Moving the Limitations: Interventions to Enhance O_2 Uptake Kinetics and Exercise Performance

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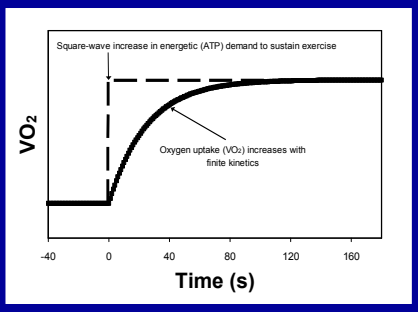
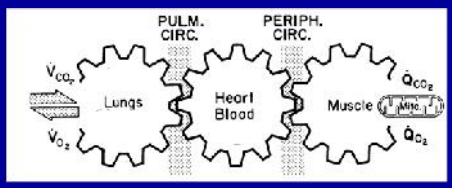
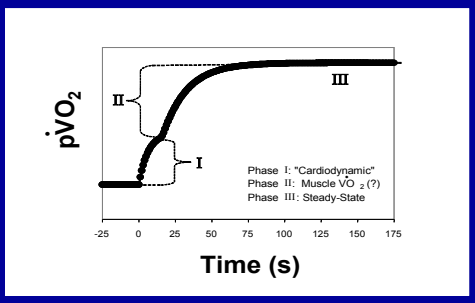
Muscle VO_2 Kinetics



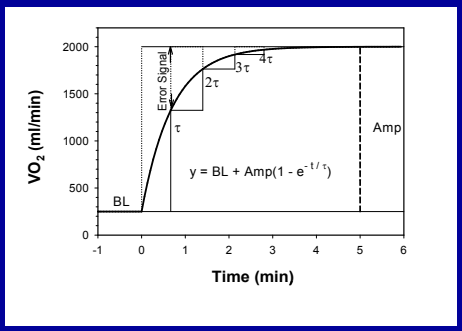
From Muscle to Mouth



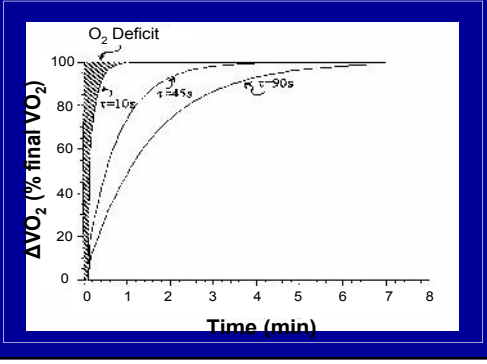
Pulmonary VO_2 Kinetics



Time Constant

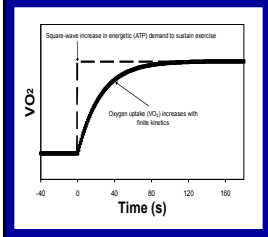


O_2 Deficit



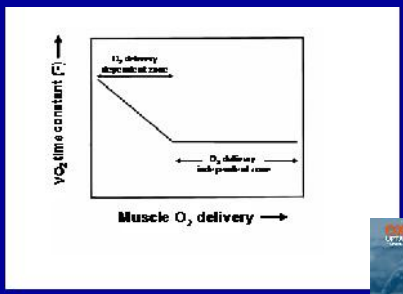
O_2 Deficit and Fatigue

O_2 Deficit = MRT x Amplitude



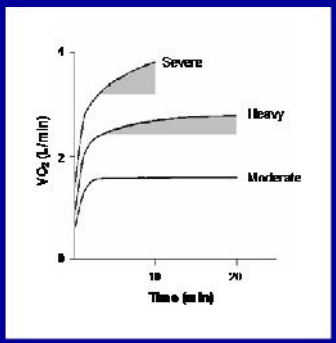
- A LARGER O_2 deficit means:
- greater PCr breakdown
- greater ADP and Pi accumulation
- greater H^+ and lactate accumulation
- greater rate of glycogen degradation

The "Tipping Point": O_2 Delivery Dependent vs. Independent Zones?

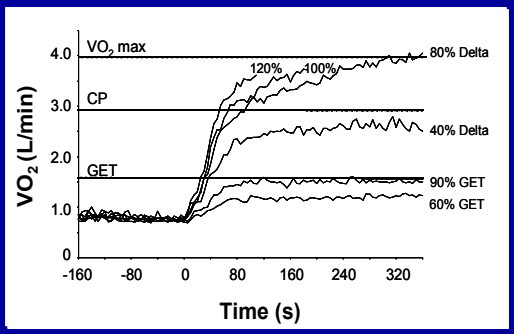


Jones and Poole, 2005, Kinetics Text Book

Exercise Domains

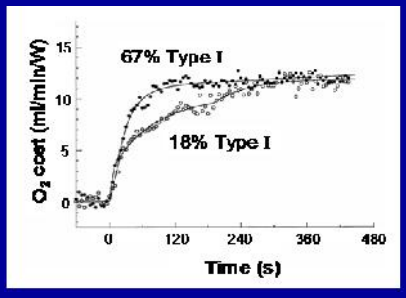


Exercise Domains



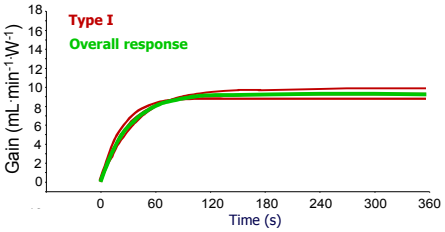
Wilkerson et al. (2004) RPNB 142:211-223

Influence of muscle fibre type on $\dot{V}o_2$ kinetics



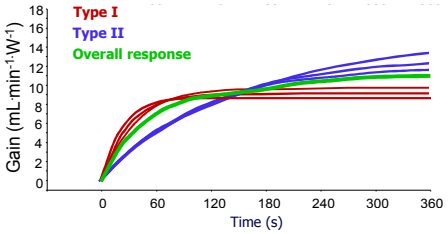
Barstow et al., 1996, J Appl Physiol

Fibre recruitment during moderate exercise



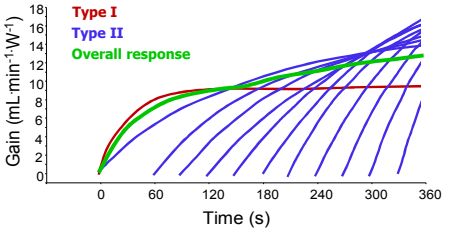
Wilkerson & Jones, *Resp Physiol Neurobiol* 156:203-11, 2007.

Fibre recruitment during heavy exercise



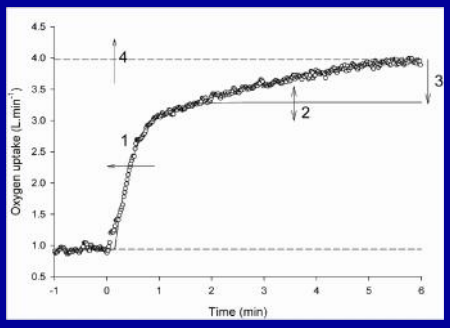
Wilkerson & Jones, *Resp Physiol Neurobiol* 156:203-11, 2007.

Fibre recruitment during severe exercise



Wilkerson & Jones, *Resp Physiol Neurobiol* 156:203-11, 2007.

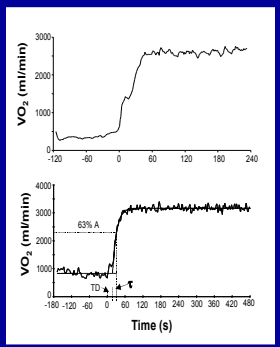
Effects of interventions on Vo_2 kinetics and performance during high-intensity exercise



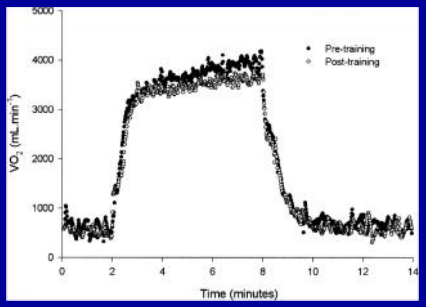
Training

Vo_2 kinetics are very fast in elite endurance athletes

Jones and Koppo (2005)

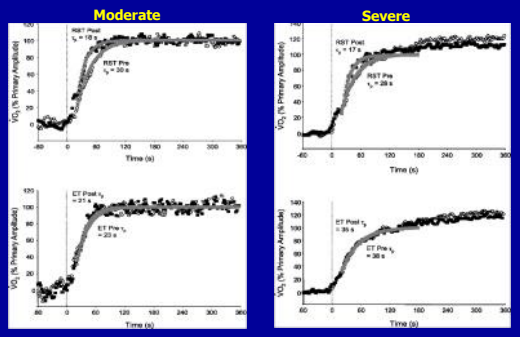


Acute endurance training enhances Vo_2 kinetics



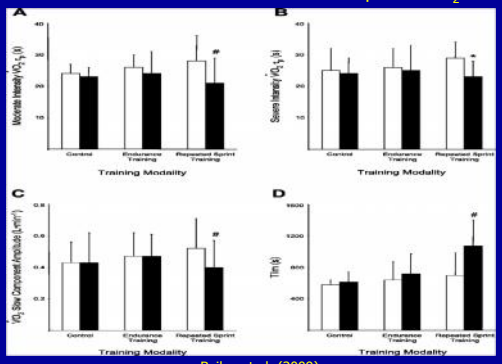
Carter et al. (2000)

Repeated sprint training also effective in improving VO_2 kinetics



Bailey et al. (2009)

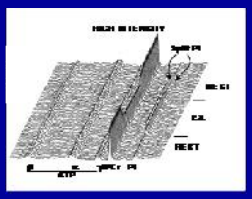
Enhanced exercise tolerance correlated with improved VO_2 kinetics



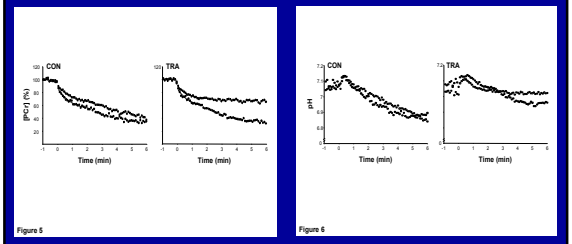
Bailey et al. (2009)

Knee extensor exercise performed inside the bore of a 1.5 T super-conducting magnet

^{31}P-MRS used to measure muscle metabolic responses to exercise following interventions



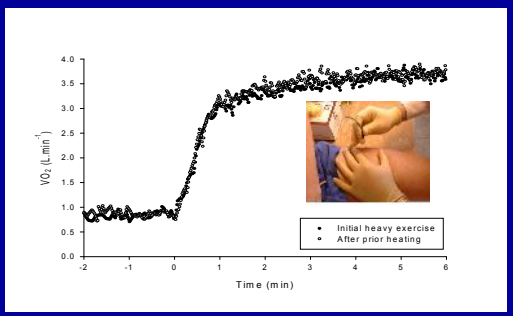
Muscle [PCr] and pH responses to high-intensity step exercise following training



Jones et al. (2007)

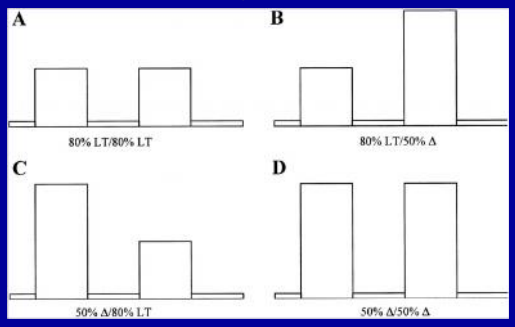
Warm-Up

Effect of increasing muscle temperature on $\dot{V}o_2$ kinetics

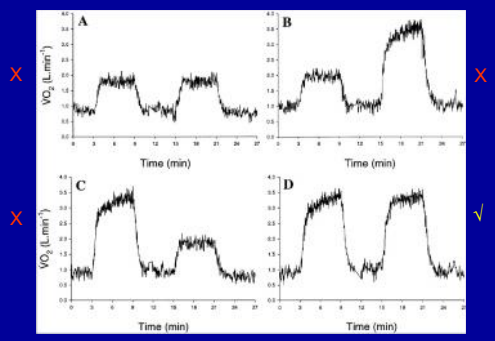


Burnley et al. (2002)

"Priming" Exercise

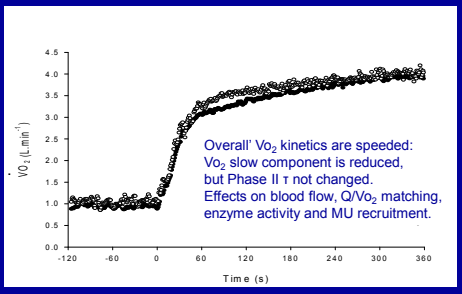


Gerbino et al. (1996)



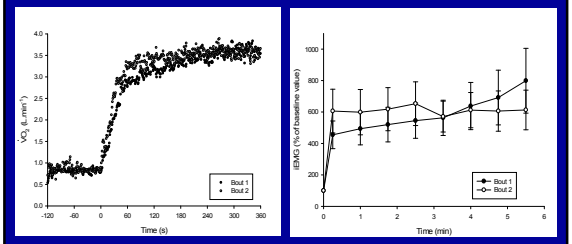
Burnley et al. (2000)

Effect of prior heavy exercise on Vo_2 kinetics



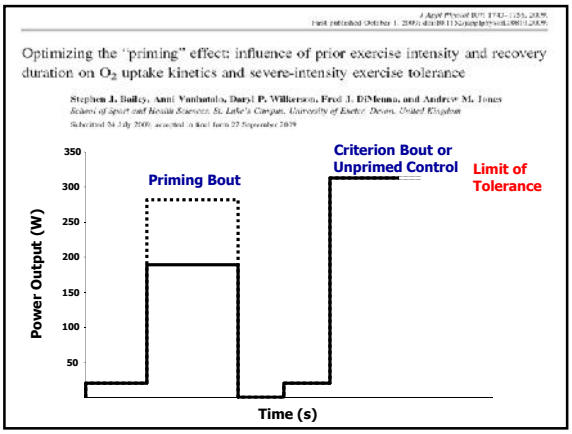
Burnley et al., 2006, J Appl Physiol

Priming exercise: effects on fibre recruitment?



Burnley et al. (2002)

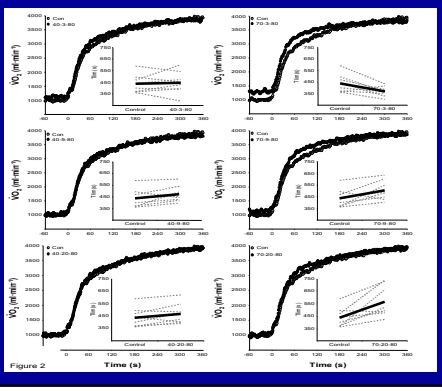
Dr Mark Burnley



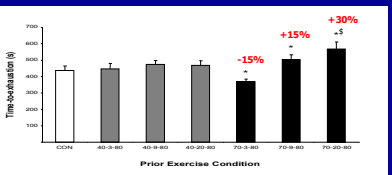
Optimizing the "priming" effect: influence of prior exercise intensity and recovery duration on O_2 uptake kinetics and severe-intensity exercise tolerance

Stephen J. Bailey, Anni Vanhatalo, Daryl P. Wilkerson, Fred J. DiMenna, and Andrew M. Jones
School of Sport and Health Sciences, St. Luke's Campus, University of Exeter, Devon, United Kingdom

Interaction of prior exercise intensity and subsequent recovery duration



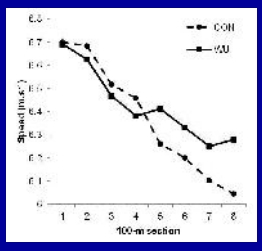
Optimal 'warm-up' enhances performance

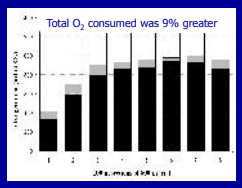


Pre-exercise blood [lactate] of ~ 3 mM appears to be optimal

Prior *high-intensity* exercise coupled with *sufficient* recovery optimizes the balance between preserving the effects of prior exercise on VO_2 kinetics and providing sufficient time for muscle homeostasis to be restored.

Prior high-intensity exercise improves 800-m running performance





ENGLISH INSTITUTE OF SPORT

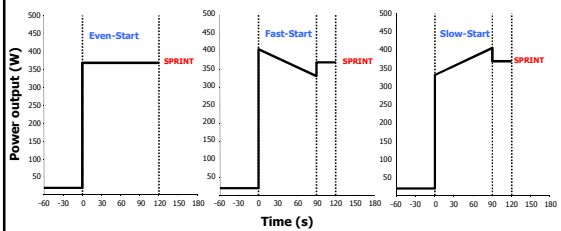
Ingham et al., 2013, IJSPP

"In elite middle-distance athletes, 800-m time-trial performance was significantly faster following HWU (HWU, 124.5 ± 8.3 vs. CON, 125.7 ± 8.7 s, P<0.05)."

Pacing

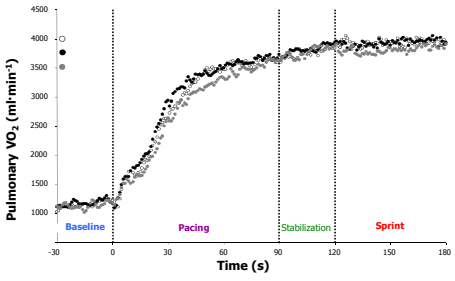
Fast-Start Strategy Improves $\dot{V}O_2$ Kinetics and High-Intensity Exercise Performance

STEPHEN J. BAILEY, ANNE VANHATALO, FRED J. DIMENNA, DARYL P. WILKERSON, and ANDREW M. JONES
School of Sport and Health Sciences, University of Exeter, Exeter, Devon, UNITED KINGDOM



- **3 × Work-Matched Pacing Strategies (Even-Start, Fast-Start, Slow-Start)**
- **Each Trial Terminated with a 1 min All-Out Sprint**

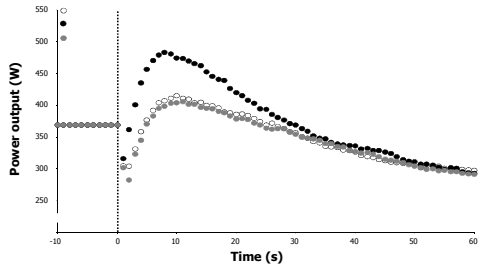
Influence of Pacing Strategy on Pulmonary $\dot{V}O_2$ Kinetics



Bailey et al., 2011, Med Sci Sports Exerc

EXETER

Influence of Pacing Strategy on Exercise Performance

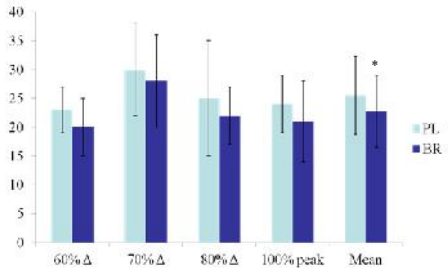


Bailey et al., 2011, Med Sci Sports Exerc

Nutrition

Effects of Nitrate on the Power–Duration Relationship for Severe-Intensity Exercise

JAMES KELLY, ANNI VANHATALO, DARYL P. WILKERSON, LEE J. WYLIE, and ANDREW M. JONES
Sport and Health Sciences, College of Life and Environmental Sciences, St. Luke's Campus, University of Exeter, Heavitree Road, Exeter, UNITED KINGDOM



Work-to-work models unveil type II fibre properties

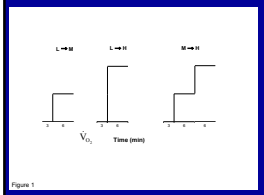


Figure 1

	L→M	L→H	M→H
Baseline $\dot{V}O_2$ (L/min)	0.79	0.80	1.66 *
Phase II Time Constant (s)	26 ± 6	27 ± 4	48 ± 11 *
End-Exercise Gain (mL/min/W)	8.1 *	9.7 *	10.7 *

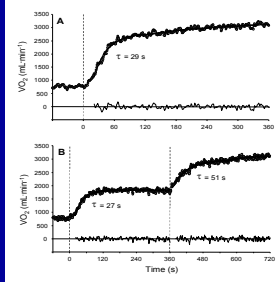
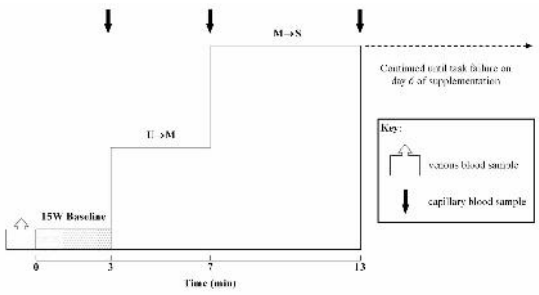


Figure 2

Wilkerson and Jones (2006)

Influence of nitrate supplementation on VO_2 kinetics during work-to-work exercise



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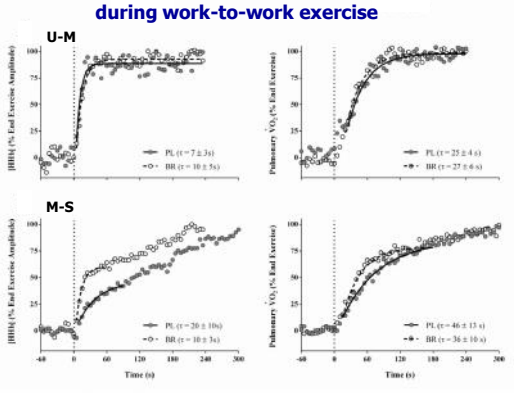
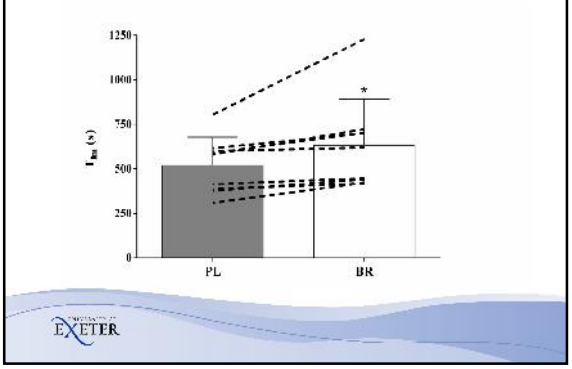


Faster VO_2 kinetics = better endurance



Effects of interventions on Vo_2 kinetics and performance during high-intensity exercise