Concept2 INDOOR ROWER®

ROWING &RUNNING

About the author

John Shepherd

John Shepherd was a regular member of the England and Great Britain athletics' teams as a long jumper in the eighties and nineties. He still competes as a master and has won European and World championship medals. He is a regular contributor to numerous sports, health and fitness magazines, notably Ultra-FIT and Peak Performance, but has also written for Running Fitness, The Times, GQ, Men's Fitness and Athletics Weekly. John holds a degree in physical education and a masters degree, numerous fitness and sports qualifications and was also a leisure centre manager for over 10 years.

Amongst his 'other' sporting accomplishments John managed to row 6 minutes 35.8 seconds for the 2k distance at the age of 40, after a love/hate affair with the erg. His exploits earned him the name of the 'mattress' from C2 coach Terry O'Neill, for his laid back approach and also because of his need for one after a 2k!

Acknowledgments:

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Introduction

The Concept2 rowing machine offers runners, of all ages and speeds, great potential. In this guide I will explain how to maximise this potential for sprint, middle, long and ultra-distance running. Workouts will be provided for you to experiment with and develop. Crucially I'll explain how rowing can develop specific running related energy pathways and muscular power, combat common running injuries and keep you running faster and longer as you age.

Contents

8 REASONS WHY THE CONCEPT2 MAKES A GREAT TRAINING OPTION FOR RUNNERS

1. **Rowing is a non-impact exercise, it places less impact-related wear and tear on the body. This is especially important for combating over-use running injuries**
2. **It adds variety to your training programme**
3. **It offers a time-efficient method to improve aerobic capacity and reduce body fat**
4. **It can provide excellent anaerobic workouts that will develop the physiological qualities needed for the development of the speed endurance needed by middle distance runners for example, and can contribute to the development of the explosive power needed by sprinters**
5. **Rowing can be done indoors anytime, important when you might not feel like going out for a 10 mile effort in the cold and the rain**
6. **It is a safe and effective way of training whilst recovering from certain injuries**
7. **It is transportable and can be used at home or other locations.**
8. **Rowing on the Concept2 provides an accurate means for monitoring your level of conditioning, and offers constant feedback whilst rowing. For example, you can train, using the heart rate monitor interface in clearly defined and applicable to you, heart rate training zones**

Adapted from: The indoor rowing rugby training guide P Herbert www.concept2.co.uk/docs/rugby_training_guide.pdf

THE MECHANICS AND PHYSIOLOGICAL NEEDS OF ROWING AND RUNNING

At first glance it may appear that rowing and running have little in common. After all the former requires a seated and therefore supported doubled leg, double arm action, whilst the latter requires a single leg, single arm non-supported action, with considerable impact forces. However, both exercises involve virtually all the same muscle groups and can train the same energy systems required for each activity (of which more later).

Physiological comparisons between rowing and running

Competitive rowers normally race over 2k, although they may train/compete over less standard distances, such as 500m, the mile and even the marathon. Runners, on the other hand compete over recognised distances appreciably shorter and longer than 2k. It's a totally different athlete that turns up to run a 100m sprint, than the one that turns up for 10k road race or 26 mile marathon. The two 'runners' will be prepared totally differently in terms of their training. Rowing training, like running training can be adapted to positively reflect the distance being trained for.

ENERGY PATHWAYS

Understanding how the body produces energy will allow you to better understand how rowing can contribute to running.

Energy can be produced in the body in three ways via the:

1) Immediate anaerobic energy pathway
2) Short term anaerobic energy pathway
3) Aerobic energy pathway

The aerobic energy pathway

Aerobic literally means 'with air'. Oxygen provides the catalyst for a chemical reaction in the muscles (including the heart) that generates aerobic energy. If it were not for factors such as, insufficient muscular fuel sources (notably, glycogen, a form of carbohydrate) over-heating and dehydration, we could theoretically continue to exercise aerobically indefinitely.

During aerobic workouts, the body's energy demands are balanced by energy supply; allowing for exercise to be continued. When this 'steady state' is breached, for example, by an increase in exercise intensity (a consequence of increased speed and/or distance, for example) the body will change the way it produces energy. It will do this with less oxygen and energy will be produced anaerobically.

Aerobic training provides basic condition for all running distances (and sports) regardless of its more specific energy pathway demands. For example, a good foundation of aerobic fitness will enable a 100/200m sprinter (who relies predominantly on the anaerobic energy pathways), to recover more quickly between training efforts.

Aerobic training also increases the body's ability to mobilise fat as an energy source at sub-maximal intensities, as well as improving carbohydrate metabolism more effectively. This will significantly improve the 'range' of the endurance athlete see fat max page 20

Anaerobic energy pathways

Anaerobic literally means without oxygen. The body can create anaerobic energy in two ways through the, ***Immediate anaerobic*** energy pathway and the ***short term anaerobic*** energy pathway. Neither produces sustainable energy for very long

The immediate anaerobic energy pathway

The immediate anaerobic pathway places no reliance on oxygen to sustain it and supplies energy that lasts for no more than 6-8 seconds. Although all sports activity is fuelled by stored 'high energy' chemicals such as, Adenosine Triposphate (ATP) and creatine phosphate (CP) and a resultant chemical reaction that 'fires' them up, the immediate anaerobic energy pathway has very short-lived intense use of them.

The short term anaerobic energy pathway

The short term anaerobic energy pathway also supplies the body with high-powered energy, like the immediate anaerobic energy pathway, however it can provide energy for a little longer, around 90 seconds at most.

Under short term anaerobic exercise conditions, such as 400m running, muscles will 'burn' (seen to be the result of an increase in muscular energy producing chemicals, lactate and lactic acid), and the heart will reach maximum out put. These physiological reactions result from the body (and in particular its muscles) demanding more and more oxygen but not getting it.

As short term anaerobic energy production passes the 20-second mark, more and more demand is placed on oxygen as a fuel source, after 30 seconds 20% of the energy produced is done so aerobically and after 60 seconds, 30%. As the one and a half minute mark is reached, no amount of oxygen gulping will save the anaerobic 'engine' and it and the athlete will ultimately grind to a potentially painful halt.

Training the anaerobic energy pathways using the indoor rower will increase the ability of the athlete's body to replenish the high energy phosphates used to create energy. This will in turn extend their ability to produce more high powered efforts, as long as adequate rest is allowed.

Selected track and field events, 2k rowing and their respective energy pathway requirements

Table 1:

Event	Aerobic energy pathway contribution	Anaerobic energy pathway contribution
200	5%	95%
800	34%	66%
15 00	50%	50%
10 000	80%	20%
Marathon	98%	2%
2k row	65%-85%*	35%-15%*

** Note these figures can vary in regard to the age and gender of the performer*

Using the indoor rower to test immediate and short term anaerobic power and aerobic endurance

You can use the indoor rower to measure and monitor your anaerobic and aerobic fitness.

Ensure workout consistency by ensuring machine consistency

It is important to set the damper lever at the 'right' setting before you start any test or training session. The indoor rower can be affected by dirt in the flywheel, temperature and humidity, and this will affect your workout. Setting what is known as the 'drag factor' will ensure you have the same set up for each session.

As a general guide the indoor rower's drag should be set at the following levels:

Male heavyweight (over 75 kg) – 125-140

Female heavyweight (over 61.5 kg) – 120-135

Male lightweight (under 75 kg) – 120-135

Female heavyweight (under 61.5 kg) – 115-125

1) Peak power test

Measures: immediate/short term (explosive) anaerobic power

Running relevance: mainly sprints, but will also benefit middle and longer distance runners as a way of measuring their general strength and power development. This test is very similar to testing for one rep maximums when weight lifting.

How to perform the test: Row 10 strokes flat out

The machine's monitor will indicate the peak power value for each stroke, plus average peak power.

Table 2 Standards for the peak power test: Males

	peak power (watts)	Average peak power (watts)
World class	1000	960
Excellent	950	910
Very good	900	860

2) Short term anaerobic power/capacity test

Measures: ability of the athlete to repeat short maximal efforts with minimal rest. The test will indicate improvements in power maintenance.

Running relevance: Sprints (particularly 400m); will also benefit 800m and 1500m runners whose events are short enough and quick enough to generate a high anaerobic metabolic cost

How to perform the test: Perform a 10 second sprint and record average power. Then perform a further 5, 10 second sprints, with 25 seconds' recovery between each

Table 3 Standards for short term anaerobic power/capacity test: Males

	Set 1	Set 2	Set 3	Set 4	Set 5	Set 6
World class	900	882	865	848	831	865
Excellent	820	802	788	772	757	788
Very Good	750	735	720	706	692	720

All runners should resistance train

It should be noted that both the peak power test and the short term anaerobic power/capacity test could be used by all runners to monitor their non-running developed strength and power. All runners should resistance train, to improve their running economy and peak speed potential. Weights, plyometrics (jumping type exercises), circuits and hill runs will all develop this greater running power potential. These two rowing tests can be used to assess (and develop) improvement in this capacity and could be scheduled into the training programme at regular intervals accordingly (see page 13).

Note before performing these tests you should be specifically warmed up see section 2

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3 Aerobic capacity test

Runners, particularly middle, long and ultra-distance exponents, will be familiar with the use of tests to determine maximum oxygen uptake, such as the incremental VO2 max test). This test could be performed on the indoor rower, although it would require the relevant laboratory set-up. However, there is a problem with testing for aerobic endurance on the rower. This centres on the need for the 'running rower' to have command of efficient rowing technique. Failure to do this will lead to poor test (and everyday rowing) performance and potential injury. Hence, I recommend that aerobic tests only be performed on the indoor rower once efficient technique has been mastered go to: **www.concept2.co.uk/training/technique**

Once this has been achieved the runner can use tests similar to those he or she might employ on the track or road. For example, row for a designated time/times, for example, 2 x 30 minutes 18 strokes per minute (SPM) with 90 seconds seconds' rest between each interval, at designated aerobic heart rate level (for example 80% of heart rate max). Improvements in distance rowed, whilst remaining within the target heart rate zone, would indicate improvements in rowing aerobic capacity.

Note experienced middle, long and ultra-distance runners are not likely to improve their running aerobic fitness from rowing, due to the different movement pattern involved. However, rowing will assist with their maintenance of aerobic fitness and as we shall see in section 5 assist their mental fortitude.

VO2 max refers to the maximum amount of oxygen you can take in, transport and use when working flat out and is an important measure in both sport and health. In endurance sports, such as rowing, VO2max is often referred to as a 'prerequisite' for good performance – ie it does not determine good performance but it is necessary for good performance. VO2max is expressed in millilitres of oxygen absorbed per kilo of body weight per minute (mls.kg-1.min-1). In body-weight supported sports such as indoor rowing VO2max is expressed in litres per minute (l.min-1).

Rowing versus running intensity

It should also be noted that indoor rowing, can for the runner, be more intense than their run training (see page 7 for suggested rowing/running multiples)

INDOOR ROWING MUSCLE FIBRE AND RUNNING

Our muscles contain different types of muscle fibres, these produce power and energy in different ways. Like the body they are made up of millions of cells. It is important to consider them when using the indoor rower to train for your specific running event/distance. This is because muscle fibres respond differently to different training types.

There are three basic muscle fibre types - slow twitch type 1 and fast twitch type 2a and 2b fibres. I have summarised what they are capable of and the 'best' ways to train them for sport and fitness purposes in table 4. Study the contents and you'll readily appreciate why a basic understanding of muscle fibre types can significantly enhance your training.

In subsequent sections you will find more specific comment and training programmes for the anaerobic sprints and the anaerobic/aerobic middle and virtually exclusively aerobic long and ultra-distances.

Table 4: Characteristics of muscle fibre, and appropriate training means

Fibre type	Comments	Training means	Physical characteristics
Fast twitch 'transitional' type IIa fibres	These fibres can be trained to become faster and more powerful, or slower and more enduring. It's because of this reason that they are called transitional fibres	For improved endurance: circuit training, steady paced rowing and 'long' interval, interval training < 5 minutes For improved speed and strength: lifting weights between 50 and 75% of 1 repetition maximum, sprint training, flat out 10 second power strokes on the indoor rower. All with full recovery	Fast twitch fibres contract 2-3 times faster than slow twitch fibres, They are thicker and more likely to increase muscle size when targeted by speed and strength training
Fast twitch 'out-and-out power' type - IIb fibres	These fibres are the 'turbos' in your muscular engine. They require considerable 'neural' (mental) stimulation to switch them on. You have to be 'psyched' to get the best out of them	Sprinting, weight lifting (over 70% of 1 rep max), all short-lived activities lasting seconds, like a tennis serve, or 10 power strokes on the rower	See above and note the need for a full recovery, if out and out power and speed is the training goal
Slow twitch type I 'endurance' fibres	Training slow twitch fibres does not increase muscle size	Dependent on fitness any steady paced running or rowing effort between 70 and 85% of maximum heart rate will primarily target slow twitch muscle fibre	These fibres have the greatest oxygen carrying potential

In reality all sport and fitness performance relies on the interaction between all muscle fibre types. It is impossible to train your muscles to take on just one fibre type response. You could not, for example, exclusively develop type IIb fast twitch fibres in your leg muscles. However, you can significantly enhance your existing fibre make up with the right training focus.

Thoughts on muscle fibre conversion

It is possible to significantly change the contractile and energy producing properties of muscle fibre, as table 5 indicates, with its focus on fast twitch muscle fibre. This can have both positive and negative consequences for the runner using rowing as a supplement to their training (and potentially vice versa). The obvious detrimental example is the sprinter who rows aerobically for pro-longed training periods, dulling the speed and power capability of their fast twitch muscle fibre.

Table 5: Fast twitch muscle percentages in selected running events compared to sedentary individuals (and a very speedy animal!)

Individual	Percentage fast twitch muscle fibre
Sedentary	45-55%
Distance runner	25%
Middle distance runner	35%
Sprinter	84%
Cheetah	83% of the total number of fibres examined in the rear outer portion of the thigh (vastus lateralis) and nearly 61% of the calf muscle (gastrocnemius0 were comprised of fast-twitch fibres.

Adapted from Golink 73 (in Dick Sports Training Principles page 109 and Williams (J Comp Physiol [B]. 1997 Nov;167(8):527-35.)

USING THE INDOOR ROWER TO TRAIN FOR SPRINTS

A top class male sprinter will move his or her legs 4-5 times a second, whilst a top class male indoor rower will achieve an average stroke rate around 28-34 per minute at max output during a 2k race. And this neglects the obvious fact that a 100m sprint race lasts at elite male level, around 10 seconds and an elite level rowing 2k race, around 5 minutes 40 seconds. Immediately, it's obvious that the speed and energy system requirements of rowing and sprinting are totally different. Consequentially, indoor rowing should only be regarded as a supplemental activity for the sprint athlete. However, used sensibly and specifically relevant sprint strength and power can be developed with its use.

Supplementing sprint training on the indoor rower will:

- Contribute to the sprinter's ability to perform powerful movements under varying degrees of anaerobic fatigue
- Boost muscles' lactate tolerance
- Improve the generation and replenishment of high energy phosphates under sprint workout conditions (notably, creatine phosphate and ATP)
- Improve the ability of the sprinter to perform under fatiguing conditions, by strengthening their mental fortitude, crucial for 400m flat and 400 hurdles athletes
- Reduce impact strain on the sprinter's body, particularly relevant to master sprinters, whose bodies may not be able sustain the same amount of specific sprint training they did in their younger days
- Provide training variety

Suggested sprint workouts using the indoor rower

1) Acceleration rows

Develops: power endurance

Row 20 strokes gradually increasing the power and speed of each stroke so that peak power and speed is generated over the last 5.

Do: 5 strokes at 20 strokes per minute (SPM), 5 strokes at 24 SPM, 5 strokes at 28 SPM and 5 strokes at 32-34 SPM

Do: 4 sets with 60 seconds, easy rowing recovery between each effort.

This session would be particularly suited to the beginning of the training year, when sprinters want to develop relevant base condition. It could also be used, providing a complete recovery is used, as the competitive season approaches - this will assist the process of power maintenance without dulling fast twitch fibre speed potential.

Variation: **Arm pulls**

Sit on the seat of the indoor rower with your feet on the floor and legs bent to a 90 degree angle. Hold the handle at arms' length. To perform the exercise pull the handle in into your body as dynamically as possible and control it on its way back.. Ensure your body is braced. This exercise will develop shoulder power over a range of movement that is quite similar to the sprint arm action, albeit in a double rather than alternate single arm action.

2) Pyramid power rows

Develops explosiveness

This workout is performed rather like a weights pyramid

Set 1: 2 x 12 strokes pulling as powerfully as possible at 24 SPM

Set 2: 2 x 10 strokes pulling as powerfully as possible at 28 SPM

Set 3: 2 x 8 strokes pulling as powerfully as possible at 32 SPM

Set 4: 2 x 10 strokes pulling as powerfully as possible at 28 SPM

Set 5: 2 x 12 strokes pulling as powerfully as possible at 24 SPM

A full 1-2 minute recovery should be taken between sets. You should concentrate on driving into and out of the 'catch', making it as explosive as possible as well as completing the stroke with a powerful arm drive.

Power outputs can be recoded for the workout (using the indoor rower's monitor) in much the same way as you would weights repetitions, set and weight lifted. This will enable you to systematically monitor your training progress.

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3) Lactate tolerance workouts *(particularly suited to 400m flat and 400m hurdles athletes)*

Develops lactate tolerance

This workout is very similar to the circuit training that sprint athletes perform at the beginning of the training year

Row at 95% effort for 60 seconds at 28-34 SPM, paddle or take a complete recovery for 90 seconds and repeat. Begin with 4 repetitions and as your fitness develops progress to 8.

This workout is very tough. Because of the length of each interval (well into short term anaerobic territory) high levels of lactate (and lactic acid) will be produced. This will improve lactate tolerance - a key aspect of 200 to 400 flat and hurdles sprint performance.

Note: this workout should not be performed more than once a week, as it could reduce the effectiveness of the sprinter's fast twitch muscle fibres. It should also be performed during a track training phase that aims to develop the same lactate tolerance, speed endurance and capability.

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4) Using the indoor rower as a part of specific sprint circuit

Develops relevant local muscular endurance and sprint condition

It is very easy to place the indoor rower within a circuit based workout. Tailored appropriately 'circuits' can be used at all stages of the training year. Here's an example, suitable for the latter stages of the sprinter's yearly preparation ie in the pre-competition phase of training.

USING THE INDOOR ROWER TO TRAIN FOR SPRINTS

Sprinting specific circuit incorporating indoor rower

Reps and exercise

1) 20 power strokes on the rower
2) 20 split jumps
3) 20 Fit ball crunches
4) 20 Step up drive (using rower) left and right legs
5) 20 Dips (using rower)
6) 20 Arm pulls (using rower)
7) 15 power strokes
8) 10 single leg squats each leg
9) 40 sprint arm action from lunge position
10) 10 slow down slide, 'explode' back strokes*

Repeat circuit 2-6 times, taking 30 seconds' recovery between exercises and 1 minute between each circuit

** How to perform this exercise: do not build up too much momentum into the catch, rather slow almost to a halt as you travel back down the slide and then explode out of the catch. This will develop the type of power that will benefit the first stride from a sprint start position, ie accelerating the body from a stationary position*

All workouts must be preceded by a rowing/sprint specific warm up see panel

INDOOR ROWING/SPRINT SPECIFIC WARM UP

To maintain as much sprint specific training relevance as possible, the warm up for the workouts described previously should be similar to those used before sprint training, but with some amendments.

Jog for a couple of minutes and perform functional to sprinting movements, such as high knees and lunges.

Stretch areas relevant to rowing ie. forearms and lower back.

Do 2-3 minutes of easy rowing, building up to 90% effort strokes

A few minutes recovery should then be taken, where more stretches/drills could be performed, before tackling the specific rowing sprint workouts or tests.

Indoor rowing can reduce running injuries

The use of indoor rowing as a means to combat some common running injuries is described on pages 9

The benefits of indoor rowing to middle and long distance running largely focus on 1) its contribution to relevant energy system development (aerobic and anaerobic) and 2) the reduction of over use running injuries.

Rowing development of energy pathways

Aerobic capacity

It is unlikely that indoor rowing training will directly improve the aerobic capacity of a well trained middle or long distance runner. However, indoor rowing can maintain aerobic condition, perhaps when the runner is unable to run due to injury, or in later years when the master runner should adopt a more circumspect approach to their training (of which more later). Indoor rowing could also provide variety in training, at transition points in the training year, for example, when moving from the track to the road season.

Indoor rowing and x-training

A number of studies have looked at the x-training implications of other training means, such as swimming and cycling on running performance. I have yet to come across one which relates specifically to the contribution of indoor rowing. From the research, cycling is usually identified as the most appropriate 'other' training method for runners. However, this may simply reflect the fact that few, if any significant rowing/running studies have been completed. I would suggest that indoor rowing can be as similarly effective as cycling as a relevant x-training means. Rowing may also have an additional benefit, as it will have a more significant effect on developing muscular strength, when compared to cycling, because of its greater upper body strength requirement.

I have provided an example of research - which although focusing on cycling's contribution to running - identifies the potential contribution that indoor rowing can make to middle and long distance running fitness.

Researchers from California looked into the effectiveness of cycling as a x-training method between competitive seasons, in female distance runners. They wanted to find out whether substituting 50% of run training volume with cycling would maintain 3000m track race performance and VO2max (see page 3) measurements, during a 5-week recuperative phase at the end of the x-country season.

Eleven college runners were assigned to either:

- A run only training group;
- A cycle and run only training group, which performed the two different activities on different days.

Both groups trained at 75-80% of maximum heart rate. Training volumes were similar to the competitive season, except that as mentioned, cycling made up 50% of the volume for the 'cycle and run' group.

At the end of the 5-week period, the team discovered that 3000m race times were on average slower by 1.4% (9 seconds) in the run-only training group, while the running and cycling group subjects were only slightly slower (3.4% or 22 seconds slower). Equally, important was the discovery that no significant change was found in VO2 max between either group.

(Reference: J Strength Cond Res. May;17(2):319-23), 2003)

The implications of this research go far beyond recommending the use of cycling (and indoor rowing) for endurance athletes moving from one 'season' into another, as there is a real possibility that cycling (and indoor rowing) has a role to play in all year round endurance training for runners. This is because:

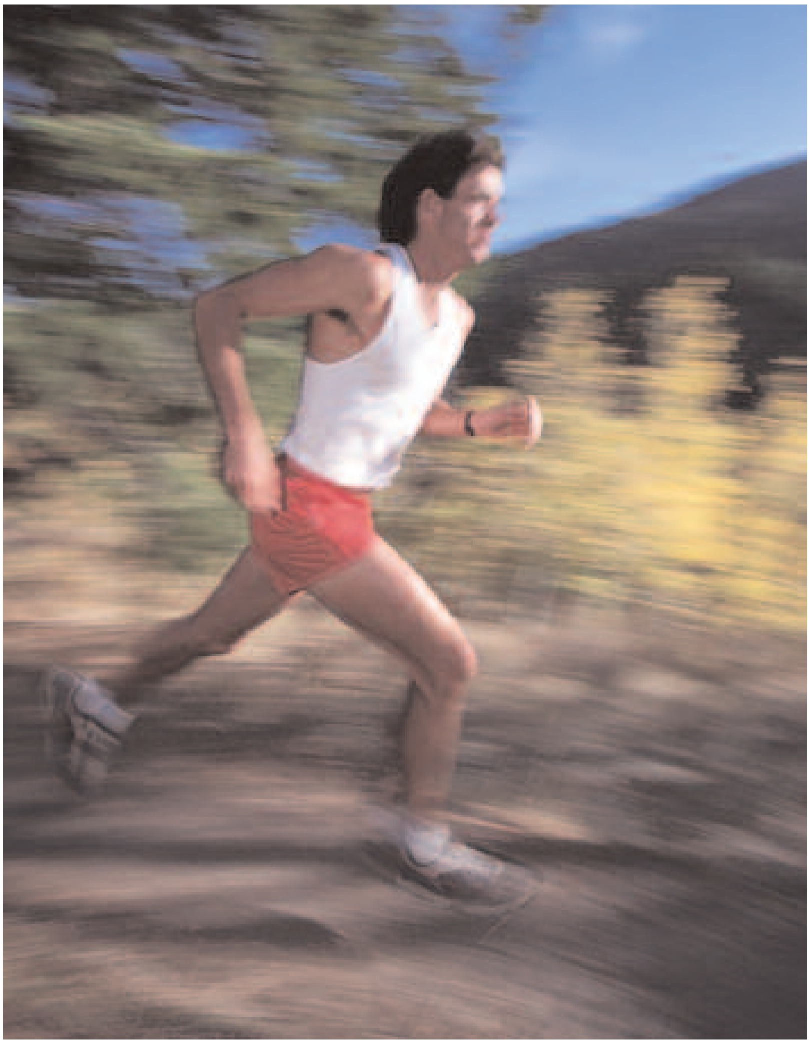
- Rowing and cycling may enable the runner's body greater time to recover from tough training/competitive training phases and improve future injury resilience (more about this later);
- From a mental perspective, the involvement of a different training method may help to 'rejuvenate' the mental approach of middle and long distance runners, and ultimately boost performance;
- The different training method can bolster mental fortitude and discourage the brain from shutting down endurance effort when the going gets tough. (see page 18)

Ratio's

How much indoor rowing and cycling should you do to get a similar running training effect?

Running to cycling effort ratio

It is recommended that running workout times should be multiplied by 3.5 when aiming for a similar training effect from cycling. Thus a 30 minute training run at a target heart rate range of 80% max, would be the same as 105 minutes of cycle at the same intensity.



Indoor rowing to running ratio

In terms of an indoor rowing to running ratio, it appears that a multiple of 0.75 - 1 should be used.

There is however a complication; most runners can cycle relevantly efficiently, however, the same cannot be said over their mastery (at least initially) of indoor rowing technique. As I stress throughout this guide, all runners should learn to row technically correctly, before using it as a major supplement to their running training. This will ensure optimal transference of rowing fitness into running fitness.

Add indoor rowing to your 'base' building

Middle, long and ultra-distance runners need to spend large amounts of their training developing base aerobic condition. Exercise physiologists indicate that these athletes should do this at around 80% of their heart rate max and that about 80% of training should be completed in this zone. Increased heart and lung efficiency, slow twitch (and fast twitch) muscle fibre oxygen processing ability and the ability to use more fat as a fuel source will result. Indoor rowing will benefit the middle, long and ultra-distance runner by contributing to the development and maintenance of a significant aerobic base, with a much reduced risk of over-use injury.

Indoor rowing may also have a significant effect on developing the mental toughness needed to be successful in endurance running. It can be argued that this may indeed be the single most effective benefit of using the indoor rower as a supplement to middle, long and ultra distance runners - of which more later.

How to get the best aerobic benefit from indoor rowing for middle and long distance running

Supplement 25% of your running with rowing training using the 0.75 - 1 multiple as recommended previously

Ensure you master optimum rowing technique before using the indoor rower as a key adjunct to your running training

Sample indoor rowing workouts for middle distance runners designed to improve aerobic endurance

Work up from 2 x 5000m at 18-20 SPM at up to 80% of heart rate max, to 2 x 6000m to 3 x 5000m and finally 3 x 6000m. Take 90 seconds' rest between each interval.

It would be advisable to periodise (that's gradually build up) these sessions over a 4-6 week period.

Indoor rowing and its contribution to the anaerobic components of middle (and long distance) running

Indoor rowing as anyone who has attempted a 2k race will know can tax your energy systems like nothing else, well except perhaps a 400m run or 1500m race! (the latter of which has similar aerobic/anaerobic requirements to the 2k row).

For middle distance runners anaerobic conditioning is a must. These runners need to be able to tolerate significant lactate/lactic acid build up, whist running at high speeds. Rowing can generate similar levels of anaerobic fatigue. This will condition the mind, perhaps more than the muscles (for reasons to follow) to specific race requirements.

A word on sports specificity

The ultimate gains in sports performance result from the most sport specific training means. Muscular movement patterns are very specific. Rowing will recruit the arms, torso and legs in different ways to running. This means that specific movement transference from indoor rowing to running will be limited. However, mentally there will be considerable transference from tough anaerobic training on the rower. Such training will fortify the runner's mind to pain - this is covered in more detail in the section on ultra-endurance training and indoor rowing.

Sample indoor rowing workouts for middle distance runners designed to improve anaerobic endurance and lactate/lactic acid tolerance

1) 6 x 90 seconds at 95% effort, 28-34 SPM with 2 minutes' gentle rowing recovery between efforts (at the end of each effort the athlete's heart should be around 90% of heart rate max)

2) 60 seconds
   90 seconds
   120 seconds
   90 seconds
   60 seconds
   Each effort should be completed at 90% rowing intensity at an average heart rate of 80-85% max heart rate, 24-28 SPM. 60 seconds' slow rowing recovery between efforts.

3) 15 minute increasing effort row

   Divide the 15 minutes into 3 minute sections.

   Begin at 2:05/500m pace and increase required pace by 5 seconds/500m every 3 minutes, increasing stroke rate to handle speeds as required.

   Target 3 minute splits would therefore be:

   2:05/500m at 20 SPM

   2:00/500m at 22 SPM

   1:55/500m at 24 SPM

   1:50/500m at 26 SPM

   1:45/500m at 28 SPM

Note: the successful completion of all these sessions will rely on developing sufficient 'understanding' of pace judgement on the indoor rower, in the same way you would on the track. Experience will develop this.

See also sprinter's circuit training workout page 6

Indoor Rowing and Reduction of Running Injuries

Having identified the potential of indoor rowing to maintain a high percentage of aerobic (and anaerobic) fitness, I now provide further reasons why substituting some of your running with rowing could be particularly beneficial in terms of reducing injury and prolonging a running career.

Eccentric muscular damage

The famed running doctor Tim Noakes, in perhaps the seminal running text, The Lore of Running, indicates that top class runners may only have 20 years of optimal performance in them, before injury and degeneration takes its toll. He believes that this two decade window is applicable to any runner, regardless of the age at which they start running. Thus a 30 year old who begins regular running training will have until they are 50 to make the most of their genetic potential.

Noakes believes that the main reason why runners can grind to a literal halt after 20 years of running is the result of repeated eccentric muscular contractions.

An eccentric muscular contraction occurs when a muscle lengthens as it contracts.

The most obvious example of this action, is that of the biceps muscle when lowering the weight during a biceps curl. However, there are numerous running specific eccentric muscular contractions. These occur around the ankles, knees and hips every time the runner's foot hits the ground (foot-strike).

Many runners will be familiar with that 'painful to the touch' tenderness in the thigh (quadriceps) muscles that develops after a race or series of intervals involving downhill stretches. This muscular soreness is the result of the quadriceps' eccentric action. These muscles stretch as they absorb impact in attempting to break the descending runner's speed. However, to reiterate an eccentric contraction occurs in these muscles (and those of the ankle/calf and hips) whilst running on the level, up hill and at any speed.

Years and years of running induced eccentric muscular contractions lead to a loss of 'running spring'. A situation can develop in which the mature in training years, runner's legs are likely to feel heavy and lifeless, particularly when attempting to race and train beyond 21k. This condition as well as slowing performance, will lead to potential injury across the runner's skeleton, for example, to the back, as they will be less able to absorb shock.

Achilles tendon problems

Achilles tendon damage is the most commonly reported 'running stopper' in older athletes (of all speeds). Damage to this band of soft tissue that connects the heel bone to the calf muscle, is often the result of prolonged eccentric muscular contractions. Basically, the calf muscles and the Achilles tendons absorb much of the impact of the body on foot-strike. After years of running they become less efficient at doing this and become more prone to injury. Indoor rowing, can contribute to reducing Achilles tendon injuries (as it can with general eccentric muscular damage), by reducing the impact forces the runner's body is subject to.

Specifically indoor rowing can assist the recovery from Achilles tendonosis in particular (inflammation of the tendon sheath) by stimulating blood flow through this area, without further impact strain. This is because the Achilles tendons suffer from a lack of blood flow which hinders their ability to heal.

Note: heavy weight machine or free weight calf raises, where the runner concentrates on the lowering (eccentric) part of the action, to a five second count, have been found to be as effective at curing numerous Achilles tendon problems as other treatments, including surgery.

Heart Rate Max, Running And Rowing

Heart rate maximum will vary between modes of exercise, but will invariably be higher for running, due primarily to the impact forces involved. You should expect your indoor rowing heart rate maximum to be around 10 beats lower compared to your running one. It's therefore important to know your heart rate maximum (HRM) for both activities, so that you can work within complimentary heart rate training zones.

How to discover your running and rowing heart rate max

Simple test

Do not perform the test when you are tired, or with little specific rowing familiarity

For any given load, there is an energy cost known as the metabolic equivalent, measured in Mets. An increase of 25 watts on the indoor rower is approximately equivalent to one Met and will bring about an increase in oxygen consumption of 3.5ml/kg/min.

The steps used for this test are displayed in Table 6 in terms of pace/500m and approximately relate to 25 watts/1 Met increments. The test consists of five four minute pieces, each rowed at a consistent 500m pace. The load is increased for each step as shown in Table 6 The first four minute step should be set at a level which will allow you to complete the four minutes comfortably with no signs of distress. Rest for 30 seconds between each step and record the details as illustrated in Tables 7 and 8. Note: if the monitor is set for four minutes work and four minutes rest, all information is stored for recording at the end of the test

During each step, the heart rate will rise, but should stabilise after around three minutes. This is called steady state.

In subsequent tests, improvement in endurance is indicated when you find that your heart rate is lower for any given step; your heart is doing less work for the same pace/effort.

Table 6

Model C 500m Pace/Watts Conversion Table

500m	4:01.0	3:11.3	2:47.1	2:31.8	2:20.9	2:12.6	2:06.0	2:00.5
Watts	25	50	75	100	125	150	175	200
500m	1:55.9	1:51.9	1:48.4	1:45.3	1:42.5	1:40.0	1:37.7	1:35.6
Watts	225	250	275	300	325	350	375	400
500m	1:33.7	1:32.0	1:30.3	1:28.8	1:27.4	1:26.0	1:24.7	1:23.6
Watts	425	450	475	500	525	550	575	600

How to Select Steps for the Step Test

To determine the appropriate start level, you will need to know your current 2,000m time. Using Table 6, select the nearest step to your 500m split time for 2,000m. To determine your Step 1, count back six steps. After rowing 4 minutes at Step 1 move up to the next step, and so on, until Step 5 which should be performed flat out to elicit a predicted 2,000m time. If your 2,000m time is slower than 9:30 you must select 4:01 as your Step 1 as this is the lowest starting point for the Step Test.

The following is an example of an athlete who rows 2,000m in 6:32. Average 500m split = 1:38. Nearest split below this figure is 1:39. Starting level (Step 1) is six steps back = 1:59. Step 2 = 1:54. Step 3 = 1:50. Step 4 = 1:47 (just above anaerobic threshold). Step 5 is done flat out to give a predicted 2,000m time.

Table 7

First Test Results

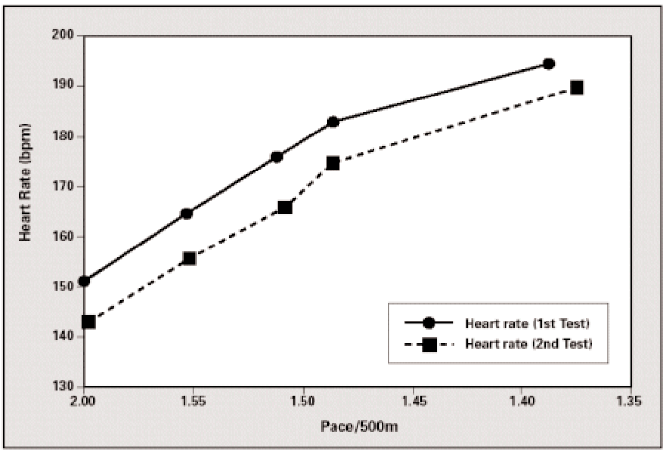
Date: 18th Nov	Step 1	Step 2	Step 3	Step 4	Step 5
Set Pace/500m	2:00.5	1:55.9	1:51.9	1:48.4	MAX
Distance (m)	1000	1035	1074	1107	1221
Stroke Rate (spm)	23	24	25	26	31
Heart Rate (bpm)	151	165	177	183	194
Actual Pace/500m	2:00.0	1:56.0	1:51.8	1:48.4	1:38.2

Table 8

Second Test Results

Date: 23rd July	Step 1	Step 2	Step 3	Step 4	Step 5
Set Pace/500m	2:00.5	1:55.9	1:51.9	1:48.4	MAX
Distance (m)	1001	1037	1076	1108	1232
Stroke Rate (spm)	22	24	25	25	32
Heart Rate (bpm)	143	154	166	175	189
Actual Pace/500m	1:59.9	1:55.8	1:51.6	1:48.4	1:37.4

The graph below shows how the plotted line for the second test indicates heart rate is lower at each point. This indicates that the training programme has had a positive impact in terms of increasing the athlete's ability to perform at a lower heart rate for a given work load.



The main difference between training for long distance races and ultra-distance races is the increased length of the (usually) weekend workout. It's recommended that indoor rowing sessions of 60 -120 minutes be progressed to (compared to the 30k running efforts required by marathon runners).

'Waiting' is perhaps the key requirement for successful ultra-distance running from a tactical/training perspective when racing. You need to be able to remain at your most energy efficient pace throughout your race (and training). If you run out of steam too early there still could be another 20k to go! The indoor rower can play a very significant role in this respect.

Mental toughness

Mental toughness is obviously crucial when it comes to success in ultra-distance running, all other things being equal. Yes, the miles will still have to be put in, but when the going gets tough, as it invariably will, it'll be the runner with the best mental attitude who'll tough it out and triumph. Training on the indoor rower can play a huge role in the development of the mental toughness required to be successful.

If the brain holds the key to successful ultra (and middle and long distance) running performance how do you unlock it?

Relatively recently research has begun to appear on what has been called the 'Central Governor Theory' (CGT). Tim Noakes, whose ideas on eccentric muscular damage were previously discussed, has been the main driving force behind the CGT. He believes that there is a type of 'governor' in the brain that determines the body's ability to sustain endurance activity. This is, or is not, achieved by tolerating increasing intensities of exercise - and this is where the indoor rower can come in and do a particularly good job, at the same time saving 'running muscles'. He argues that the central governor's setting can be altered through experience of intense exercise and a corresponding shift in will power that will permit greater endurance perseverance. This theory can be substantiated by the fact that muscles can still hold onto 80-90% of their high energy source, ATP and some glycogen after intense endurance effort has been truncated. In such a scenario the athlete may have 'thought' that he or she could not continue, when there was actually still more fuel in the tank. This is seen to be a consequence of the body, and in particular its muscles, always holding onto some crucial energy producing materials - just in case it is called upon to react in an emergency situation. In terms of our evolution this is seen to be a legacy of our pre-historic past when our ancestors, never knew if they would need a bit more energy to run away from a sabre-toothed tiger, or other predator, after a long day's hunting and gathering! Ways of unlocking this fuel reserve using the indoor rower will be provided later.

Glycogen

Glycogen is basically carbohydrate stored in the muscles and liver. It can be regarded as premium grade muscle fuel. It can only be stored in the body in limited amounts around 375g and therefore needs to be constantly replenished (by carbohydrate consumption). Glycogen is used up during exercise and it can take over 36 hours for it to be fully re-stocked after tough workouts.

Closely related to the CGT is another self-preservation consideration, apt when thinking of the sabre-toothed tiger. Noakes has again explored this endurance determinant, although this functions in a different protective realm to the CGT. The 'Central (nervous system) Fatigue Hypothesis' (CFH) postulates that the brain will 'shut down' the body under certain conditions when there is a perceived threat to damage to vital organs, irrespective of how 'fit' an individual's endurance system is. The conditions specifically identified are high altitude and high temperatures. However, researchers believe that the CFH could also apply under less taxing external conditions. As Noakes writes, " … there is no evidence that exhaustion under these conditions is associated with either skeletal muscle 'anaerbosis' or energy depletion …. There is sufficient evidence to suggest that a reduced central nervous system recruitment of the active muscles terminates maximum exercise." Basically, like the CGT it's being argued that 'the foot is being taken off the endurance pedal when it probably does not have to be'.

All this research indicates that the brain may have an even more significant effect on endurance potential than previously thought. So how can you release its potential using the indoor rower?

Physical preparation is obviously key to ultra-distance running, and avoiding over-training is crucial. This can be a difficult proposition when faced with a challenge, such as the Comrades marathon (a double marathon in South Africa), or events, such as the Marathon de Sables (in the Sahara) or Jungle Marathon (in the Amazonian rain forest) that take days. Not unnaturally you will want to put in as much training as possible to maximise your potential. However, doing this on your feet (by running) could run the risk of burning yourself out and irreparably damaging your muscles. There is only so much running that you can do in training if overuse injuries are to be avoided. Aerobic capacity will develop accordingly, but there will come a time, after years of preparation, when this value cannot be significantly enhanced. There will also come a point with ultra-endurance preparation when how you develop endurance becomes a secondary consideration.

As such competing 30-40% of your ultra-endurance training on the indoor rower can:

1) Develop and maintain aerobic capacity, whilst minimising running induced injury
2) 'Train' your mind to sustain physical exertion, perhaps challenging the CGT and CFH to unlock further endurance potential

Indoor rower ultra-distance workout suggestions:

Note: these sessions could replace your long weekend run perhaps every third week.

1) 60 min (2 x 30 min with 3 min recovery) Alternate 7.5 min at 85% of HRM and 7.5 min @ 75% - 80% of HRM
2) 90 min (2 x 45 min with 4.5 min rest) Alternate 15 min at 85% of HRM and 30 min 75% - at 80% of HRM
3) 120 min (4 x 30 min with 3 min rest) Alternate 30 min at 85% of HRM then 3 x 30 min at 75%-80% of HRM
4) 60 min run followed by 60 minute indoor row - Heart rate average 80% of max

Shorter duration ultra-endurance running training using the indoor rower

For most people work, family and study commitments will curtail their opportunity to go for long training outings in the week, or perhaps train twice a day. Therefore it's recommended that these week day workouts, although demanding, should be more about maintaining, rather than developing endurance in preparation for longer weekend efforts. Such a circumspect approach will also reduce the potential for over training. So what can you do on the indoor rower as part of your ultra-endurance week day training? Here's an example:

20 minutes at 22 SPM, 3 minutes at 24-26 SPM, 20 minutes at 22SPM.

Heart rate average 75-80%

You should aim to maintain the same heart rate during the 3 minute higher stroke rate interval. This may be difficult, but the idea is to realise the benefit of heart rate control when energy expenditure is increased and to develop your body's ability to use fat as its preferred fuel source. In an ultra-endurance running race, you will invariably have hills to climb. If you tackle these too briskly, you'll deplete your carbohydrate stores, due to your fast twitch muscle fibre using glycogen to power you up the hill. This could have potentially disastrous consequences for the rest of the race. Remember that in a continuous ultra-endurance race, such as the Comrades Marathon, you could have 20km to run on empty if you set off too quickly or tackle hills with too much gusto.

Fat Max

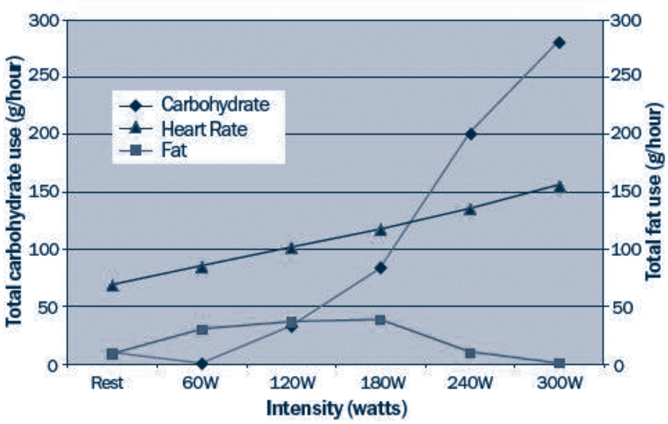
Tour de France riders complete virtually all their training around 80% of HRM and do very little faster, higher heart rate, sharpening work in training. They do this to develop superb heart and lung function, great oxygen processing slow (and fast) twitch muscle fibres, and also to enhance their ability to use fat as a fuel source at relatively high aerobic energy expenditure levels (as opposed to carbohydrate).

Exercise physiologists have coined the term Fat Max, to represent the level when endurance athletes are using fat at an optimal level to sustain endurance.

Table 9 displays the total metabolic cost of exercise in relation to carbohydrate and fat use at different exercise intensities, study it and you'll further understand why training your body to be more fat fuel, efficient by training around 80% of maximum heart rate, will be a big a plus.

Table 9

Total metabolic fuel use with increasing exercise intensity



From Peak Performance 224; Lawson T; p4 2006

Over-training

Ultra-distance (and middle and long distance) runners are prone to over-training. You may think that the more training you do the better athlete you will become. However, not tempering this belief can lead to potential injury and/or illness. I noted potential eccentric muscular damage previously.

If you are experiencing any of these symptoms then you need to rest. Take at least a day off (obviously, illnesses will require more time). You should then return to full training slowly. If the symptoms return take more time off and reduce your training load. You could row instead of run, remembering to adjust using the appropriate rowing running ratio).

Over-training symptoms

- Greater susceptibility to illness, for example, upper respiratory tract infection
- Irritability
- Inability to sleep
- Changes in sleeping patterns
- Sore, aching muscles - more than likely the legs
- Continuous weight loss
- Changes in resting heart rate (this is your heart rate as taken on rising in the morning)

A note on hydration

Hydration is crucial for all endurance activities as it will extend your endurance potential. You should be optimally hydrated before you complete any of the workouts provided in this and other sections of this guide and before your races. When completing a workout or competing in an activity that lasts for more than an hour you should drink a carbohydrate/electrolyte energy drink every 10-20 minutes throughout (aiming for 125-150ml). If you don't, you'll perform poorly and could risk damaging your health. A 4% loss in body fluid could impair aerobic ability by 30%.

After your workout a recovery drink or energy bar should be consumed to immediately kick-start the recovery process. Mind you after the Comrades marathon you might want a little more!

Further thoughts on developing mental toughness using the Indoor Rower

Visualising endurance success

It is apparent that visualisation can work for the learning of sports skill, but can it be as useful a method for enhancing endurance or ultra performance, where technique, such as running, has been mastered and is much less of a performance determinant than in, for example, a sprint race? Considerable research has taken place at the University of Wolverhampton on this subject. The following forms part of their recommendations. Study the comments, and you'll readily appreciate how visualisation can be applied to enhance ultra endurance running and indoor rowing to combat the negatives associated with the CFH and CGT.

The researchers use imagery to help endurance athletes cope with difficult situations. They stress that it is crucial that the athlete successfully imagines themselves tackling a number of eventualities that will make the task difficult. This, they stress, should never be underestimated otherwise there is a risk of creating a false sense of self-confidence. Specifically, the athlete should imagine themselves coping successfully with the fatigue that will come (during the toughest part of the race). They should meet this head on and know that it will hurt. To mentally challenge this they should always see themselves getting through this section and then feeling better. To achieve this they should rehearse the psyche-up strategies that would enable them to gain more energy. 'Self talk' is recommended as an important tool in this respect, as it will enable performance to be enhanced and the 'negative' voices pushed away. By repeatedly applying this type of visualisation with self talk, the athlete will bolster their physical preparation, for the times when the going literally gets tough.

Self talk refers to using affirmative statements, such as, 'I will get through this phase, I have trained long and hard to do so'.

Indoor rower visualisation tip

When you are on the indoor rower (or performing another endurance exercise mode) focus on technique. You'll be in control when you do this and this can detract attention from the fatigue that you may be experiencing, or how long you've still got to go. On the indoor rower, focus on leg drive, back movement, arm pull and release, literally repeating these cues, over and over in your head as a mantra as you repeat each stroke.

Endurance training self-talk tip

Anticipate difficult moments in competition or in training. Develop self-talk scripts to change negative scenarios to positive ones. As Andy Lane from Wolverhampton University explains, "Use a combination of imagery and self-talk to create situations in which you experience unpleasant emotions, and see yourself deal successfully with these situations, using positive self-talk to control the inner voice in your head that can be negative."

Reference: Peak Performance; 226; pp2-5 2006

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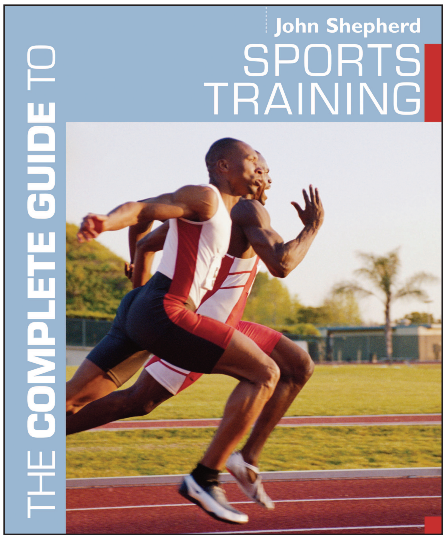

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