A sporting chance: The 5 rings of success

Valerie Gladwell
University of Essex
6th January 2011
ASE annual conference
The Olympics is coming...

But what makes an Olympian
Why is someone a couch potato?

And another a double gold winning Olympian? -like Kelly Holmes
The Body
Which sports involve the brain?
The mind: arousal

Let’s start at the start!

- Cognitive anxiety vs physiological arousal

- Competition seen as challenge or a threat
- Is the athlete a Crowd pleaser?
The mind: the use of music

- Music can help increase/decrease arousal

Different sports stars are believed to listen to different types of music- not always what you would expect
The mind: getting it wrong!

On your marks.....
Reaction time
1. Gun sound
2. ear
3. brain
4. processing
5. muscle contraction

False start:
If respond quicker than 100ms
The brain: controlling the body

Gymnastics
Feedback from receptors: position of body in space to alter response of muscles

Modern pentathlon
Combined event, shoot and run
Shoot accurately need to: control breathing and even heart rate
The Body
The body: all systems go

Physiology of the body
- Cardiovascular
- Respiratory
- Nervous
- Gastrointestinal
- Urinary
The body: energy supply

Creatine\(\sim P\)  
Creatine + \(\sim P\)  

Glycogen  
Lactic acid + \(\sim P\)  

Glycolysis  

Glucose or other fuel  
Respiration  

\(~P\)  
\(\text{CO}_2 + \text{H}_2\text{O}\)  

ATP  

Muscle Contraction
The body: energy supply
The body: lactate friend or foe?

Anaerobic metabolism

Pyruvate + NADH + H+ → Lactate + NAD+

Lactate allows ATP to be made (energy currency)
And unloads H+ from NAD preventing a traffic jam
BUT creates acidity
The body: Lactate Threshold

Lactate threshold: lactate accumulation when production > clearance.
Training can shift lactate threshold.
The body: Lactate clearance

Lactate + sodium bicarbonate → Sodium lactate + carbonic acid → Sodium lactate + Carbon dioxide + water

Fast removal required in:
Short burst intermittent sports:
- Hockey
- Football
- Rugby
- Squash
The body: aerobic respiration

The journey of oxygen

Oxygen used in muscles to transform energy = aerobic respiration
Training increases VO\textsubscript{2} max - an indicator of fitness is dependent on:

- air into lungs (not much change in functional capacity)
- blood collecting air from lungs (potential increase RBC concentration, blood volume increase)
- heart pumping blood (size and force contraction increases)
- blood capillary network around muscles (increase numbers with training, rerouting of blood)
- uptake of oxygen from the blood into muscle tissue (increased efficiency with training)
- Mitochondria (increased numbers with training but also determined by your Mother!!)
Training: improving oxygen uptake

Train high: hard work as less partial pressure of oxygen but you increase EPO production leading to increases in red blood cells.

Train low - sleep high.
Better tolerance than exercising but takes longer for adaptations.
Training: practice makes perfect?

- Andy Murray: reaction - shots without thinking
- Amy Williams: precise body moves - life and death
- Jonny Wilkinson: over and over again
- Daley Thomson: train harder than anyone else

Practice needs to be perfect to gain the edge
Training: too much?

Overtraining can lead to:
- Decreased immune function
- Altered heart function and control
- Changes in mood
- Increased injury rate

Measure by:
- Mood
- Cortisol
- Blood count
- Sleep
Fuel and ergogenics
The right fuel is really important: Also need to get timing right

BUT what about other things: like caffeine, beetroot juice, supplements
Ergogenic aids: caffeine

1000 articles about caffeine and exercise:
Improves endurance performance???

100 mg of caffeine in small cup of coffee
Require 3mg per kg body weight 2-3 hours pre-performance
Side effects
Ergogenic aids: beetroot juice

• Infancy- only 9 articles about beetroot and exercise (Mainly from Prof Jones Exeter)
• Improves endurance performance
• Acute dose beetroot 2.8% improvement time trials
• Six day dose 16% longer
• Works via nitrate
Ergogenic aids: the use of music

Music - may help especially in training (Karageorghis, Brunel)
The X Factor
Recovery is really important:
• Get quality sleep – learn and recover
• Massage therapy - 200 articles but no clear evidence
• Ice therapy - very popular but no clear evidence
The X-factor: The support team

A good support team is required
The X-factor: choose your parents

Your mitochondria comes from your mum!!
Mind over body?

The ultimate challenge: Ironman Triathlon
http://www.youtube.com/watch?v=MTn1v5TGK_w

140 miles of exhaustion: swim, cycle, run

Chrissy Wellington (Great Britain) set women’s course record for Hawaii 2009
The Mind/Brain

The Body

Training

The X Factor

Fuel and ergogenics
Inspired???

- The Physiological Society’s competition
  - The science of sport: how to win gold
    - www.understanding-life.org
- Wellcome Trust Physiology experiment kits for schools
  - www.getinthezone.org.uk
- Wellcome Trust Big Picture publication
Contact me

vglad@essex.ac.uk
University of Essex
Colchester
CO4 3SQ

Thanks to: