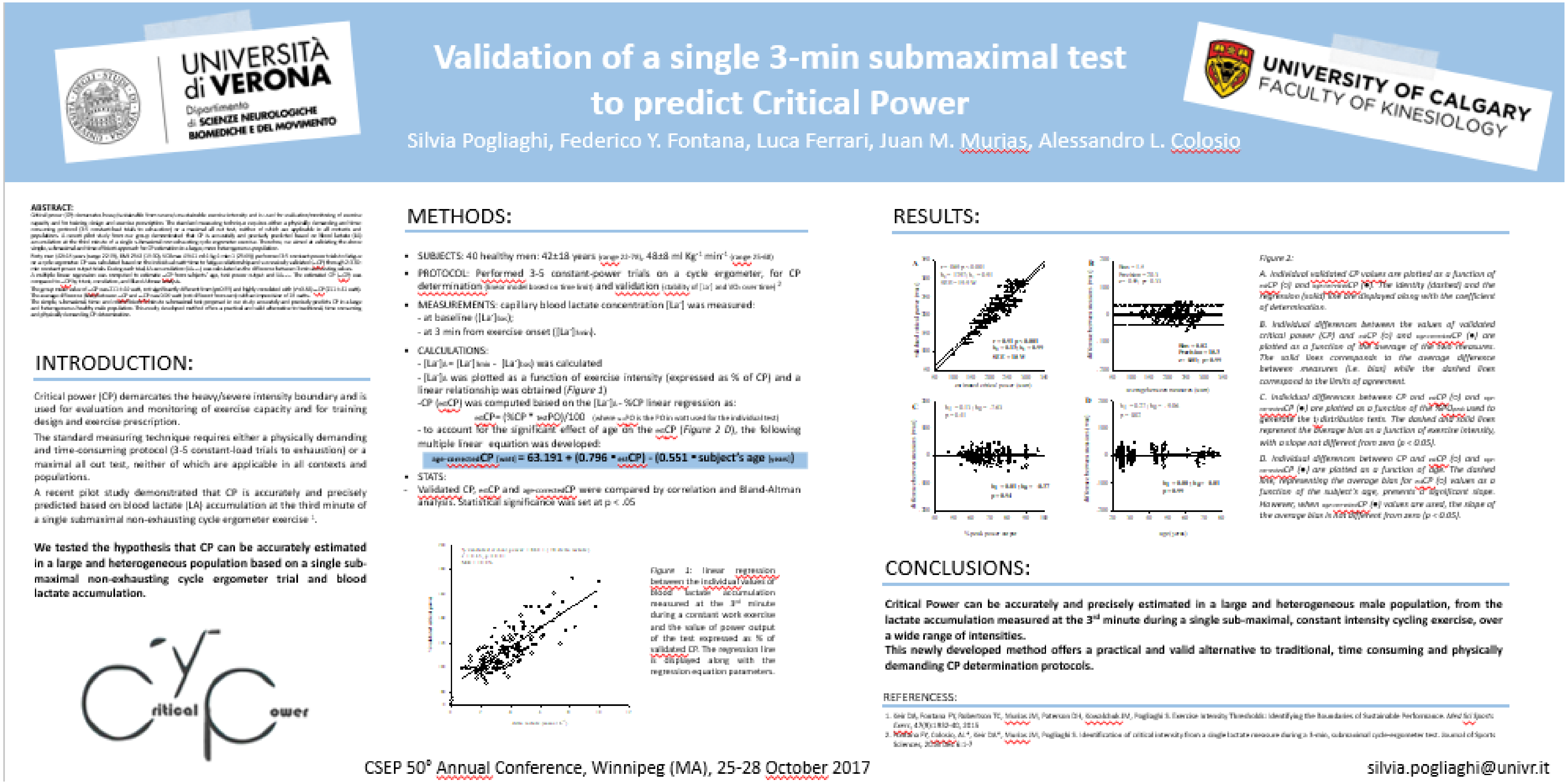


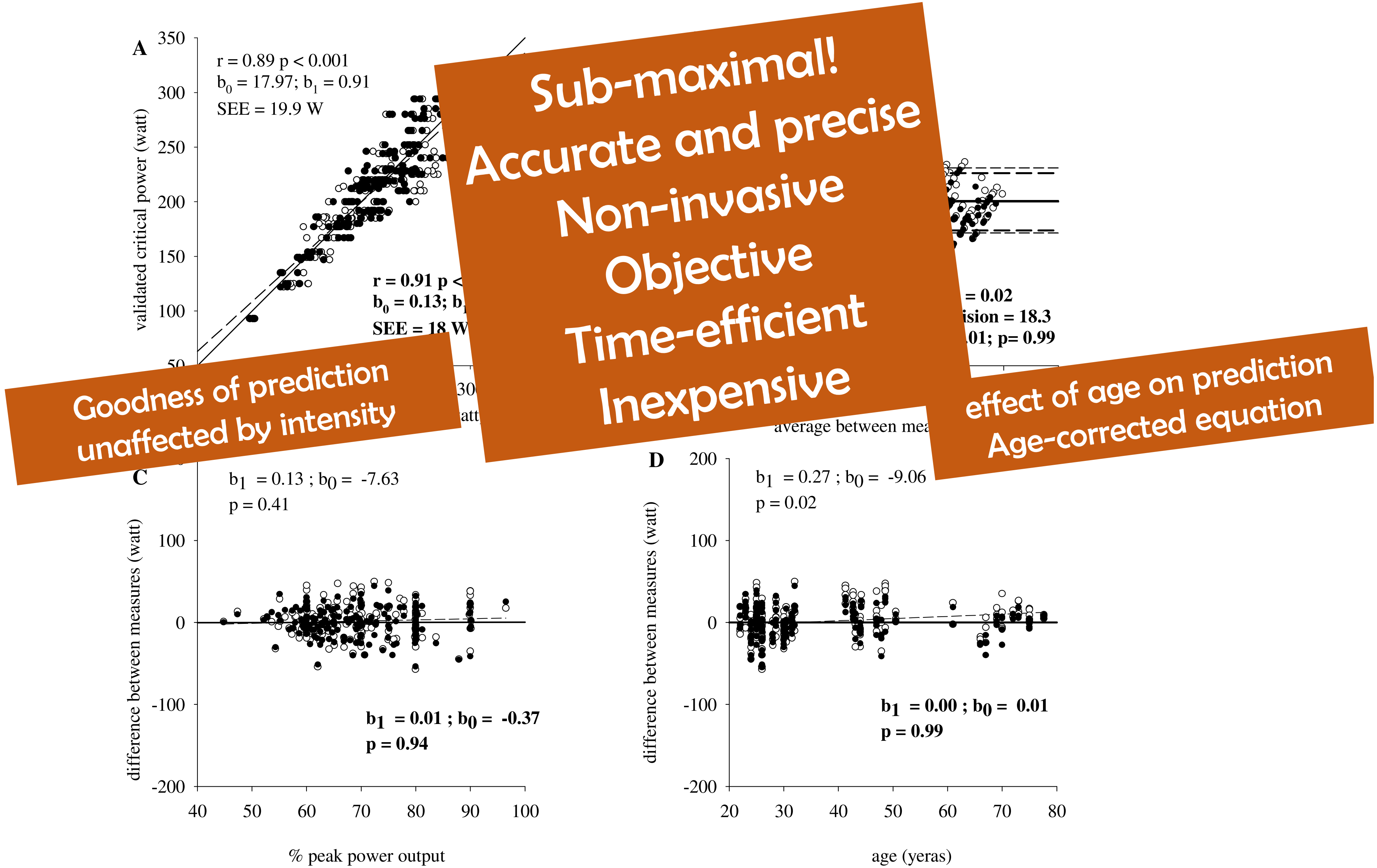
Goodness of prediction unaffected by intensity

Fontana FY, JSS 2016

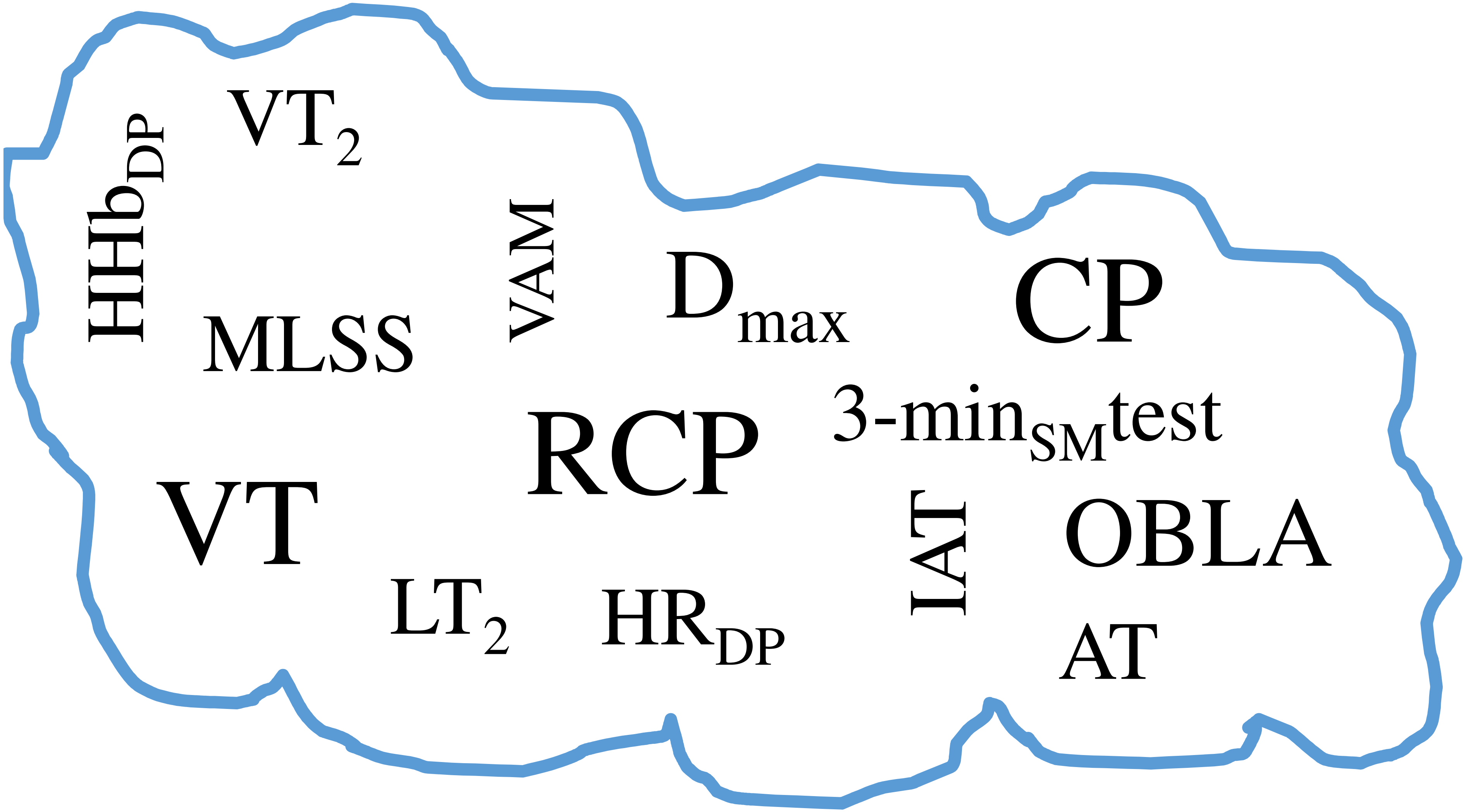
SUBJECTS:

40 healthy ♂: 42±18 years (range 22-78), 48±8 ml Kg^{-1} min^{-1} (range 25-68)

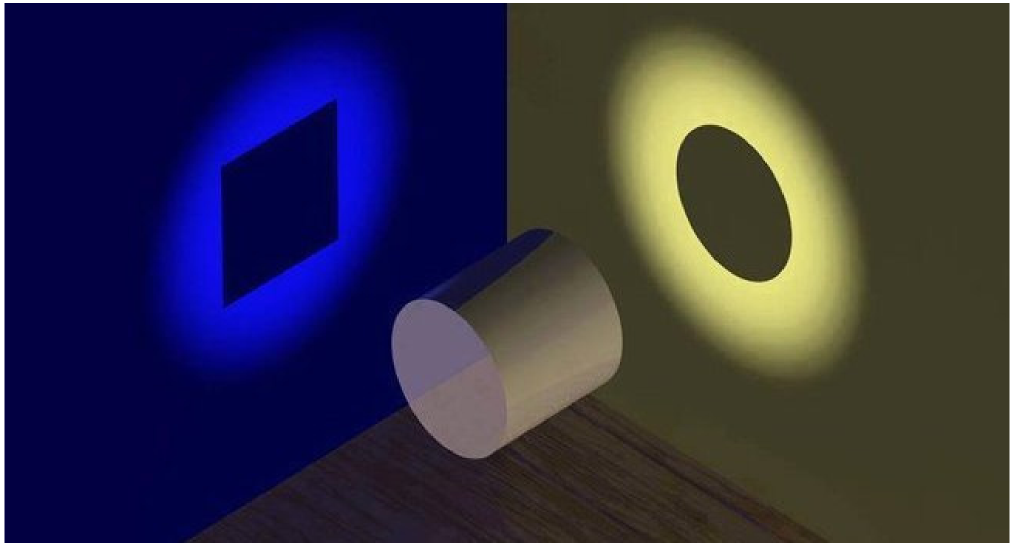



Sub-maximal!
Accurate and precise
Non-invasive
Objective
Time-efficient
Inexpensive
Goodness of prediction
unaffected by intensity
effect of age on prediction
Age-corrected equation
A
r = 0.89 p < 0.001
b0 = 17.97; b1 = 0.91
SEE = 19.9 W
r = 0.91 p <
b0 = 0.13; b1
SEE = 18 W
validated critical power (watt)
= 0.02
ision = 18.3
.01; p= 0.99
average between mea
C
b1 = 0.13 ; b0 = -7.63
p = 0.41
b1 = 0.01 ; b0 = -0.37
p = 0.94
difference between measures (watt)
% peak power output
D
b1 = 0.27 ; b0 = -9.06
p = 0.02
b1 = 0.00 ; b0 = 0.01
p = 0.99
difference between measures (watt)
age (yeras)

Correspondance between measures?

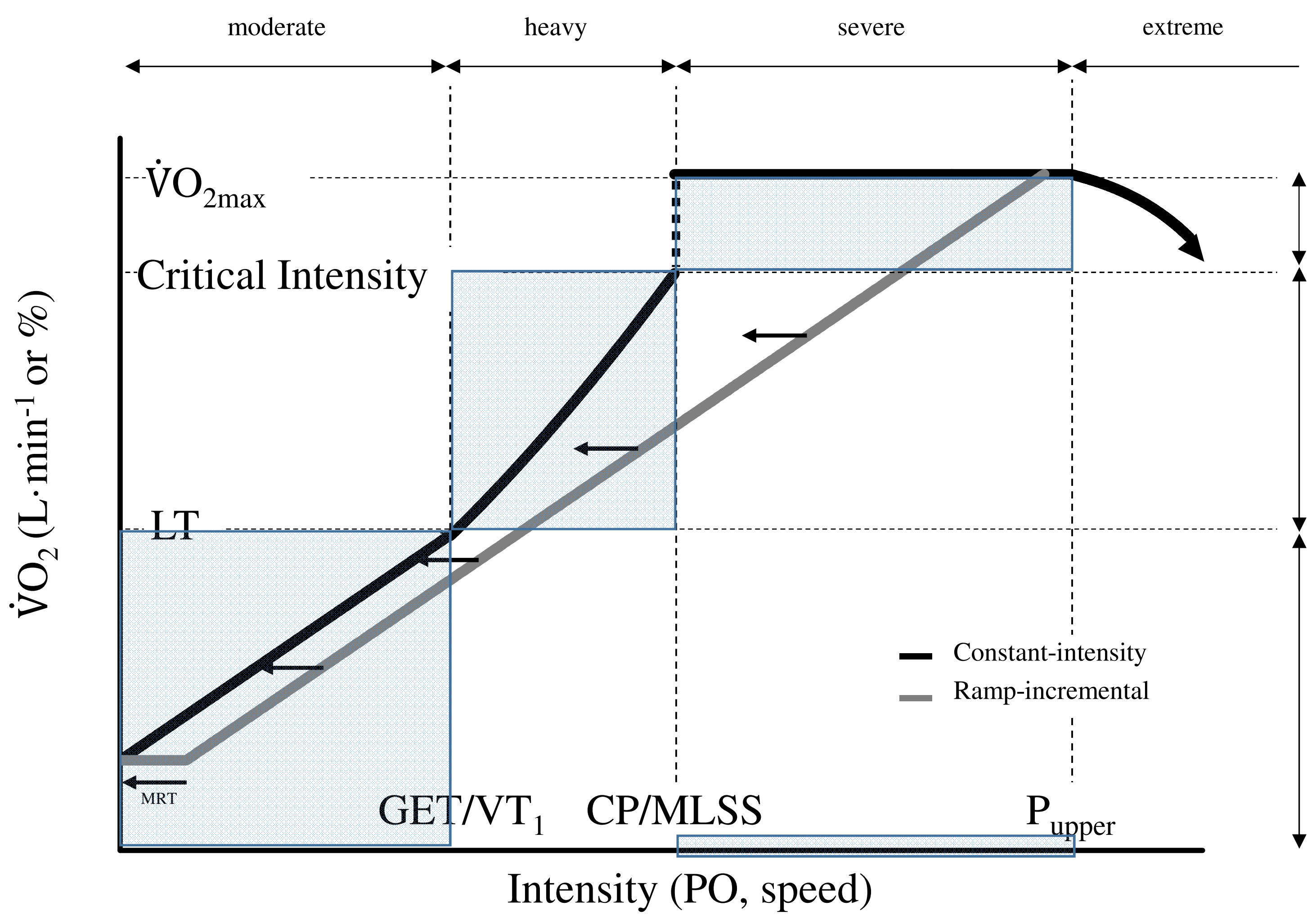


Same thing from different angles?



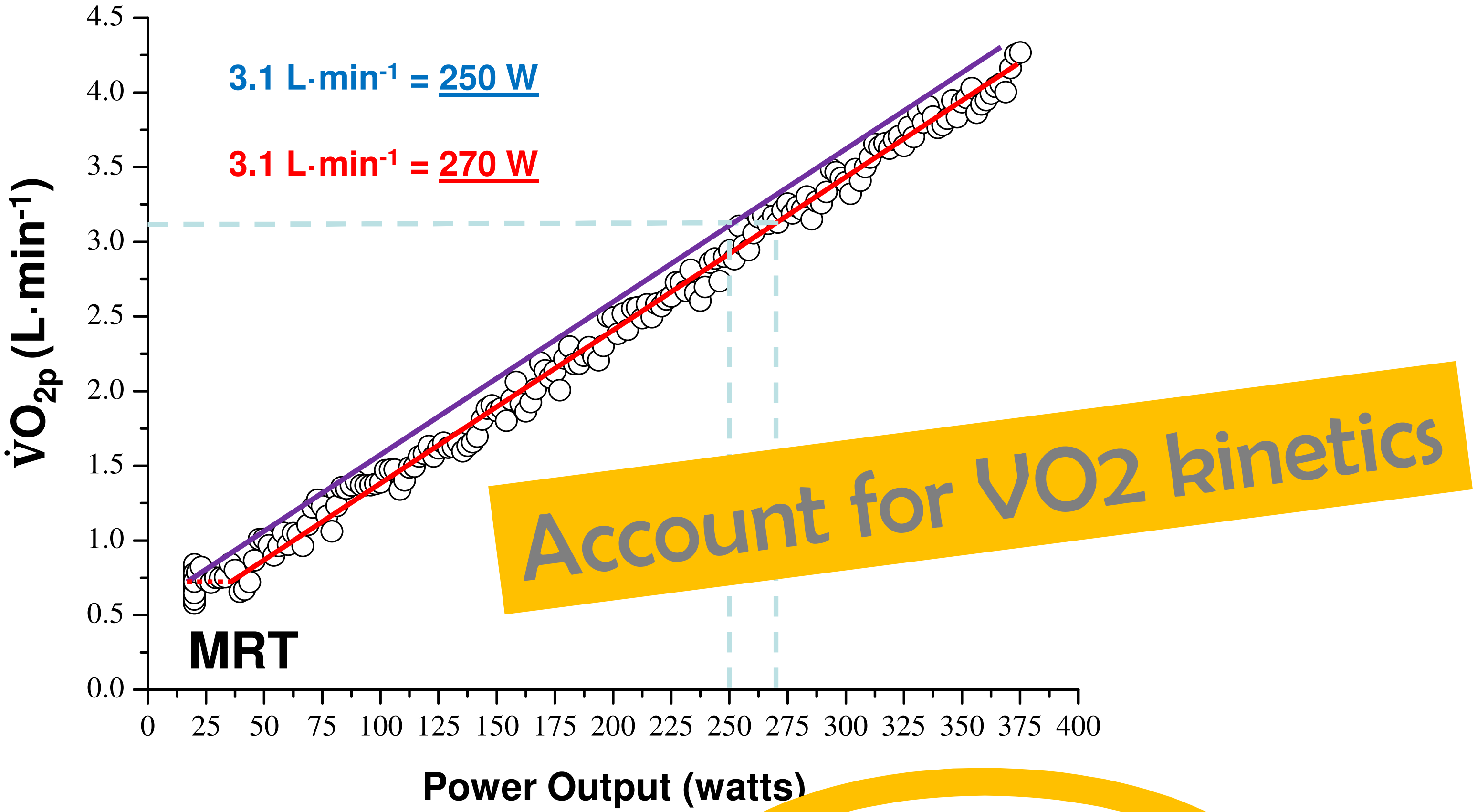
HHb_{DP}
VT_2
VAM
MLSS
D_{max}
CP
RCP
IAT
VT
OBLA
LT_2
HR_{DP}
AT

$\dot{V}O_2$ - exercise intensity in Incremental vs Constant PO exercise The issue of "Translation"



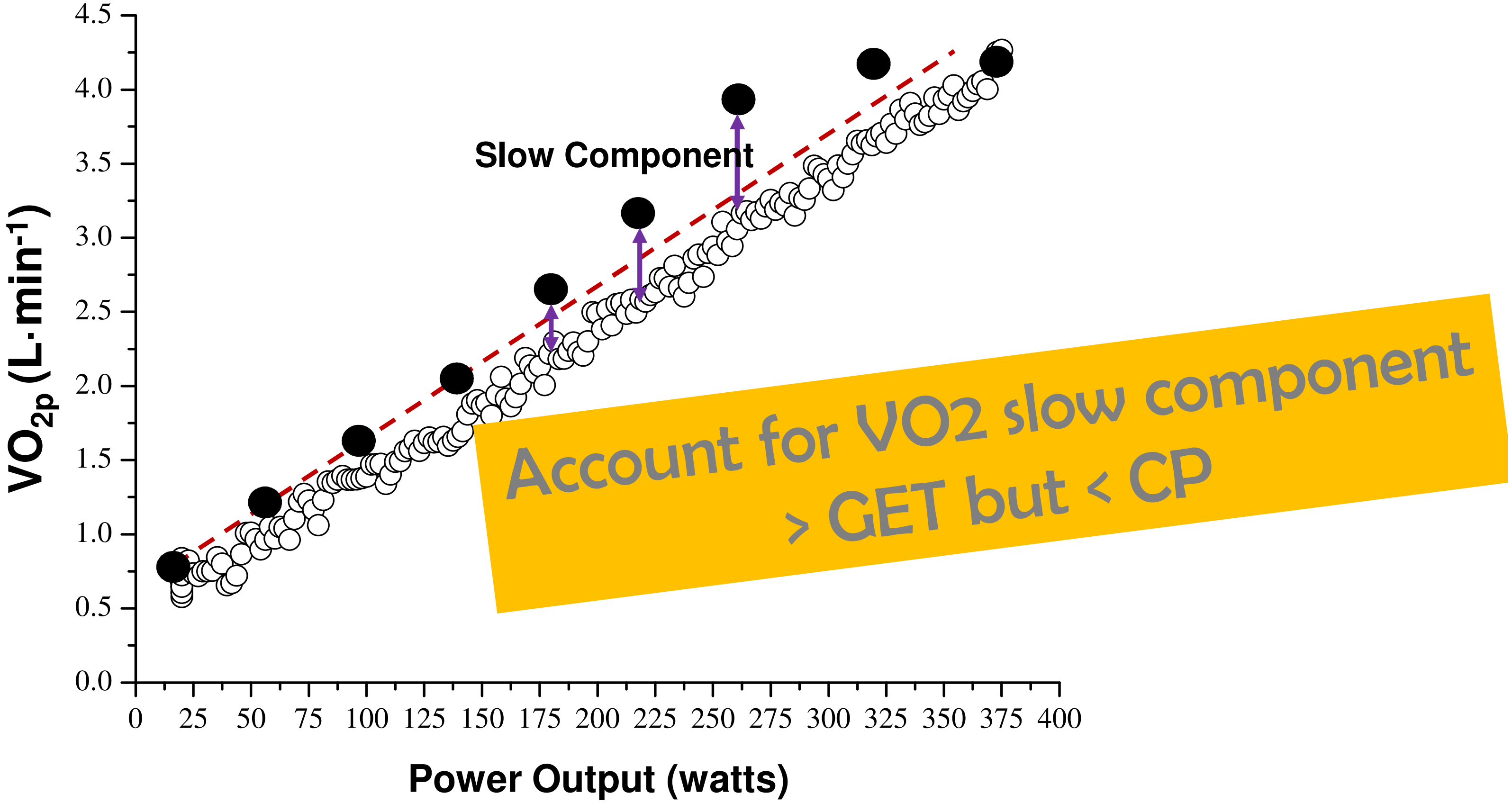
Keir *et al.* (in review)

Incremental exercise→ Constant PO



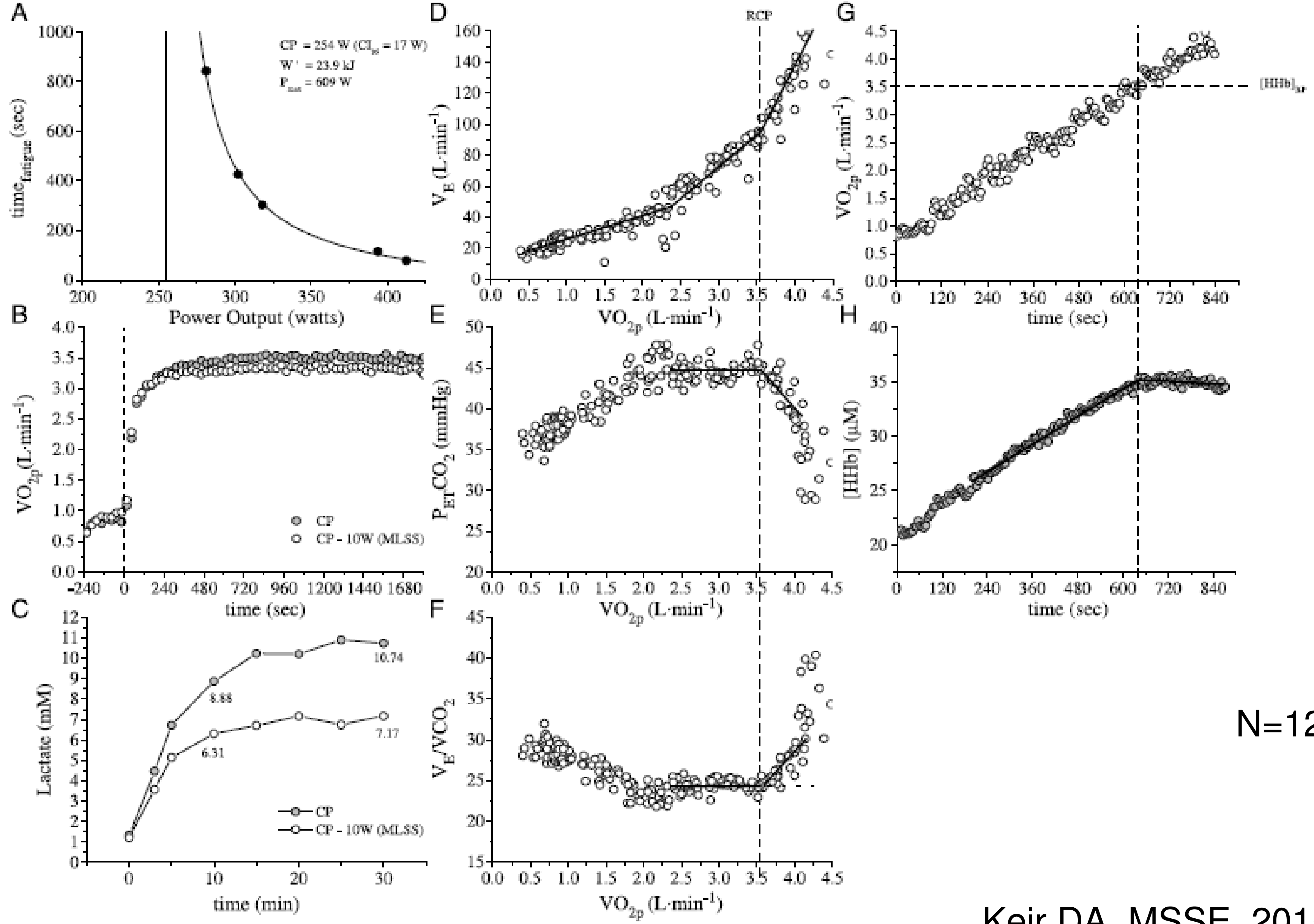
$$_{\text{corrected}}W = \frac{(VO_2\text{-intercept})}{\text{slope}} - \frac{\Delta W}{\Delta \text{time}} * MRT$$

Incremental exercise → Constant PO



$$_{corrected}W = -\left(VO_2 - VO_2@GET\right) * \frac{(slope_2 - slope_1)}{(slope_2 * slope_1)}$$

CP, RCP, MLSS and HHB_{BP} occur at equivalent VO2?



N=12

Keir DA, MSSE, 2015

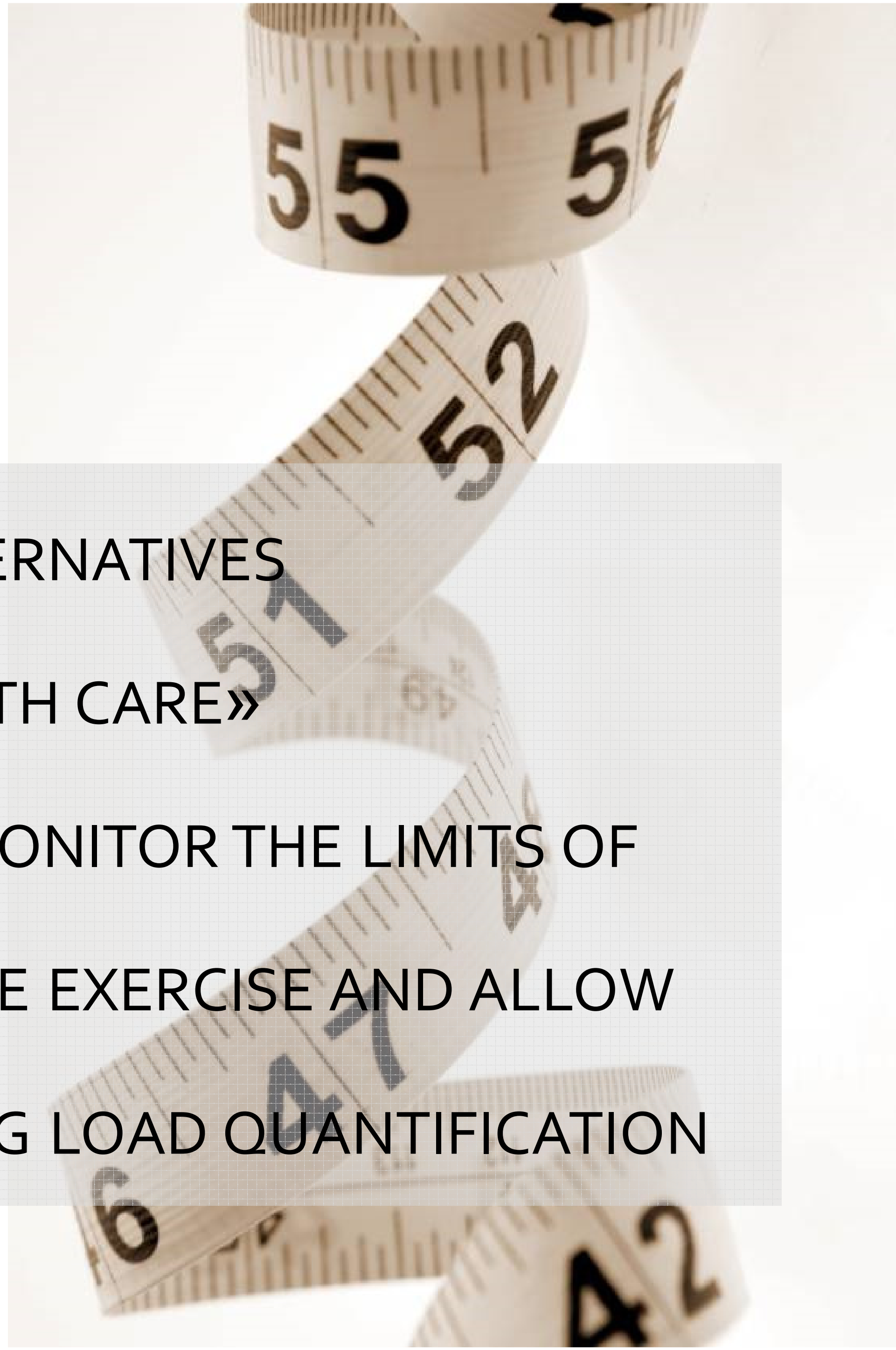
	CP	MLSS	RCP	$[HHb]_{BP}$
$\dot{V}O_{2p}$ ($L \cdot min^{-1}$)	3.29 ± 0.48	3.27 ± 0.44	3.34 ± 0.45	3.41 ± 0.46
PO (W)[a]	226 ± 45	223 ± 39	262 ± 48*,**	273 ± 41*,**
HR (bpm)	162 ± 10	161 ± 10	158 ± 9	160 ± 8

CP, MLSS, RCP and HHB_{BP}
identify an identical «metabolic boundary»
between sustainable and unsustainable exercise

Possible common physiological mechanism
Interchangeable «with care»

Keir DA, MSSE, 2015

How to measure heavy-severe boundary



- ✓ WE HAVE «SMART» ALTERNATIVES
- ✓ INTERCHANGEABLE «WITH CARE»

TO DETERMINE AND MONITOR THE LIMITS OF TOLERABLE ENDURANCE EXERCISE AND ALLOW INDIVIDUALISED TRAINING LOAD QUANTIFICATION

Individual Measure of heavy-severe boundary
«Translate» it correctly
=
Essential for exercise quantification and development of evidence-based, individualised exercise prescription to improve exercise tolerance

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Luca Dal Sacco
Paolo Bruseghini
Federico Fontana
Giorgia Spigolon
Alessandro Colosio

Don Paterson
Juan Murias
Daniel Keir

MINISTERO DELL' ISTRUZIONE, DELL'UNIVERSITÀ E DELLA RICERCA

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