XXXII MEMORIAL
PAOLO D'ALOJA

# FISA ROWING TRAINING CAMP

## Seminar for Coaches of Development Countries

**Thursday 11 April 2019**

# *Monitoring training adaptation in elite endurance rowers and tapering to the main competition: opening the door to effective monitoring*


**Dario Cerasola, PhD**

**Sciences of Human Movement and Sport Performance**

**Italian Rowing Federation Coach**

**Biomechanical, Performance and functional evaluation of the Olimpic Team**


PIEDILUCO (TR) – ITALY

- Rowing Introduction

- Physiological Aspects
  - Evaluation
    - Aerobic >> VO2max
    - Anaerobic >> Alactacid - Lactacid

- Biomechanic Aspects
  - Evaluation
    - Rowing tecnique >> power and angle

- State of fatigue
  - Evaluation
    - Heart rate variability >> overtraining

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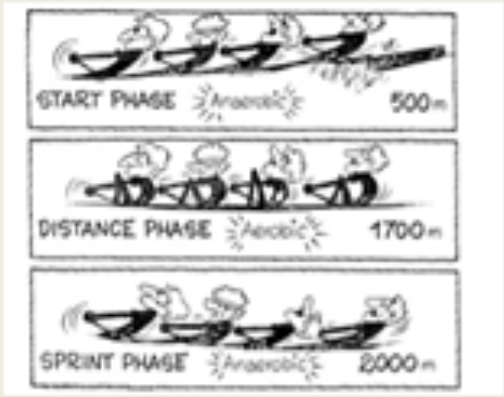
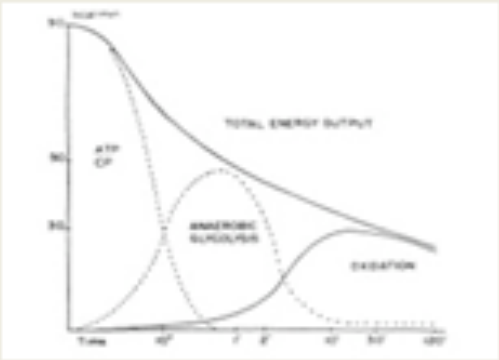
# STEP 1°

## Introduction

# Rowing Physiology

- Aerobic 75-80%
- Anaerobic 15-20%
- 2000 mt
- 1xf 7,40 min / 8+m 5,30 min



Mikulić, P. (2008). Anthropometric and physiological profiles of rowers of varying ages and ranks. *Kinesiology*, 40(1), 80-88.

Secher, N.H. (1983). The physiology of rowing. *Journal of Sports Sciences*, 1(1) 23-53.

# Rowing Performance Aspects

Environment condition

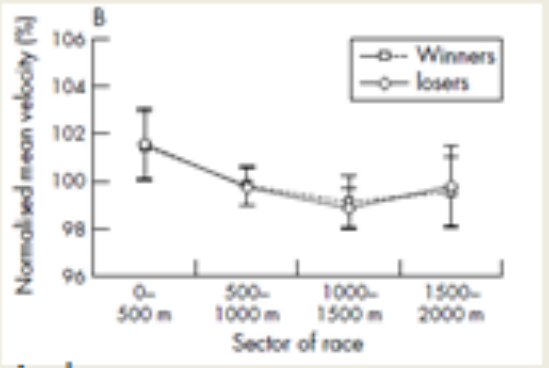
Physiological

Training

# Rowing Performance Aspects

## Technique

## Race Strategy




## Psycological

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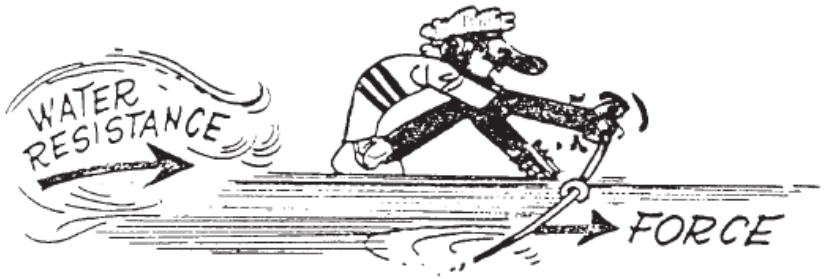
## The main purpose of the coaches is:

Rowers Faster

Resistent ↓

- Influenze of water
- Influence of air
- Technique




Propulsion ↑

- Physiological aspect
- Training
- Technique

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# STEP 2°

## Physiological factors

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# Anatomy of a


Anatomy of a Rower.mp4

# Season Program

"The annual plan is often viewed as the most important tool for the coach to guide athletes' training over a year."
*T. Bompa*

*Figure 1: The Periodisation of Dominant Abilities in Rowing*

| | Preparatory | | | Competitive | | Transit |
|---|---|---|---|---|---|---|
| | General Preparation | Specific Preparation | | Pre-Competition | Main Competition | Transit |
| **Strength** | Anatomical Adaptation | Max strength | Conversion to Musc. End. | Main-tenance | Chps | Rehab. |
| **Endurance** | Aerobic Endurance | Development of Foundation of Specific Endurance | | Specific Endurance | | Aerobic Endurance |

October >> February March >> Agust

$VO_2max$ → 70% central conditions
30% peripheral conditions

- Central conditions → Systolic cardiac output
- Peripheral conditions → Muscular capillarization

*Figure 1: The Periodisation of Dominant Abilities in Rowing*

| | Preparatory | | Competitive | Transit |
|---|---|---|---|---|
| **Endurance** | Aerobic Endurance | Development of Foundation of Specific Endurance | Specific Endurance | Aerobic Endurance |

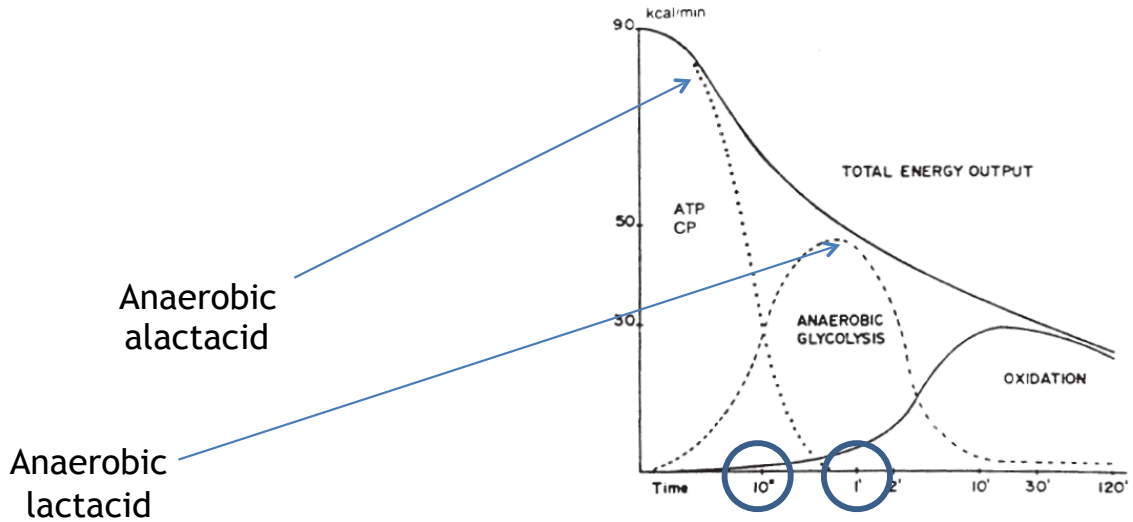
Low aerobic intensity training ↑ ↓ Muscular capillarization

High aerobic intensity training ↑ ↓ Systolic cardiac output

# Anaerobic

**Table 1** Stroke rate, peak force, peak power, work and power per stroke and average power for stroke and recovery during a typical rowing race in the single scull. Results are compiled from biomechanical measurements and evaluations in the former department of biomechanics of the Humboldt-Universität at East Berlin and the center of rowing research of the former East Germany (courtesy of P. Schwanitz and W. Roth).

| | Time (min, s) | Stroke rate (l/min) | Peak force (N) | Peak velocity (m/s) | Peak power (W) | Work per stroke (Nm) | Power per stroke (W) | Average power (W) |
|---|---|---|---|---|---|---|---|---|
| Start spurt | 0–10 s | 36–42 | 1000–1500 | 3.0–4.0 | 2500–3000 | 900–1100 | 800–1200 | 600–700 |
| Start phase | 10–60 s | 34–38 | 600– 800 | 2.2–3.5 | 1400–2800 | 800– 950 | 700–1000 | 450–600 |
| Final spurt | 5– 6 min | 34–38 | 600– 700 | 2.2–2.8 | 1300–1800 | 700– 800 | 750–1000 | 400–500 |




Steinacker, J.M. (1993). Physiological aspects of training of rowing. Internationa Journal of Sports Medicine,14 Suppl 1, 3-10.

*Figure 1: The Periodisation of Dominant Abilities in Rowing*

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| | General Preparation | Specific Preparation | | Pre-Competition | Main Competition | Transit |
| Strength | Anatomical Adaptation | Max strength | Conversion to Musc. End. | Main-tenance | Chps | Rehab. |

Anaerobic alactacid

Anaerobic lactacid

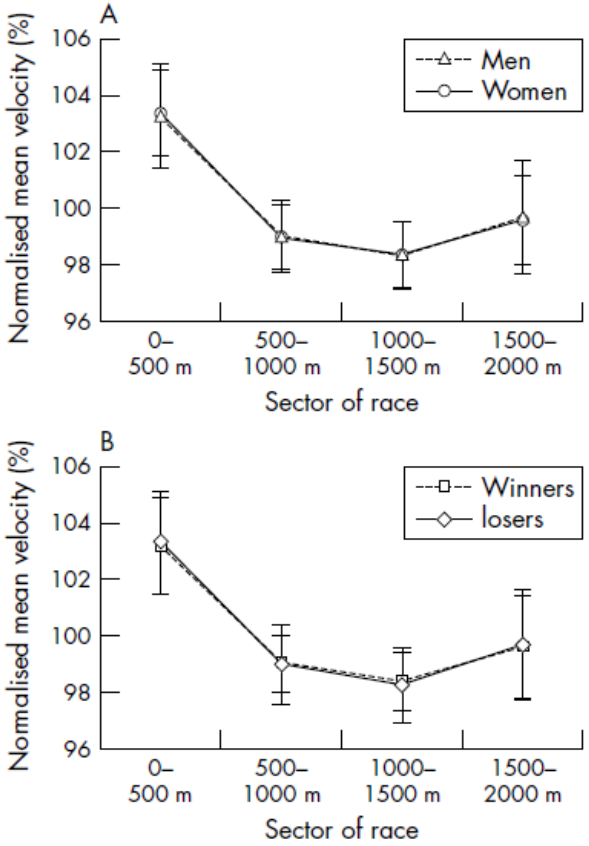



**Figure 1** On-water race pace profiles comparing (A) men (n = 661) and women (n = 287), and (B) winners (n = 500) and losers (n = 448).

**Aerobic** →

**Anaerobic** →

**Race strategy**

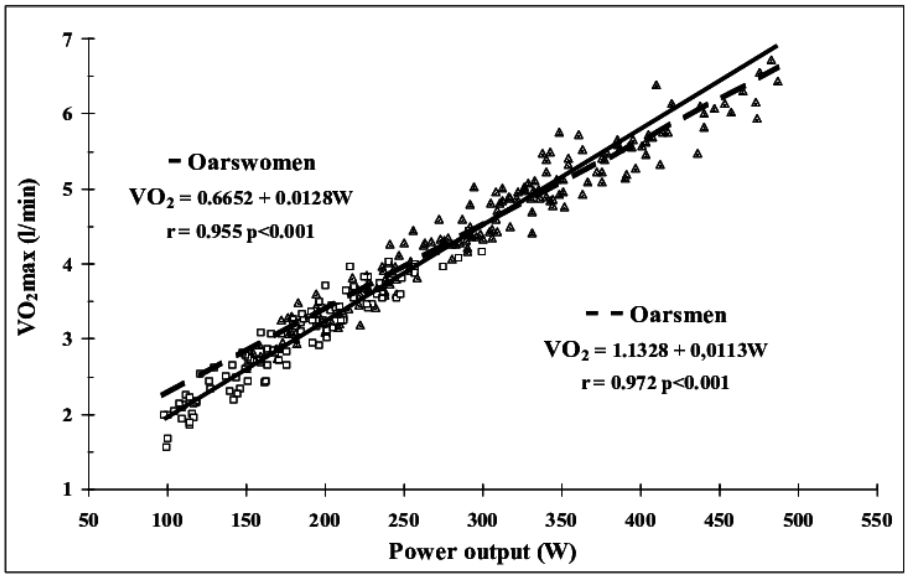
Cerasola, D, Cataldo, A, Bellafiore, M, Traina, M, Palma, A, Bianco, A, and Capranica, L. Race profiles of rowers during the 2014 Youth Olympic Games. J Strength Cond Res 32(7): 2055-2060, 2018

Garland, SW. (2005). An analysis of the pacing strategy adopted by elite competitors in 2000 m rowing British Journal of Sports Medicine 39:39-42.

# Types of evaluation tests

- Direct tests: they measure the required parameter
- Indirect tests: they measure the parameter across an secondary factor

# Indirect tests VO2max




Relation between oxygen uptake and power output in oarsmen (▲, n=44) and oarswomen (□, n=27) exercising on the 2000 mt Concept II rowing ergometer .

- Math formulas
- Test / graphic
- Device (garmin-suunto)

A.Klusiewicz, J.Faff (2003). Indirect Methods Of Estimating Maximal Oxygen Uptake On The Rowing Ergometer *Biology of Sport*, Vol. 20 N3, 2003

# Direct tests VO2max

| Time Min | Work Watt | HR | BF | RQ | EQ-CO2 | VE l/min | Vo2 l/min | Vo2/mL kg*min | MET | VO2/kg /HR | VCo2 l/min | FCo2 % | EQ-O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0:30 | 450 | 158 | 37 | 1.13 | 41 | 82.2 | 1.75 | 19.5 | 5.6 | 0.12 | 1.99 | 3.07 | 47 |
| 1:00 | 420 | 171 | 59 | 0.85 | 40 | 161.3 | 4.79 | 53.3 | 15.2 | 0.31 | 4.07 | 3.20 | 34 |
| 1:30 | 420 | 178 | 63 | 0.92 | 38 | 214.6 | 6.10 | 67.8 | 19.4 | 0.38 | 5.61 | 3.32 | 35 |
| 2:00 | 390 | 174 | 67 | 1.00 | 38 | 227.3 | 6.00 | 66.7 | 19.1 | 0.38 | 6.03 | 3.37 | 38 |
| 2:30 | 400 | 175 | 64 | 1.03 | 37 | 227.7 | 5.95 | 66.1 | 18.9 | 0.38 | 6.11 | 3.41 | 38 |
| 3:00 | 380 | 178 | 65 | 1.03 | 37 | 236.1 | 6.11 | 67.9 | 19.4 | 0.38 | 6.31 | 3.39 | 39 |
| 3:30 | 390 | 180 | 67 | 1.03 | 37 | 234.7 | 6.09 | 67.7 | 19.3 | 0.38 | 6.30 | 3.41 | 39 |
| 4:00 | 370 | 181 | 62 | 1.02 | 37 | 229.2 | 6.03 | 67.1 | 19.2 | 0.37 | 6.16 | 3.42 | 38 |
| 4:30 | 390 | 179 | 65 | 1.01 | 38 | 233.8 | 6.13 | 68.1 | 19.5 | 0.38 | 6.18 | 3.36 | 38 |
| 5:00 | 380 | 178 | 64 | 1.01 | 37 | 232.6 | 6.16 | 68.4 | 19.6 | 0.38 | 6.21 | 3.39 | 38 |
| 5:30 | 380 | 181 | 68 | 1.00 | 38 | 235.5 | 6.18 | 68.6 | 19.6 | 0.38 | 6.19 | 3.34 | 38 |
| 6:00 | 434 | 180 | 67 | 1.01 | 38 | 229.6 | 5.98 | 66.4 | 19.0 | 0.37 | 6.02 | 3.33 | 38 |
| 6:30 | | | | | | | | | | | | 3.34 | |
| 7:00 | | | | | | | | | | | | 3.32 | |
| Max | 450 | 181 | 68 | 1.13 | 41 | 236.1 | 6.18 | 68.6 | 19.6 | 0.38 | 6.31 | 3.42 | 47 |
| Pred | | 193 | | | | 199.5 | 3.37 | 45.7 | | | | | |
| %Pre | | 92% | | | | 118 | 183 | 150 | | | | | |

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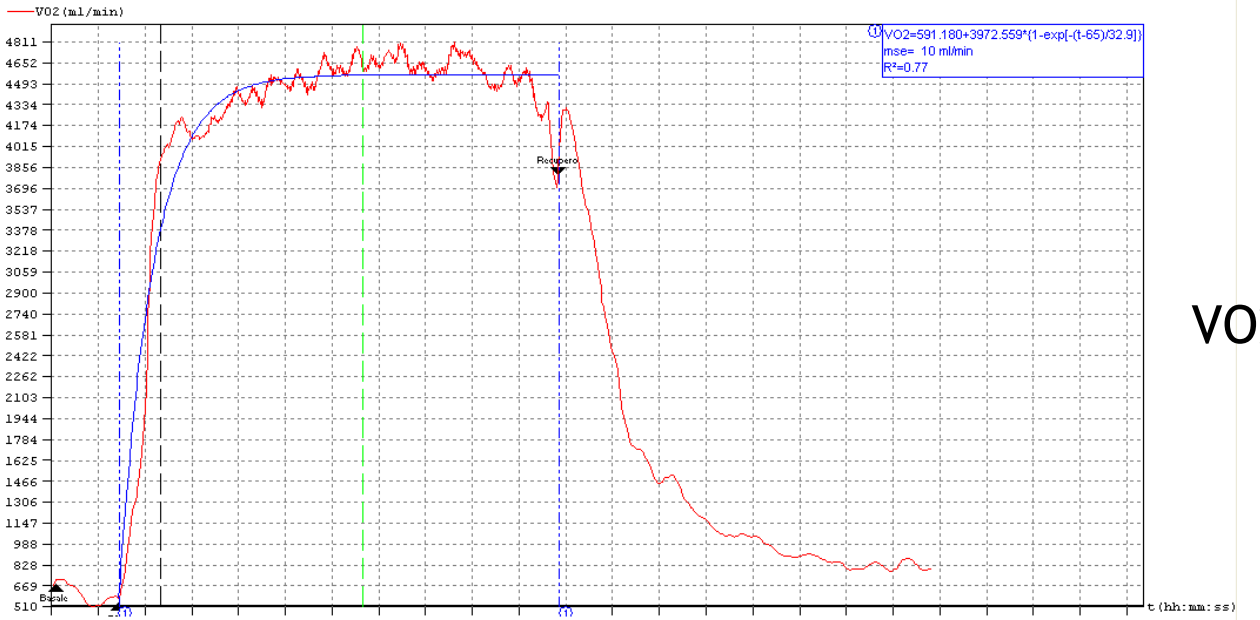
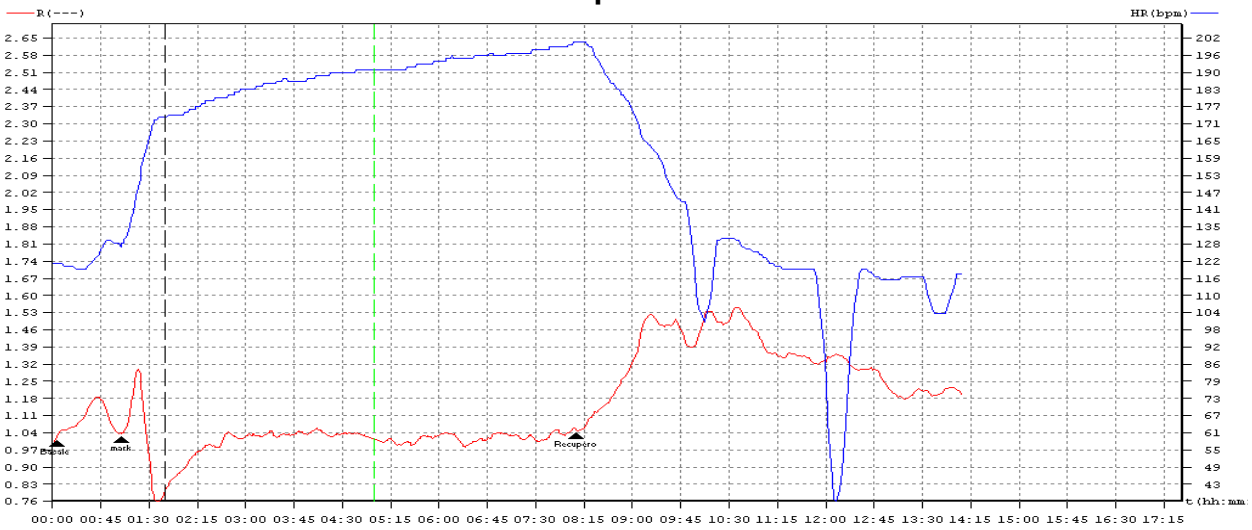
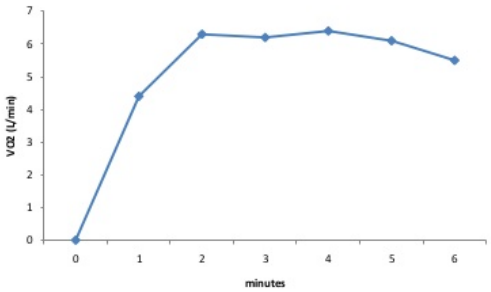



Start Stop




VO2max during 2000 rowing ergomete

A typical VO2 curve during simulated 2000 m race is shown below. To calculate average VO2 during the test the values of the first minute VO2 have to be excluded from the analysis due to the „slow take-off" of the aerobic energy system. The ability to **sustain high VO2 during the race** is trivial for rower and this ability can be increased even if there is the plateau of the VO2max in elite rowers.




NOTE: As VO2max is the prerecuisite of becoming a high level rower, the ability to sustain high VO2 for longer period is the marker of how effectively a rower uses his potential.

Maximal oxygen consumption values during the simulated 2000 m rowing ergometer test.

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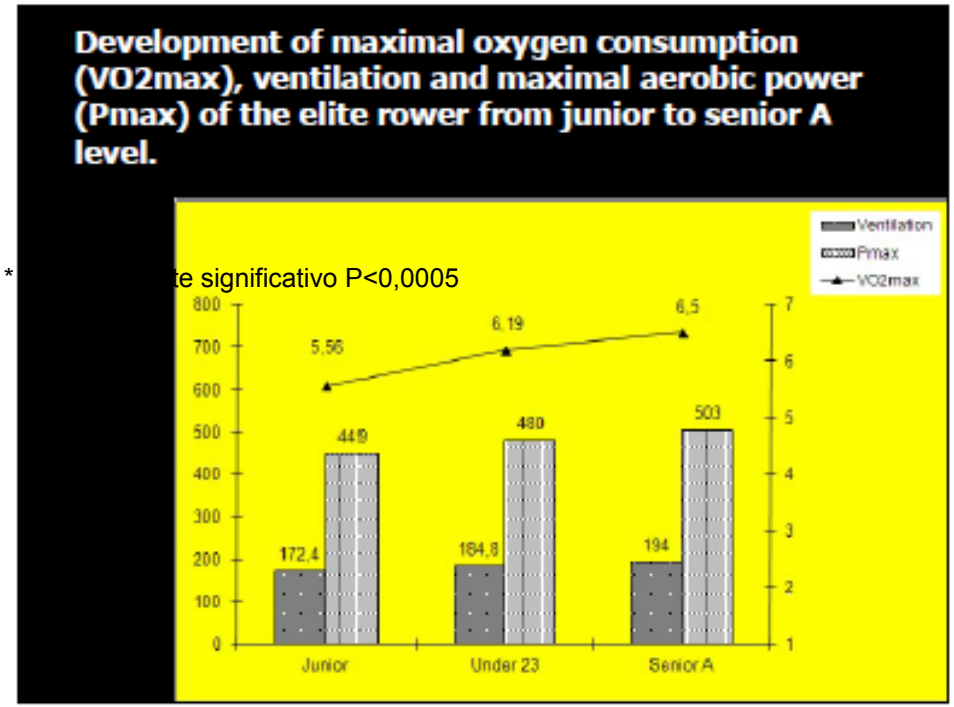
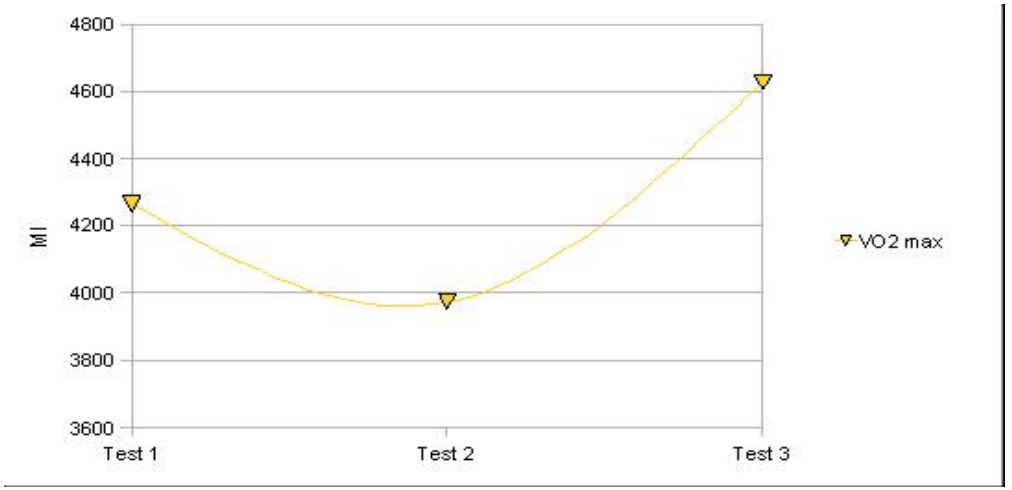



Jurimae (2017). Monitoring of performance and training in athletes

## Seasonal changes in VO2 max




Cataldo A, Cerasola D, Russo G, Zangla D, Traina M (2013).
Seasonal changes in physiological parameters in young club level rowers. Sport Science Foe He vol. 9, p. 30, ISSN: 1824-7490

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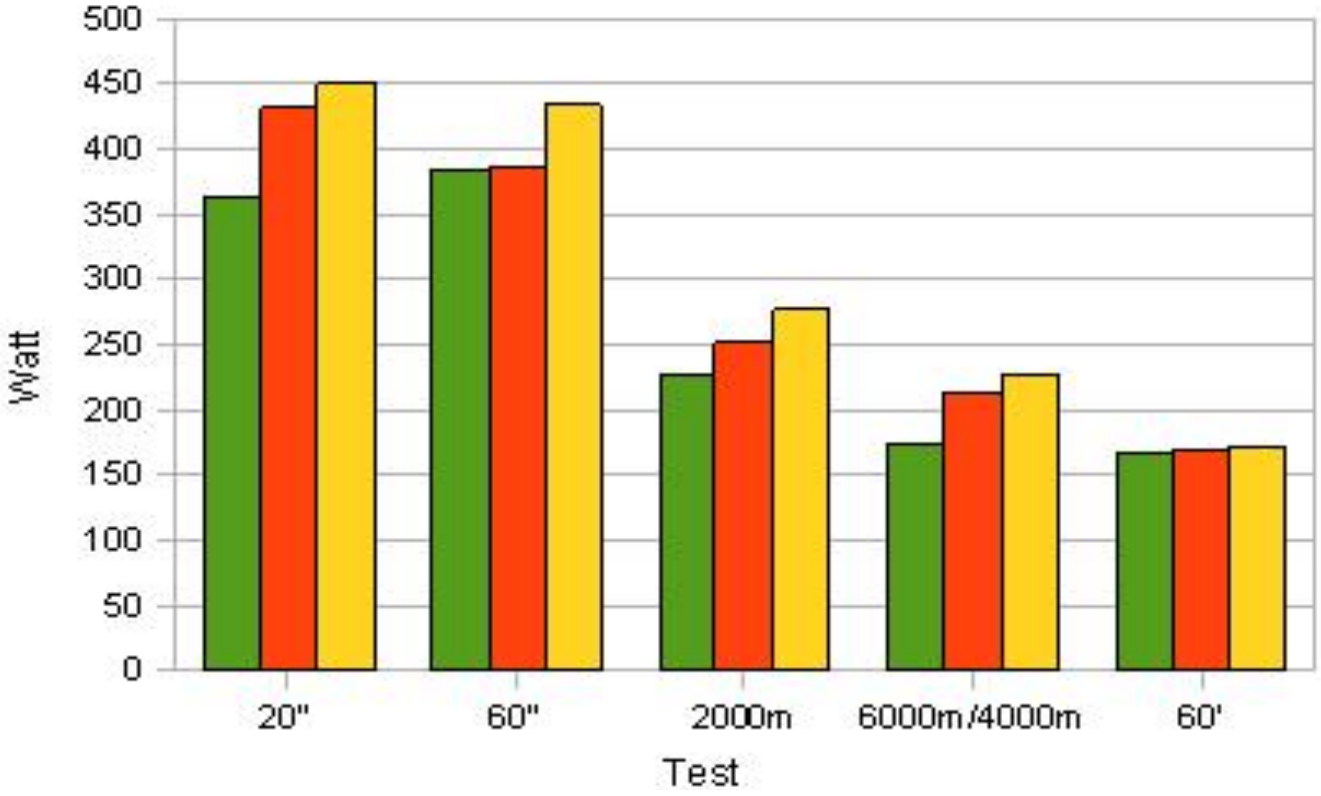


| Preparatory | | Competitive | | Transit |
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Cataldo A, Cerasola D, Russo G, Zangla D, Traina M (2013). Seasonal changes in physiological parameters in young club level rowers. Sport Science For Healty,

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# STEP 3°

## Biomechanical factors

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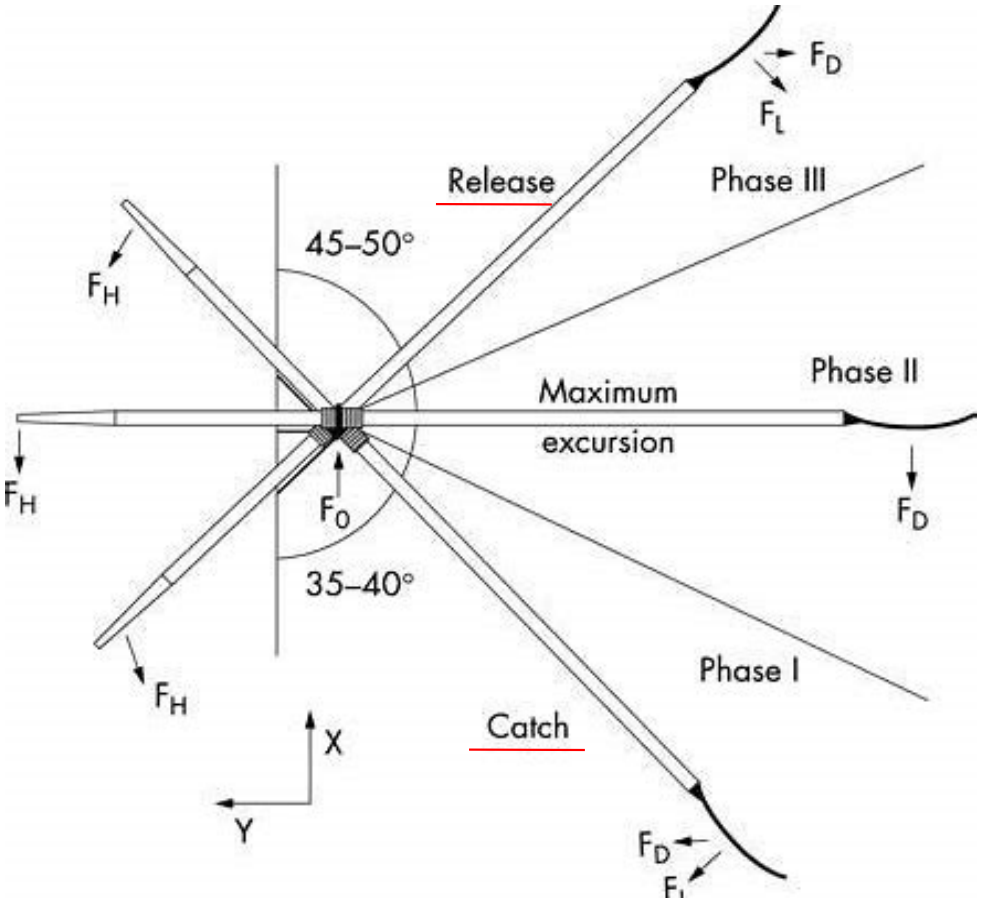
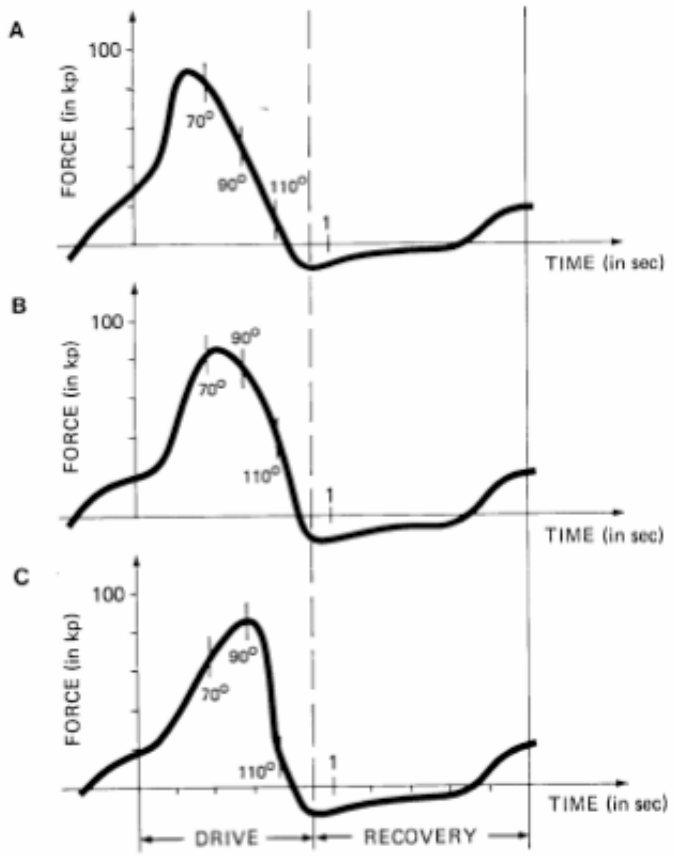
# TECNIQUE

## biomechanically correct application of the forces

# Stroke length and power



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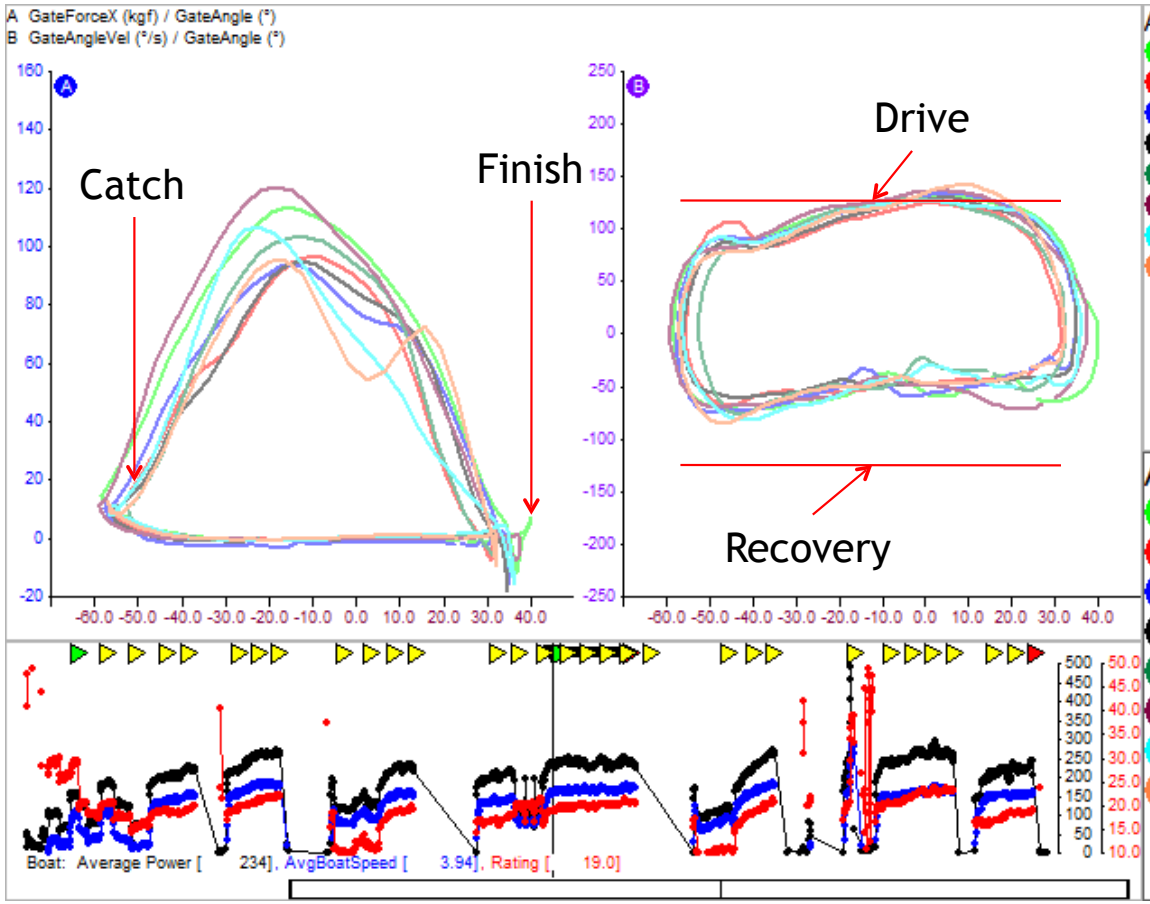
# Power line
# 8+ Boat




| Average | | min/ max | length | effect | catch/ finish |
|---|---|---|---|---|---|
| 1 | S | -59.0/ +40.8 | +99.9 | +83.3 | +6.4/ +10.2 |
| 2 | P | -56.1/ +32.1 | +88.2 | +68.6 | +10.5/ +9.1 |
| 3 | S | -58.3/ +33.3 | +91.6 | +78.7 | +9.6/ +3.3 |
| 4 | P | -56.7/ +34.9 | +91.6 | +71.7 | +11.8/ +8.1 |
| 5 | P | -52.9/ +33.0 | +85.9 | +67.8 | +8.6/ +9.6 |
| 6 | S | -59.7/ +38.2 | +97.9 | +80.9 | +7.0/ +10.0 |
| 7 | P | -56.7/ +36.9 | +93.5 | +72.4 | +10.6/ +10.5 |
| 8 | S | -57.5/ +33.0 | +90.5 | +73.7 | +12.9/ +3.9 |

| Average | | |
|---|---|---|
| 1 | 287 | W |
| 2 | 213 | W |
| 3 | 235 | W |
| 4 | 222 | W |
| 5 | 230 | W |
| 6 | 290 | W |
| 7 | 216 | W |
| 8 | 216 | W |
| | 4.00 | m/s |
| | 20.0 | spm |

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# STEP 4°

## State of fatigue

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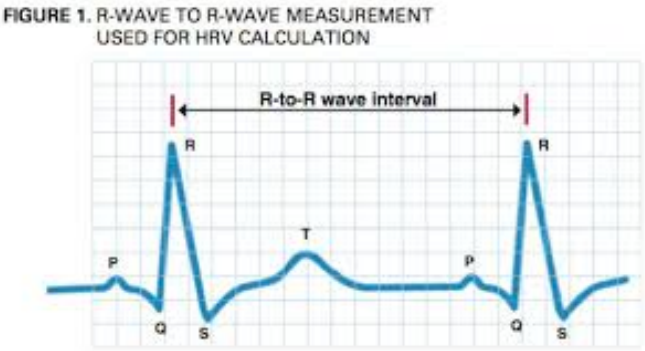
# The evaluation of the state of fatigue to prevent the overtraining

- Heart Rate Variability (HRV)

- The HRV describes the variations in the intervals between successive heartbeats
- Parasympatetic and Sympatetic Systems




- Parasympatetic Systems >> (HF) decrease heart r
- Sympatetic Systems >> (LF) increase heart rate

- Relationship Parasympatetic and Sympatetic >> **state of fatigue/overtraining**
- Ratio 0-2 Good >2 Probably overtraining

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Polar V800

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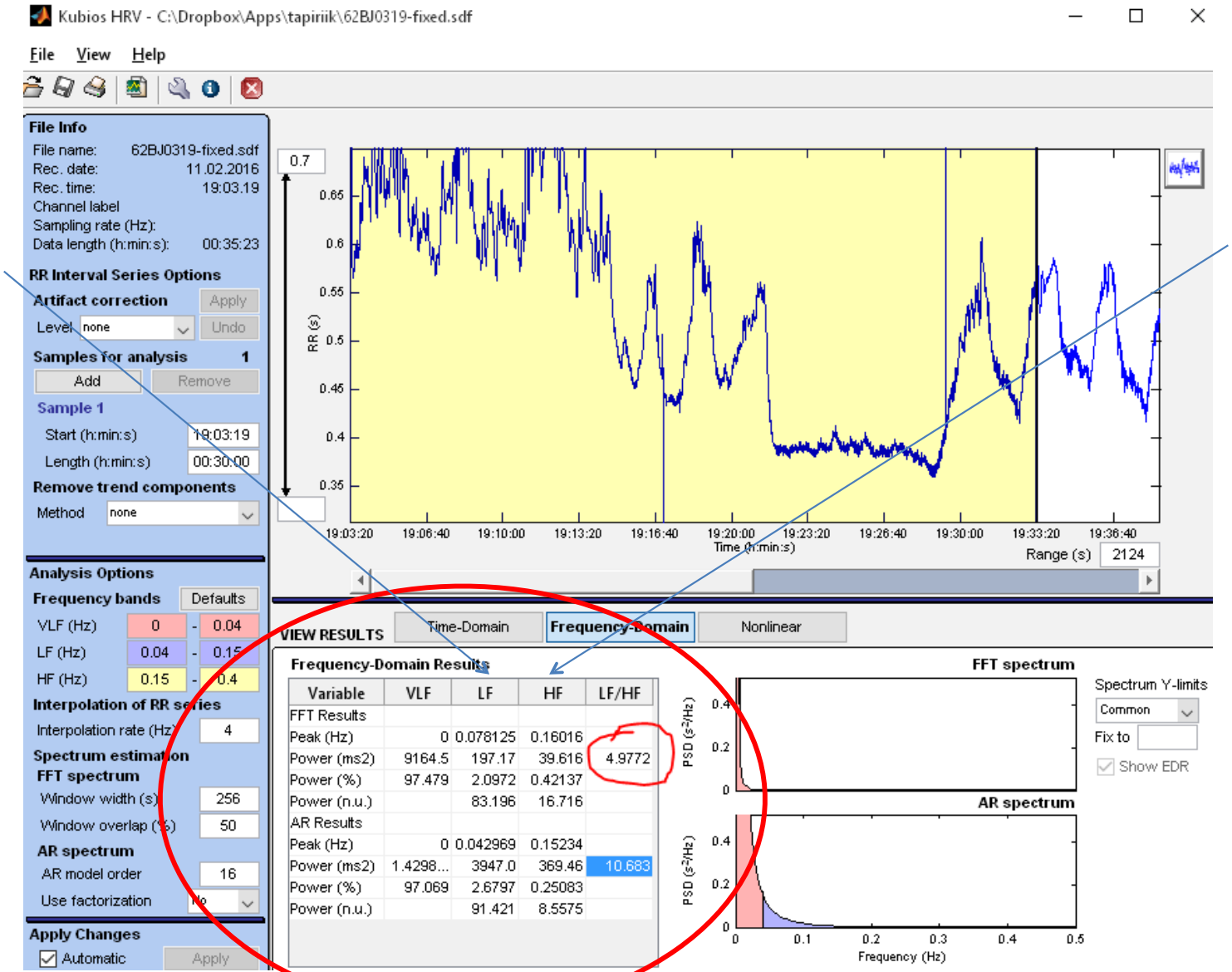
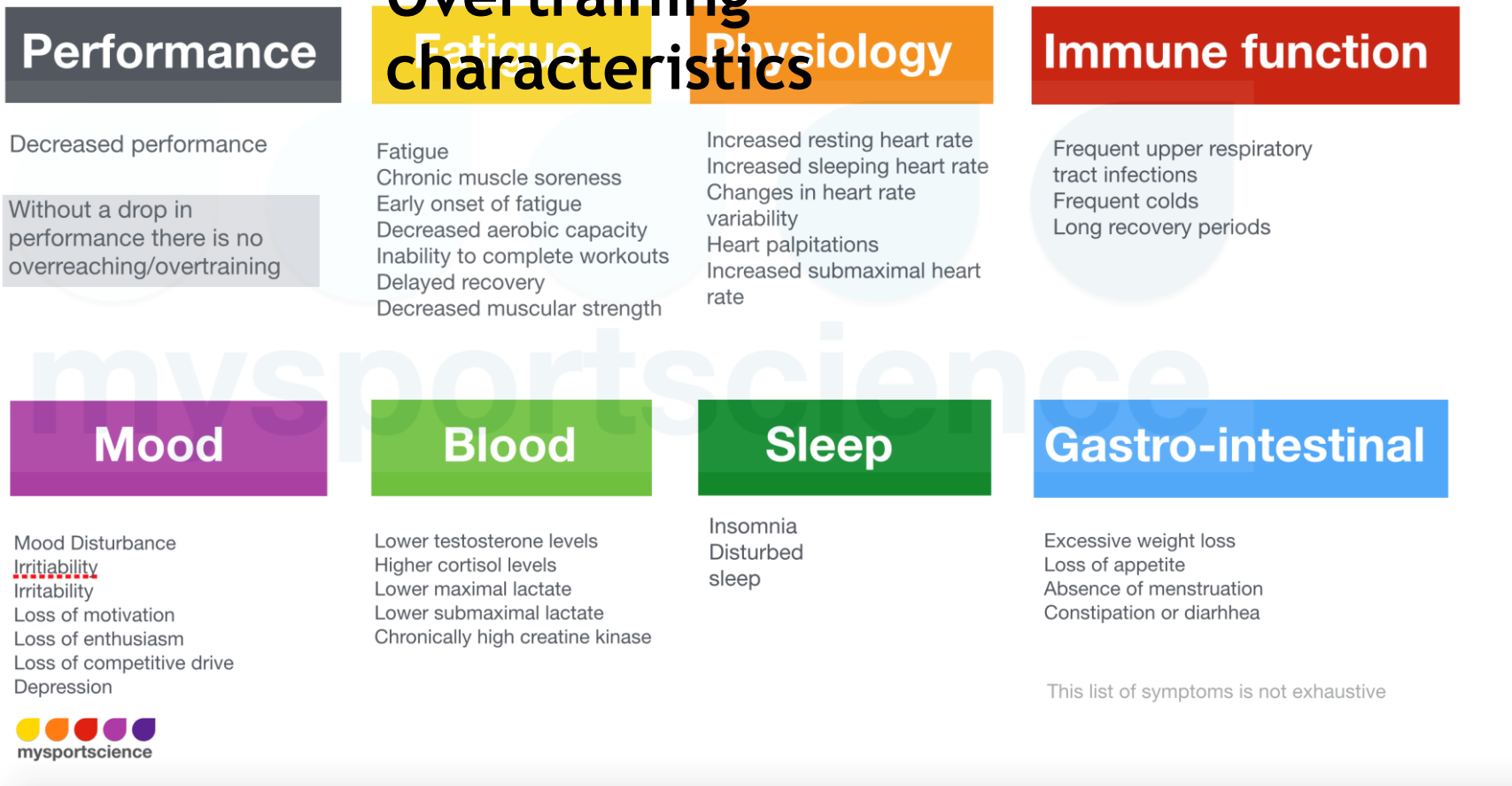
Sympatetic

Paraympatetic



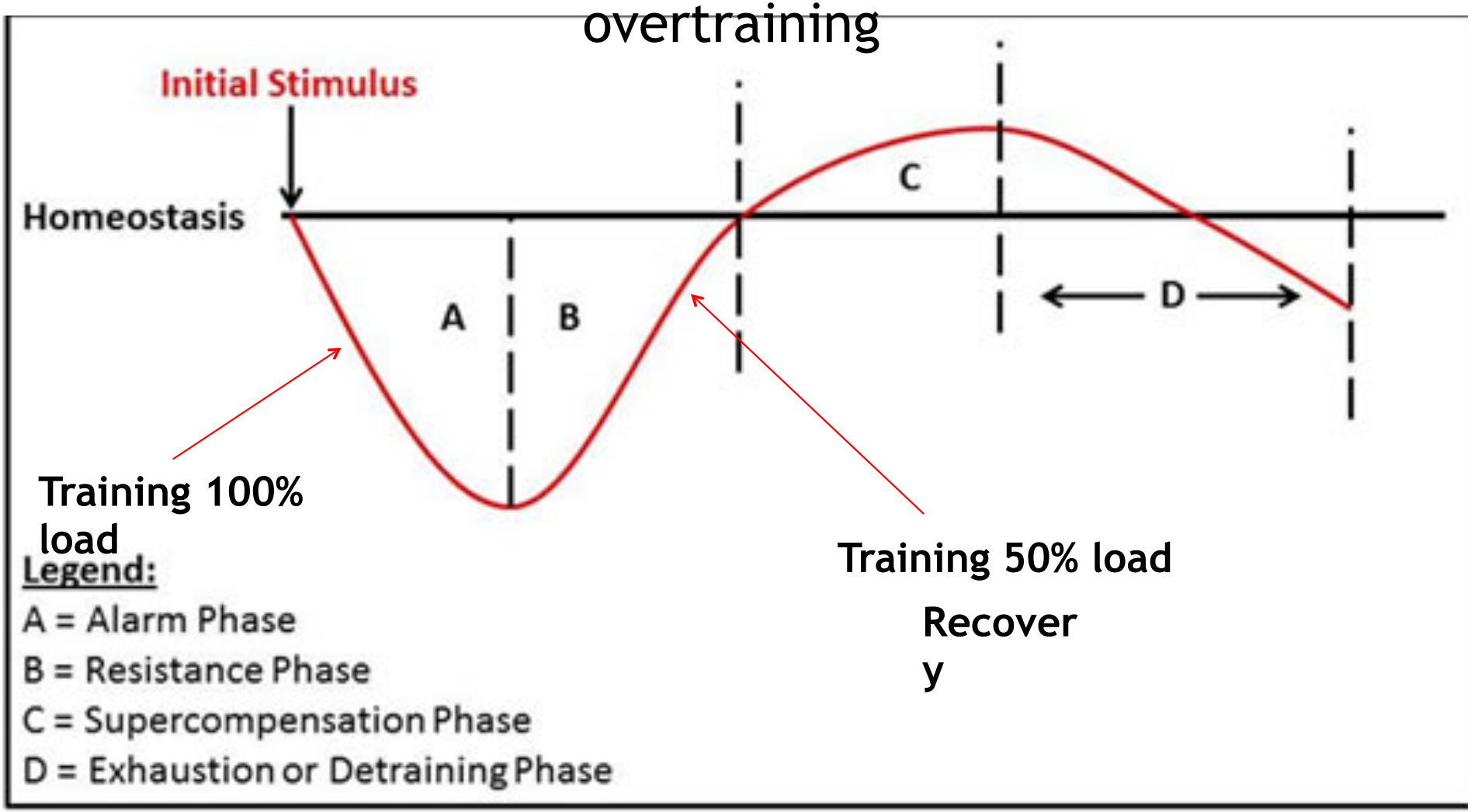
# Overtraining characteristics




Bojan Makivić, Marina Djordjević Nikić, Monte S. Willis. Heart Rate Variability (HRV) as a Tool for Diagnostic and Monitoring Performance in Sport and Physical Activities. *Journal of Exercise Physiology Online* *16*(3):

# Surpercompensation Principle

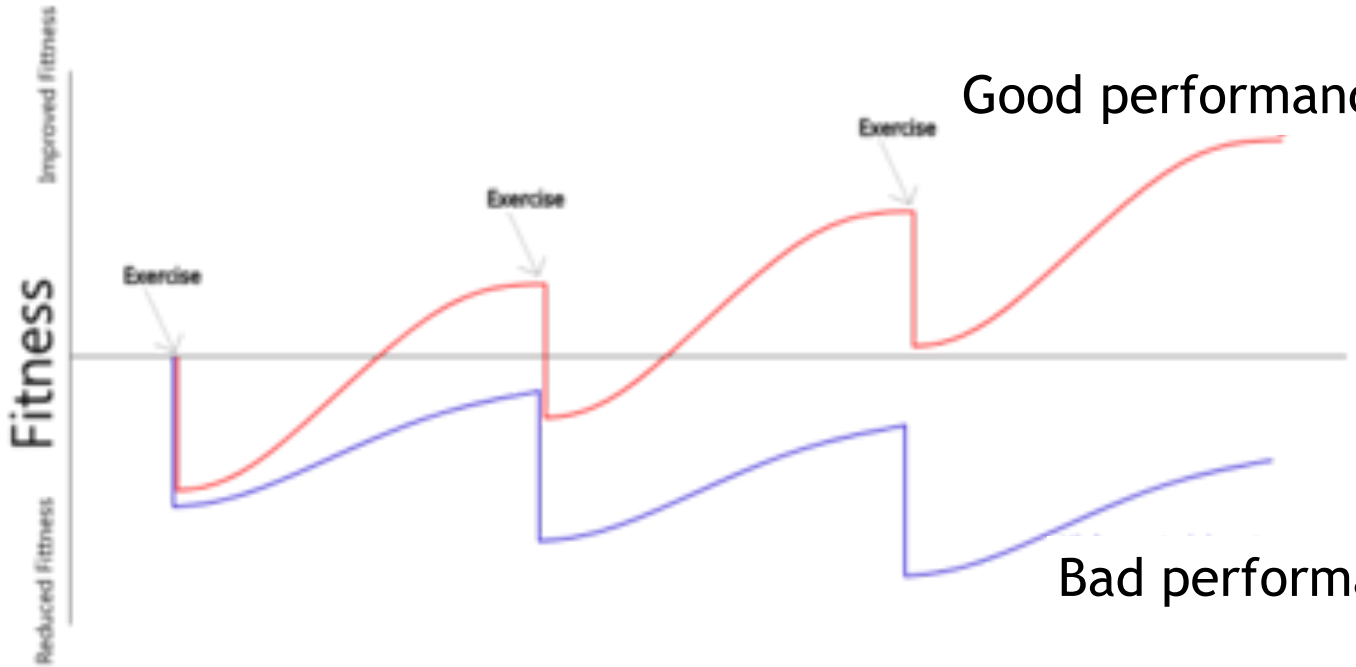
An unbalanced supercompensation is the first cause of overtraining



# Surpercompensation Principle

Adeguate training and recovery ratio

Not adeguate training and recovery ratio



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# Problem!!!
!

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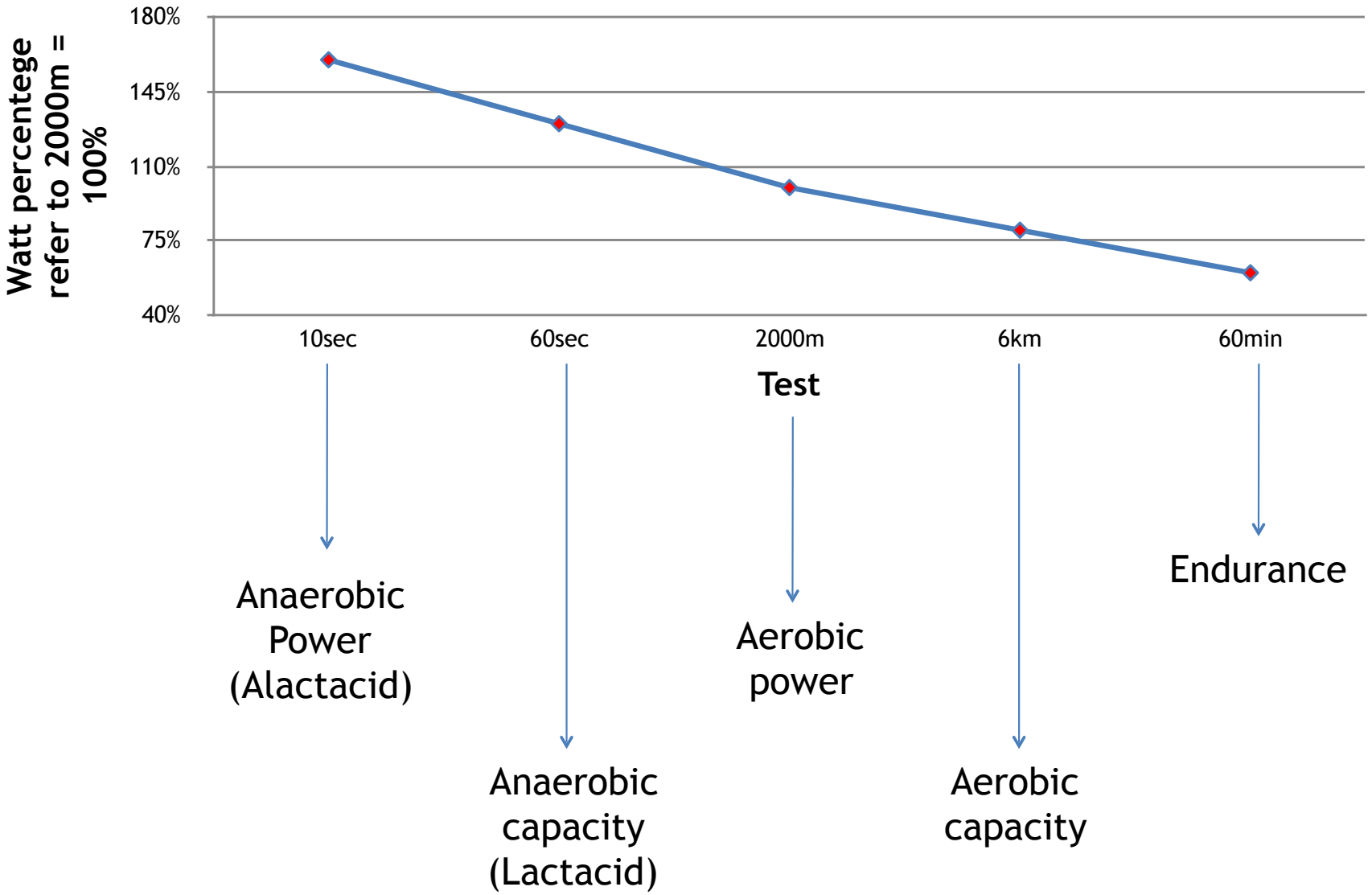
## Kurt Jensen Model



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# Video Analisys

Simple Rowing Stroke Analysis with Kinovea.mp4

Kinovea.lnk

# Conclusion

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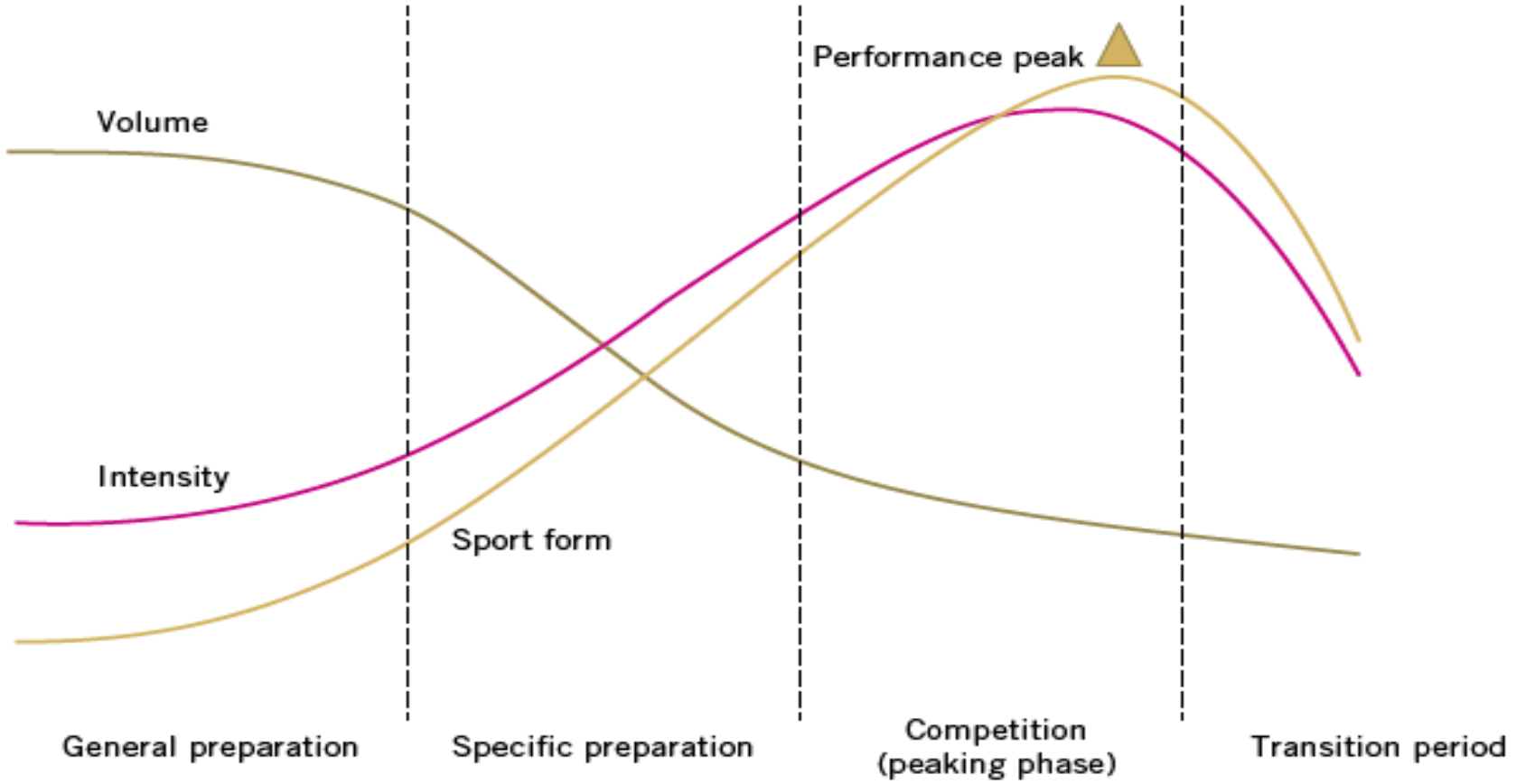

# The importance of monitoring the athlete

- Provide an initial assessment of the subject's strengths and weaknesses
- Evaluate the effectiveness of the training program
- Assess the health status of athletes

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**Dario Cerasola, PhD**

cerada@icloud.com Mobile+39 3391485145