STROKEARCS

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TABLE OF CONTENTS

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CONFERENCE TRANSCRIPT

BEPPE DU CAPPUA

Session 1

Ladies and Gentleman Good Morning. I will try to KISS.
To keep things simple and short.
Please interrupt me during the presentation if you don't understand.
If you don't agree or if you have other point of view let me know at the end of the presentation.

We know that there are many ways of rowing technique and these are some of them.
We will talk about what the Italians think is the best from a technical and biomechanical perspective.

We start from boat speed and this is an illustration of boat speed with a propeller, which starts and stops. But in our boats the propeller is the body that moves up and down and this makes some differences. You can see when we start to propel the speed goes down.
Now we have to fix something that for the rower point of view doesn't exist.

When I start to pull I think and I feel that the boat is going faster but this is not true.
So we have to teach the rower to feel. To listen to the boat.

We have to invite the rower to feel this point as this is a very important point. Due to the fact that muscles begin to increase in contraction velocity I think as a rower that the boat is increasing in speed as well. The boat is slowing down. Why. This is the big difference between the weight of the body and the weight of the boat.

That is why some people who are good at ergometer are no good in the boat.
The ergometer is fixed.

The boat is not fixed and is very light in comparison to the weight of the crew.
When we take kinetic energy from the ergometer the ergometer doesn't pay anybecause it is fixed.

But the boats pays big a price.

This is the price that the boat is paying.

There are some explanations of why because the blade is not covered. But the main factor is the reason why the boat goes down in speed is because we are taking kinetic energy from the boat.

After that the boat starts to increase the speed and when we stop to pull the boat continues to increases in speed. Whereas with the propeller as soon as we stop the propeller the boat speed immediately goes down. In rowing we have the body travelling in the opposite direction to the boat. The faster the movement of the body on the recovery the faster the movement of the boat. We know that the resistance is square of the speed and velocity. If we increase 2 go down 4 if we increase 3 we go down 9. This is a gift that we don't want, as we pay too high a price.

To keep it short and simple our goal is to reduce these two peaks.

We know that if we reduce the peaks the average of the boat will be lifted.

Now what to do to decrease this and to decrease this.

This I have already mentioned. If I am too fast I increase this too much.

Really important that you don't move too fast on the recovery.

We say that the rowers should glide during the recovery. Again we are talking about the feelings. We spot a lot with the rowers with beginners and top rowers even people who are three times Olympic Gold medallists. Every day we talk about feelings. Because it is not a natural feeling in rowing. It is not football like it is natural to walk. Rowing is not natural. So top rowers has to work every day to develop this side if not he go down in feelings. When we recognise that they are not feeling then they stop co-operating with the boat.

Our goals is that rowers must co-operate with the boat. Blades, body, boat and water. The rower has to learn to listen to the boat. We tell them that the blades are like their hands and the rower must feel what their hands are doing.

When we are at the catch we don't talk about catching the water. We talk about catching the boat. You have to feel that you put upon your hands the boat. You take the boat. Then you start to move the boat to build the acceleration. It is very important that you get the placement towards the bows.

Try to finish the recovery in a very soft way. We tell the rower they have eggs under their foot stretcher and they must not crush them. Of course we do this at 18-22 stroke rate and we do hundreds and thousands of strokes at this rate, which is also beneficial from a physiological point of view. At 18-22 they learn to work with the boat and the blades. So that when they increase the rate we have no problems.

We are trying to reduce the negative pressure on the recovery. If I go to fast I can increase the negative force I put on the foot stretcher.

We normally say that the same speed you have coming in is the same speed you have going out. Physics tells us that that we reach zero speed. The rower is a human being with muscle feeling. The rower does not recognise that they are slowly to zero. We are not teaching biomechanics to the rower we are teaching how to be as fast as possible in the boat. So we look for the same speed in and out. We don't break the muscles natural movement we don't ask it to slow down we don't ask it to go faster.

We ask them to swing the body. At 22 strokes a minute it is very important that they do arms, body, legs sequence. We know at this stroke rate it gives a very good rhythm. Good rhythm is a very good help for our goal. Our goal is to be economical. When our rowing is economical we will have the top speed from that crew.

We prepare the body and then start to slide and prepare the blades earlier. We don't want them to wait until the last moment. At the last moment the rower should only be doing one thing - which is lift the hands to allow the blades to go in. If we sky at the catch we increase the negative force due to more pressure on the foot plate and more time for the boat to slow down. So it is really important to go closer to the water and have the blades ready in the last part of the recovery.

It is really important that we don't move the body in the last part of the recovery. We immediately increase the negative force. The boat feels the mass of the back, which is doing this movement. As I am gliding in I start looking for the contact.

When I feel I have the boat in my hands - then I can start to push. It is a timing question.

The rower has to spend time thinking about this feeling and time. I must be careful in the last part of the recovery and be close to the water.

Our secret is the economical stroke. Always working on economical stroke. For instance on the start most crews are uneconomical for the first stroke they make lot of negative. If you ask the stake boat boys at regattas they will tell you that some boats come back on the start and others do not. It is very important in the first stroke that you don't start too hard as the boat is at zero. You have to start with the boat and move the boat from zero. As well the second stroke many crews don't finish the first stroke they just rush it. They feel they are moving very fast because the muscles are telling them they are moving very fast but the boat is very slow.

It is very important that you feel how much force the boat needs. No co-operation between the speed of the body and the speed of the boat. Maybe I am leading because I am so strong because I have anaerobic capacity but I am paying a very high price, which comes in the second 1000m. It is important that you are economical at least for the first 30 strokes ideally for the entire race.

We start the drive phase with the legs then with the body and then the arms. Question is when do we bring the body and then the arms. When the legs are in the middle of their drive we start the body and when the body is in the middle of its drive we start with the arms. But this is theoretical as we have a human body and even between two brothers they have different leavers and different capacities with the muscles. If we try really hard we might get them all the same but you might not be getting the best from them. You are asking their muscles to do something unnatural. We try and get people to row the same but we allow for individuals to achieve it in their own personal style with the same technique. What we must have the same is the blades in the water. We must have the blades at the same arcs not just at the catch and the finish but all the way through. Our aim is to have fast boats.

About the catch the blade moves. This is called by some hydrodynamic lifting. The boat is not an aircraft the proportions are not the same. We do not believe in hydrodynamic lifting. As a coach we have to say what is important for our goal - to be economical.
In the quad you have to put more pressure in the first part of the stroke than a double and more in the double than the single. The question is how much? No mathematical equation exists to tell the rower how much pressure they need to apply in each part of the stroke. Our bodies can tell us in feelings. Our rowers can jump between the boats and within a few minutes find out what the boat needs. It is like a racing car driver. Why is Michael Schumacher the best driver in the world. If you ask Ferrari they tell you it is because he has a sense of feeling that the other drivers lack. It means that whatever car he gets into be it a rally or go cart he feels the engine the speed and what the car needs. It is not the same with his brother. They have had the same teaching but he does not have the same feeling for the boat as Michael does. In rowing it is the same some rowers will feel more and some less. The important thing is to feel that in different boats you put different

pressures at different times. Remember the boat at different speeds will give different feedback.

Why do we insist for a very long sector (arc). Why should the quad be longer than the single? It is not true. One difference between sweep and sculling is that I can be even longer in sculling. Two positive reasons for being longer 1) More acceleration and 2) More efficient.

Avoid one negative e.g. longer you are less resistance to the blades as they cut the water.

One characteristic of a British Sculling crew is to be short. One characteristic of a Italian Sculling crew is to be long. We stop the stroke in front of the body as there is a lot more resistance the closer you go to the body plus lose time and energy.

How to hang, how to grip. We see too many rowers with cocked wrists which can cause inflammation and reduces power. Of course we want pressure through the elbow at the finish with the elbow up and in front of the body. Finish should be very simple out of the body with the hands out of the water with the blades.

Sculling is symmetrical and very simple. If you don't get rid of the details then it will make seconds difference at the end. Compression should be the same in all boat types. We should be aiming for economical. You can do more strokes but in an economical way. The Dutch Olympic 8 beat the Germans in Atlanta the Dutch rowed at 36 spm and the Germans at 39spm. The swing of the body is the same in all boat types. Of course it is hard to row in this way but that is all down to muscle adaptation over years.

The rigging is very important. It is important how much overlap you have. The ideal is between 18-22cm not more it depends on the width of shoulders of the rower. It is also important to have the swivels high one for leg size and big blades. If the swivels are high (20-21cms) they can make a good round movement around the finish. Also at the catch the swivels should be high for anticipation, power and to avoid waves. If you have a smaller rower e.g. lightweight women with smaller legs they should still have the swivels at 17-18cms.

This should be the same in the quad, double and single. The only difference is the velocity of the stroke they should all row the same arcs.

Span in the quad should be less than in the single because the boat is faster. But when the span is too narrow the rower has problems at the catch with being uncomfortable. Most of our quads are on a span of 160-161cm because we want the rower at the catch to be very comfortable. The catch is the key point in rowing. What happens just before the catch and what happens just after the catch are so important in rowing.

Be careful were you measure the span from. Always start from the runners that is were the runners are working. Taking the pitch you can use something a simple as a plum line.

Question: Would lightweight women row on the same 160-161cm span?
Answer: Yes, span remains the same for all our crews we change the outboard not the span.
Question: Are you advocating getting all the rock over from backstops and is this true for low and high rates?
Answer: You are looking for some degree of automatisation. When working at 18-22 we need to get all the rock over from backstops. But our goal is to row at 36 and you can't get all your rock over from backstops because you run out of time. When we teach them arms, body, slide at 18-22 that when they go higher they are able to avoid lunging with the body at the last moment.

Session Two:

Body Positions:

Of course I would say this position, as it is an Italian crew. I feel the crew pictured above is not using enough leg drive. The crew at the bottom of the screen has started the body too early. In the Italian crew which one of the athletes is in the correct position? The answer is very simple, all of them. We believe that if each rower is in their natural position then it is right for them. We ask the rower to sit in the boat just as they sit to watch television. Don't change what is your natural position. The stroke rower is losing his natural position, his position is slightly false and we think this is why he is losing his leg drive.
We try to adapt the boat to the rower. Throughout the year their muscles become stronger so the rower may change their natural position. Don't make complicated what nature has made simple for each one of us.

Sydney Olympic Games 2000 - Men's Quads Final.

Germans are very fast in the first 1000m. Germans hit the catch with very little body rock over and not a very large arc. Italian quad is longer and more fluid at the catch. We say the blade talk. I am stressed you are stressing me and the boat doesn't like it when the blade gets stressed. You are touching the boat, not banging the boat, just touch. A small cat playing with a ball is a good analogy it is a very quick but relaxed movement. Not strength. Remember it is the last part of the recovery and you have to rest. When you feel the contact with the boat then you can go. Remember when you go you need to build the acceleration you can't just bang it. In the last part of the drive you can go faster and faster you have to feel that the boat is escaping from under you. But it is different in the first bit of the drive phase you need to build gradually.

Close up on the German Quad.

In this position they are short. In this position with the shoulders down they can be much longer. Also at the finish they are not so long. We know the Germans are stronger from a test point of view on the ergometer. They now see the Italians are coming so what do they do they become more aggressive. They answer the Italians but in the wrong way. The Germans bow is bouncing the Italians bow is more fluid. The Germans are doing one stroke more than the Italians but they are shorter.

From a technical point of fluid the two big differences between these crews is we have a longer sector (arc) and a more fluid rhythm.
Rhythm:

The Germans are fast, slow, fast. The Italians are the same speed. If you think from a physics point of view space and time are lines. If you think from a music point of view it is not a line. From the catch to the finish there are no stopping points, no slowing down, no changes of speed and this rhythm is more economical.
In the last 100m even the Italians are becoming shorter and they think they have to increase their stroke rate, which is wrong.

Sydney Olympic Games 2000 - Women's Quads Final.

A very good result Silver for Britain. But we are not talking about results we are talking about technique what to do and what to avoid.
German quad - why are they shorter than the Italians? Is it because they are women.
We don't think so. We have already talked about the rigging.
They row like the men they row the same length with the same arc and just different outboard.
All these leading crews are short all of them.
The German crew is longer in the finish arc than the catch arc. This isn't right.
We don't know why this women is stroking as she is not connected around the finish. She is not behind the blades she is over the blades. It is very important to stay behind the blades.

From the physiological point of view the Germans are much stronger than the British and maybe that is why they are winning. You can see the bows of the boats are starting and stopping. Would the British quad with different rigging and longer arcs have beaten the Germans?
Not by changing things in the last few weeks but by making changes over time. Whenever you make any adjustment like rigging you need to allow time for adaptation to occur and this can take weeks or months. Change things and see what is for the best. Sometimes we don't know what to do at the end because there isn't often a large distance. But in this speculation we try to be sophisticated by testing using the stopwatch.
Question:
Yesterday you talked about the finish as being soft and today you talked about it being hard can you clarify?
Answer: Not softly. Covering the blades is softly. I forgot the video of the Atlanta Olympic Games were the TV cameras picked up the blades of the Italian double going in and there is hardly a splash and they are in the final of the Olympics. So at the catch we can be softly because we don't push until we have the contact. Then we start to push and it is important that the muscles get used to moving fast even when we are doing 18-20 spm.
At the finish I want to be clean and efficient. Remember the movement of the blades in the water. I want to stop the finish in front of the body but arrive with a lot of acceleration. What is the right moment when I finish the pull? The boat can tell you when you need to do these things. The rower needs to develop feelings for the boat. We say when you feel when the boat is going to escape from your hand you need to change. If I move too quickly it is too traumatic for the boat.
It is very important to develop this sensitivity and too co-operate with the boat.

World Championship 2002 - Seville (Women's Double Sculls Final)

New Zealand Double (eventual winners) - very long. Some people say you can do this in the double but not in the quad. They say you need a higher stroke rate in the quad than in the double because it is a faster boat. Of course if you row shorter you can use higher stroke rate but it is not economical.
To row this long is hard. If I ask them to row in this way a month before the regatta it won't work it takes three-four years to achieve this. At the finish the double is working very well particularly bow. They still have contact throughout the stroke.
When you get too a long catch position it is not easy to bang.
The quad is the same the only difference is the velocity of the stroke.
The Italians, British and Russians are all shorter than the New Zealanders.
Italian double are relaxed but not long.
New Zealand double you can see some difference in the finish, the arcs are not the same. The stroke is coming out at the finish a little earlier than the bow.
Italian double have a good leg drive but they need to be longer. They are trying to be longer but it takes time.

Question: Was it heavy for the New Zealand double to row that long?
Answer: Muscle adaptation takes time. It is not a question of outboard but a question of arcs. They have the same

rigging as the Italian double but they are longer because they are trained to do it, they have adapted.

Question: How much time do people spend in the single before they go into the quad?
Answer: Many months and years in the single. The single is easy to train in. We don't have many professional rowers in Italy. We have lack of time. You lose time just driving to the rowing club. Stretching is very important but it is not training. Nutrition is very important but it is not training. Rest is very important and there is no point them training if they can't get sufficient rest in between the sessions. It is a question of priorities what we do with this time. They might have as little as 14 hours for training per week. So do we run, do we do weights, cycling, cross training if we did we might get to 4-5hours for rowing. It is not enough. You can only do one thing with 14-17 hours per week and that is row and row and row.
But what about strength - we do that rowing and on ergometer. If I have a professional then I can do all these things and still row 180km per week. After rowing 180 km throughout the year you will see the difference.

Question: How important is it for everyone rowing to be the same height?
Answer: You can see from the Italian quad they are all different sizes. It is a question of rigging and the natural behaviour of the bodies and flexibility.

Question: When we watched the German Women's Olympic Quad you said the women at stroke shouldn't be in that seat. How do you decide who is going to sit in the stroke seat?
Answer: The first quality is a sense of rhythm. To be good at rhythm you must have very good timing at covering the blade. Secondly you have to have a good arc as the others will follow you. If we look at the stroke of the Italian straight four in Sydney he is a fantastic stroke. He is not very big. He does not have a large physiological capacity. But he has fantastic feelings he talks to the boat. When I talk about arc I don't just mean the catch but the finish as well it is important they are able to combine length and pressure. Mentally they have to be very cool and focused. An American psychologist talked about the 'killer instinct' and I feel they have to have that.

World Championship Final Italian Lwt Men's Sculler

Just to give an idea of position of the catch. We were not satisfied with this position. There was a problem with this foot stretcher and we couldn't get it to go any lower. Also the athlete is very tall and the knees were too high because of the foot stretcher. After we were able to move the feet he was able to be even longer. Again we are talking about rigging the distance the feet are from the seat and what angle we have the foot stretcher is very important.
You can see the others are shorter.
You can see on the recovery he is gliding the last part of it, not rushing.
Drills

Single strokes pausing at hands away, then moving the back over between the pauses.
When they move the back they have to be very careful not to stop the boat.
It is important to keep the boat moving so we normally do some full strokes in between.
The other drill we do is about the finish. When crews are rowing with arms only all we see is chop, chop, chop this is wrong. They move too quickly and there is no rhythm. It must be slower. The body and the boat moving and co-operating together.

When rowing you can pause at the finish and check. You can pause at the cross over.
You can pause anywhere.
But it is important that you pause every three or four strokes to keep the speed in the boat.
A lot of rowers use the back in the early drive phase. We work on pushing with straight arms no back.
Piano playing is also very useful. You can also use it as an opportunity to check the grip.
Placement at the catch. Just sliding forward and dropping in. It is used to practice the anticipation. The second part of this drill is just using the first six inches of the slide.
Square blade rowing helps a lot to get the right finish and the right pressure at the finish.
It also helps a lot with the catch. They row many kilometres with square blades.
Eyes closed rowing. We want to develop feelings in the boat. They mustn't squint with the eyes the muscles should be relaxed.
Selection

If you want to select for double you use the double. If you want to select for a quad you use a quad. This year are aim is too do a very strong double so we get everybody in single and the best two in the single do the double, why? This year our goal is to do the quad so the best four single go in the quad, why? Maybe the sixth, eighth, tenth in single is among the best four for the quad. Because there are different muscle contraction velocities in different boats. Maybe one persons muscles are too fast for the single but ideal for the quad.
If I only had one single and one quad then we get people to go in single and then in quad and swap over. We don't use seat racing we trust in stop watch. For seat racing you need two quads or two doubles but if you have just five rowers to select a quad you can't use seat racing. That is the way to see in that boat who is the best rower.
We use the single a lot because mentally you get a lot out of it. The boat can give a lot of self-confidence and really help people improve technically. We use the single for training but not for selection.
Question:
If you go for a very big arc don't use waste a lot of energy at the front end?
Answer: Yes we can see from the efficient stroking chart that when you are at 60 degrees or even 70 degrees you waste almost half of your effort. But this is a price we are prepared to pay. So why don't we start the strokes were it is more efficient? Because we know we need to build the acceleration. The more acceleration we have when we get to this efficient arc the better. In sculling we should be 70-75 which means you have 110 degrees. But remember the knife effect the blade goes in easier at the higher arc.

These two positive factors weigh more than the negative side.

Physiology

Lactic Acid, Blood Lactate & The "Lactic Acid Myth"

Many coaches and athletes routinely perceive lactic acid, or more specifically lactate, as a dead end waste product that is completely unfavourable to all athletic performance. This assumption however, may longer be considered accurate - so much so that it has been labelled 'the mythology of lactic acid' (1).

While Sports Scientists are largely in agreement that lactate behaves more like an athlete's friend than foe, recent research has now begun to question one of the basic tenets of muscular fatigue – increased acidity or lactic acidosis.

This article explores some of the current understanding about how lactate and lactic acid functions in the human body, particularly during exercise. It examines the compounds' roles in fatigue and energy metabolism and as a limiting factor in performance.

A basic understanding of energy metabolism during exercise is helpful to appreciate some of the current issues surrounding lactic acid.

Lactic Acid and Oxygen

Recall that the end product of glycolysis is pyruvic acid. Traditionally, it was believed that oxygen availability, or lack thereof, lead to the conversion of pyruvic acid into lactic acid and accompanying increases in muscle and blood lactate.

Over the past 35 years, evidence has mounted against this idea (3,4,25). The best evidence seems to suggest that oxygen availability is only one of several factors that cause an increase in muscle and blood lactate during submaximal exercise. In fact, lactic acid can be formed anytime glycolysis takes place regardless of the presence or absence of oxygen and is even produced at rest (2).

Lactic acid and **lactate** are not the same substance. The glycolitic energy pathway produces lactic acid, which then quickly dissociates releasing hydrogen ions (H^+). The remaining compound then combines with sodium ions (Na^+) or potassium ions (K^+) to form a salt called lactate (2). Blood lactate and not lactic acid, is the substance usually measured in athletes under laboratory conditions.

Historically, the lactate threshold has often been referred to as the point at which energy is generated through predominantly anaerobic metabolism. Yet the onset of blood lactate accumulation (OBLA) only represents the balance between lactate production and removal and suggests nothing about the aerobic or anaerobic metabolism per se (8).

Researchers have been unable to show a lack of oxygen in the muscles at an exercise intensity above the lactate threshold (8). Instead OBLA may be caused by many different factors other than those associated with anoxia or dysoxia.

For a more detailed discussion of other factors leading to the increased production of lactic acid and blood lactate, see Gladden's 2003 paper *Lactate metabolism during exercise* (5).

Lactate is Not a Waste Product

Before the 1970's lactic acid was considered a waste by-product resulting from a lack of available oxygen to the working muscles. It was blamed for the 'burning' sensation during vigorous exercise, delayed onset muscle soreness and central to the process of fatigue. The general consensus was, and still is amongst many coaches and athletes, that lactic acid is responsible for fatigue and exhaustion in **all** types of exercise.

On the contrary, lactic acid only accumulates within muscle during relatively short, highly intense exercise such as sprint swimming or running. Endurance athletes, such as marathon runners for example can have near-resting lactic acid levels following a race despite being exhausted (2).

In 1984, George Brooks (6) proposed the **lactate shuttle** hypothesis and at present, the cell-to-cell lactate shuttle has almost unanimous experimental support. This hypothesis questioned many of the widely held beliefs about lactate.

Far from being a waste product, the formation of lactate allows the metabolism of carbohydrates to continue through glycolysis (2). Keep in mind from the energy systems that glycolysis allows rapid production of energy required to sustain intense exercise.

The heart, brain and most slow twitch fibres are very apt at clearing lactate from the blood – to the extent that they prefer lactate as a source of fuel (27,28,29). Note however, that lactate must first be converted into pyruvate before it can be used as a source of energy.

Clearance of lactate from the blood can occur either through oxidation within the muscle fibre in which it was produced or it can be transported to other muscles fibres for oxidation (31,30). Lactate that is not oxidized in this way diffuses from the exercising muscle into the capillaries and it is transported via the blood to the liver (31). Through a process known as the **Cori cycle**, lactate can be converted to pyruvate in

the presence of oxygen, which can then be converted into glucose (2). This glucose can either be metabolized by working muscles or stored in the muscles as glycogen for later use (2).

So lactate should be viewed as a useful form of potential energy that is oxidized during moderate-low intensity exercise, during recovery and at rest (28,30). Unlike lactic acid, lactate is not thought to be fatigue-producing (31).

Based on this more sympathetic view of lactate, sports nutrition companies have introduced sodium lactate into sports drinks and there is some tentative support that these may have an ergogenic effect (9,18).

What the lactate shuttle model essentially shows is that lactate is a crucial intermediary in numerous cellular, localized and whole body metabolic processes, and may help to prolong submaximal activity, rather than hinder it.

Lactate Accumulation

During intense exercise, muscle and blood lactate can rise to very high levels (10). This accumulation above resting levels represents the balance of production and removal. It says nothing about whether accumulation is due to an increased rate of production or decreased rate of removal, or both. Similarly, if lactate concentrations in the blood do not rise above resting levels during or immediately following exercise, it also infers nothing about lactate or lactic acid production during that activity. It may be that lactic acid production is several times higher than at rest but that it is matched by its removal showing no net increase (26).

A common misinterpretation is that blood lactate or even lactic acid, has a direct detrimental effect on muscle performance. However, most researchers agree that any negative effect on performance associated with blood lactate accumulation is due to an increase in hydrogen ions. When lactic acid dissociates it forms lactate and hydrogen ions - which leads to an increase in acidity. So it is not accurate to blame either lactate or lactic acid for having a direct negative impact on muscular performance.

The increase in hydrogen ions and subsequent acidity of the internal environment is called **acidosis**. It is thought to have an unfavorable effect on muscle contraction (10) and there has been considerable research to demonstrate that this is the case (11,12,13,14,15,16,17).

Lactic Acidosis

So this unfavourable acidosis is the result of an increased concentration or **accumulation** of hydrogen ions. It may seem logical to conclude then, that any increase in **production** of lactic acid and hence lactate is detrimental as it will increase the production of hydrogen ions.

However, **accumulation** is the key term here as an increased **production** of hydrogen ions (due to an increase production of lactic acid) will have no detrimental effect if clearance is just as fast. In fact Robergs *et al.* (19) takes it a step further…

They suggest that **lactate** production (especially if accompanied by a high capacity for lactate removal) may be more likely to **delay** the onset of acidosis (19, 25). The reasons for this, amongst others, are that lactate serves to consume hydrogen ions and allows the transport of hydrogen ions from the cell. Similarly, they maintain, there is a wealth of research evidence to show that acidosis is caused by reactions other than lactate production (19).

Rogers *et al.* do conclude however, that increased lactate concentration, although not causative, coincides with cellular acidosis and remains a good indirect marker for the onset of fatigue.

Acidosis and Fatigue

As mentioned earlier, there has been substantial research to show that an increase concentration of hydrogen ions and a decrease in pH (increase in acidity) within muscle or plasma, causes fatigue. Additionally, induced acidosis can impair muscle contractility even in non-fatigued humans and several mechanisms to explain such effects have been provided.

Yet in the last 10 years a number of high profile papers have challenged even this most basic assumption of fatigue. A 2006 review of these by Cairns (18) suggests that experiments on isolated muscle show that acidosis has little detrimental effect or may even improve muscle performance during high-intensity exercise.

In place of acidosis it may be **inorganic phosphate** that is major cause of muscle fatigue (20). Recall that an inorganic phosphate is produced during the breakdown of ATP to ADP. However, there are several limitations regarding this phosphate hypothesis (21). Another proposal for a major contributor to fatigue, rather than acidosis, is the accumulation of potassium ions in muscle interstitium (22,23,24).

Contrary to this new research (which is by no means definitive) is the argument that if acidosis plays no role in fatigue then it is surprising that alkalosis (through sodium bicarbonate consumption for example) can improve exercise performance in events lasting 1-10 minutes. To reconcile this, Cairns (18) hypothesizes that while acidosis has little detrimental effect or may even improve muscle performance in **isolated muscle**, severe **blood plasma** acidosis may impair performance by causing a reduced central nervous system drive to muscle.

Lactate Accumulation and Exercise

At rest the normal range for blood lactate is 0.5 – 2.2 mmol per litre (32,33). It is thought that complete exhaustion occurs somewhere in the range of 20 – 25 mmol/L for most individuals (34) although values greater than 30 mmol/L have been recorded (35).

Blood lactate concentrations peak about 5 minutes after the cessation of intense exercise (assuming cessation is due to exhaustion from acidosis) (32). The delay is attributed to the time required to buffer and transport lactic acid from the tissue to the blood (36). A return to pre-exercise levels of blood lactate usually occurs within an hour and light activity during the post-exercise period has been shown to accelerate this clearance (32,35,37). Training can also increase the rate of lactate clearance in both aerobically and anaerobically trained athletes compared to untrained individuals (32,38,39).

Interestingly, Stone *et al* (40) noted that trained individuals generated **higher** levels of blood lactate at the point of failure compared to untrained subjects when exercising intensely (squats). The time and amount of work they completed, unsurprisingly, was greater in the trained group. This seems to suggest that training may induce greater tolerance to lactate accumulation and it may also add weight to the argument that lactate serves to delay acidosis and fatigue. At any absolute workload (i.e. when both groups were lifting the same weight) the trained group had **lower** levels of blood lactate.

This indicates that training-induced adaptations include a lower blood lactate concentration at any given workload and higher blood lactate concentration during maximal exercise (32,41,42).

The 'anaerobic' or lactate threshold is based on the point at which blood lactate abruptly accumulates. It can be used as a prediction for race performance and to prescribe training intensity.

To Summerize...

- Lack of oxygen is not necessarily responsible for an increase in lactate production or even lactate accumulation. Other causative factors may play a more significant role.
- Blood lactate accumulation represents only the balance of production and removal. It says nothing about the absolute values of either of these.
- Only relatively short, very intense activity causes lactc acid to accumulate. Lactic acid is not thought to be a contributor to fatigue in low-moderate intensity activity of any duration.
- Lactate is an important substrate that can be used during submaximal exercise, recovery and at rest. It is the preferred source of fuel for the heart and brain.
- Lactic acid or lactate 'pooling' is not the cause of delayed muscle soreness.
- Lactate **accumulation** and not necessarily an increase in production, causes an increase concentration of hydrogen ions and corresponding acidosis. Lactate production may actually help to curb the development of acidosis.
- Acidosis is thought to be a primary factor in muscular fatigue and is based on a good deal of research. Recent research is contesting this claim but it is still too early to dismiss acidity as a cause of fatigue.
- Training accelerates lactate clearance, reduces lactate accumulation at any given workload and results in a greater level of lactate accumulation during maximal effort.

This is clearly an area that is far from resolved but what seems clear is that lactate can no longer be labelled definitively as the athlete's enemy. On the contrary, gathering evidence suggests that many aspects of lactate production are beneficial to athletic performance.

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COACHING SKILLS

PLAYING FAVOURITES

One day a few years ago, a club board member accused me of "having favorites" on our club team. Several other parent board members nodded their heads in agreement The implication was that this was a terrible sin. When I was a younger coach, I thought it was terrible also. And he was right. I did have favorites. My favorites were those athletes who most fervently did what I asked of them. Those that did, I gave more attention to. I talked to them more. I spent more time teaching them. I also expected more of them.

The implication that he was making was that my favorites got better than the others because they were my favorites, and that was somehow unfair. He mistook cause for effect.

The fact is, that the athletes who came to me ready to learn, ready to listen, ready to act on what they learned and try it my way, even if it was more challenging, more difficult than they imagined, were ready to get more out of our program. And they were my favorites.

As a coach, I have only one thing to offer to an athlete. That is, my attention. Which means that I attend to their needs. The reward for good behavior should be attention . . . attending to their needs. The consequence of inattention, lack of effort, unwillingness or unreadyness to learn or just plain offensive or disruptive behavior is my inattention to that athlete.

How could it be other than this? If you have three children, and you spend all of your time and energy work working with the one that is badly behaved, what does that tell your other two children? It tells them that to capture your attention, they should behave badly. What we reward, is what we get.

As a coach, I want athletes who are eager to learn eager to experiment to improve, eager to work hard. I want athletes who come to me to help develop their skills both mental and physical, and are willing to accept what I have to offer. Otherwise, why have they come to me. And I am going to reward that athlete with my attention. In so doing, I encourage others to become like the athlete above. If I

spent my time with the unwilling, the slothful, the disruptive, I would only be encouraging that behavior.

The link I want to forge is between attention and excellence. Excellence in the sense of achieving all that is possible, and desired. My way of forging that, is to provide my attention to those who "attend" to me. This does of course result in increased performance for those that do so. I am a professional coach, and when I pay attention to a person, that person is going to improve. Over time, this makes it appear that my "favorites" are the better swimmers. Not so at all. The better swimmers are those that pay attention, and thus become my favorites.

What Dad didn't realize is that you must have favorites if anyone is to develop in a positive fashion. The coach's job is to reward those who exhibit positive developmental behaviors. Those are my "favorites," and they should be.

ASSOCIATION OF ROWING COACHES, SOUTH AFRICA

COACHING SKILLS

PEAK PERFROMANCE UNDER STRESS

INTRODUCTION
Stress is a direct result of an athlete or team focusing on, and trying to control the "uncontrolables" within their sport (i.e., officiating, play of opponents, playing conditions, crowd, etc.). When an athlete focuses on these uncontrollables he/she is more likely to tighten up and "choke." The following are some brief guidelines to follow to help you train your athletes to better manage competitive stress.

STEP ONE

COACH THE PROCESS, NOT THE OUTCOME
When an athlete focuses on the importance of the game, winning and losing, or anything to do with the outcome of the performance, he/she is in big trouble. This focus distracts the athlete from a performance focus, tightens them up physically and insures that play will be tight and tentative. Get your athletes to focus on specifically what they have to do to win, not on winning.

STEP TWO

TEACH AN AWARENESS OF THE STRESS/PERFORMANCE CURVE
If you can help your athletes understand the relationship between their level of nervousness and how well they perform you will have taken a major step towards helping them to better handle pressure. If an athlete can "read" their nervousness preperformance and can tell the difference between "good", "bad", and "not enough" nervous, then they will be in a better position to be able to do something about their arousal level before it's too late.

STEP THREE

TEACH COPING SKILLS, DON'T WASTE YOUR TIME YELLING AT YOUR ATHLETES TO "RELAX"
This is not how to teach relaxation. Instead, spend a small amount of time preseason providing your athletes with a number of mental skills that they can use to help them to better relax under pressure. Not all members of your team will need these, but you'll do far more good than not by investing a small amount of practice time offering 2-3 relaxation techniques (progressive muscle relaxation, autogenic training, breathing exercises, etc.) to everyone. Armed with ways of cooling down, your athletes will be less likely to fall apart under stress.

STEP FOUR

TEACH REFRAMING IN PRACTICE
Reframe adversity teaches your athletes how to use whatever adversity comes their way to boost confidence rather than erode it. Help your players see that poor weather conditions, bad call by the officials, unsportsmanlike play, fatigue, etc., can work for them. There is always an advantage in a disadvantage. Train your players to find it.

STEP FIVE

USE HUMOR
The surest way to get your athletes to tighten up and play poorly is by being too serious. Peak performance comes out of having fun. You play your very best when you are enjoying the competition; regardless of the level. By using humor as a coach, you can help your at-athletes stay loose, keep the game in perspective and perform like champions. An athlete that is too serious is an at-athletes who has a tendency to choke under pressure.

STEP SIX

PROVIDE A PERSPECTIVE
If you make the competition "bigger than life" your athletes' performances will suffer. If the game is built up too much, or if that "must win" situation becomes too important, then chances are you will not get a good game from your team. Helping in helping them handle a highly pressured situation. An athlete that chokes usually has lost his/her perspective and made the competition much too important.

STEP SEVEN

USE SIMULATION DAILY
Practice does not make perfect, perfect practice makes perfect. It's the quality of your practices that is ultimately responsible for how much your athletes get from practice tune and how well they handle highly pressured situations. Integrate competitive elements into your

practices to help your athletes better adjust to the actual pressure of game day. The more your practices resemble competitions, the less chance your athletes will have of falling apart under pressure. If your athletes have trouble with bad calls, certain playing conditions, being down early, etc., simulate these elements as closely as possible in your practices.

STEP EIGHT

CREATE A GO-FOR-IT ATMOSPHERE
In practice create an atmosphere of "nothing to lose" or "free to fail". When athletes are not concerned about making mistakes they perform their best. If your players are worrying about messing up they will be distracted enough and tight enough to indeed mess up. Encourage your players to let their mistakes go immediately and to focus on what they want to have happen, not what they are afraid will happen. Reward mistakes when an athlete has truly gone for it, when they have given a winning effort. If you can teach your athletes to become oblivious to failure and mistakes (i.e., that they learn from them and that they are useful only for feedback on how to improve), then they will perform well for you.

STEP NINE

SEPERATE SELF-WORTH FROM PERFORMANCE
At every level of play, athletes get stressed out when they attach their self worth to the quality of their performance (i.e., "I played well so therefore I am a winner", "I was awful and therefore I am a not a good person"). You set the tone for this in how you coach and interact to your athletes. Do not make the mistake of equating their performance with how you feel about them. If you do not make this separation, then they will not be able to understand and their performance will suffer. If your ego is on the line every time you compete you have a lot to lose. When you play with a lot to lose, you will most likely get stressed out and play poorly.

STEP TEN

CHALLENGE YOUR ATHLETES, DON'T THREATEN THEM
When an athlete or team is threatened with consequences should they not perform well, they will consistently fall apart when the game is on the line. Threats only serve to distract the athlete from the task at hand and get them to worry about the consequences for failure. Focusing on the "what if's" of losing is the last thing you want your athletes to do before and during an important game. Instead, challenge them. Give them the message, which is implicit in any challenge that you think that they can do it, that you believe in them. Athletes will most frequently rise to your challenges and respond poorly or inconsistently to your threats.

STEP ELEVEN

FOCUS YOUR PLAYERS FOR PEAK PERFORMANCE UNDER PRESSURE
Most stress related performance problems are a direct result of faulty concentration. The athlete that gets easily psyched out or intimidated does so because he or she is focusing on the wrong things (i.e., the actual or imagined prowess of the other player or team). Help your athletes concentrate on specifically what they have to do to play well. Teach them to "control their eyes and ears", to only look at, or listen to things that keep them composed and performing their best.

ASSOCIATION OF ROWING COACHES, SOUTH AFRICA

PSYCHOLGY

TOP 10 GUIDING PRINCIPLES FOR MENTAL TRAINING

1. Mental training can't replace physical training and talent.
We haven't seen any Olympic Athlete who succeeded without doing the physical and technical work, even though we have worked with some of the most mentally talented athletes in the world. The reality is that even an exceptionally talented athlete who has not prepared well physically loses confidence and is vulnerable in competition. The best and easiest confidence is that which comes from the knowledge that you are as prepared, or more prepared, than your competitors, and that you are physically capable of a winning performance.

2. Physical training and physical ability isn't enough to succeed consistently.
On the other hand, we have worked with a number of athletes whose coaches called them "the most talented athlete on the team," yet these athletes never achieved

international success. These physically gifted athletes were not able to manage the mental demands of the sport. Some athletes can't handle the focus and discipline of training, where others can't handle the pressure and stress of competition. If you are lacking in either of these areas, you may succeed at times, but you will not succeed consistently.

3. A strong mind may not win you an Olympic medal, but a weak mind will lose you one.
It is very difficult to predict that a mentally strong athlete will win an Olympic medal, due to all the factors that play into winning a medal. There are so many variables—training, health, finances, coaching to name a few—to properly account for, that success for any athlete is never certain. On the other hand, one of the easiest predictions to make is who will fail under Olympic pressure. Athletes with an obviously weak mental game virtually never win at the biggest competitions.

4. Coaches frequently don't know what their athletes are thinking.
While all great coaches pay close attention to behavior of their athletes on the field of play, very few coaches have a similarly detailed knowledge of what their athletes are thinking or should be thinking. Few coaches know enough about the specific mental "demons" all athletes have, so they are often unable to intervene when they need to at competition. We have come to the conclusion that like politics or religion, it is an area many coaches are afraid to ask about. While some coaches know that "psychological factors" were the cause of an athlete failing in competition, many of these coaches are not aware of the athlete's mental state before they compete.

5. Thoughts impact behavior. Consistency of thinking = consistency of behavior.
It is a simple but powerful idea that all sport behavior starts with a thought. While much of coaching focuses on making sport behavior more consistent and controllable, much less of coaching focuses on making thinking more consistent and controllable. Because of this, many coaches are surprised by not only the difference between their athletes' practice behavior and competition behavior but that the reason for that difference is due to how their athletes are thinking. One goal of sport psychology is to understand and control the thinking process, therefore understanding and controlling behavior.

6. Coaches often have a different view of changing technical mistakes vs. mental mistakes.
As sport psychologists, we are optimistic about the ability to work on mental mistakes. Thus we are often surprised when coaches are willing to write off an athlete as a "choker" when they repeat mental mistakes in competition. These are often the same coaches who will work literally for years with an athlete on a repeated technical mistake. To a coach who says, "I don't think they'll ever do it", we ask, "How many times have you specifically worked on changing the mental mistakes? What drills have you tried? How do you give the athlete feedback on his mental mistake? Does the athlete know exactly how she should think? Have you had this discussion?"

7. Coaches must be involved in the mental training process.
Historically, in sport psychology, we have heard coaches say after a strong period of training before the season "Well, now it is all mental. Now it is up to the sport psychologist!" While it is nice to feel important to a team's success, we have learned from hard experience that it is all wrong for coaches to "outsource" mental training and sport psychology to a sport psychology consultant. We have learned that many elite coaches feel out of their comfort zone when dealing with in mental training issues, and fear asking probing questions about how an athlete thinks and feels. We have also learned to push coaches to go past their fears and get used to coaching the mental as well as the physical athlete. If coaches don't become the prime provider of sport psychology for their teams, all kinds of teaching opportunities and chances for excellence will be missed. At worst, coaches who are unaware of their athletes' mental skill building will coach in ways that oppose or undermine the mental skills acquired. The bottom line is that coaches must be involved in mental training for it to be successful.

8. Sometimes it is ok to force athletes to take the time do mental training.
The USOC's Sport Psychology Department's philosophy on this topic has evolved over the past ten years. In the past, we were unwilling to say that all teams should do some form of mental training. We had been fairly passive, waiting for coaches to approach us with requests for service. Unfortunately, many of those requests came from coaches who had seen their athlete melt down in the biggest competition of their life. Obviously, it is too late at that point!

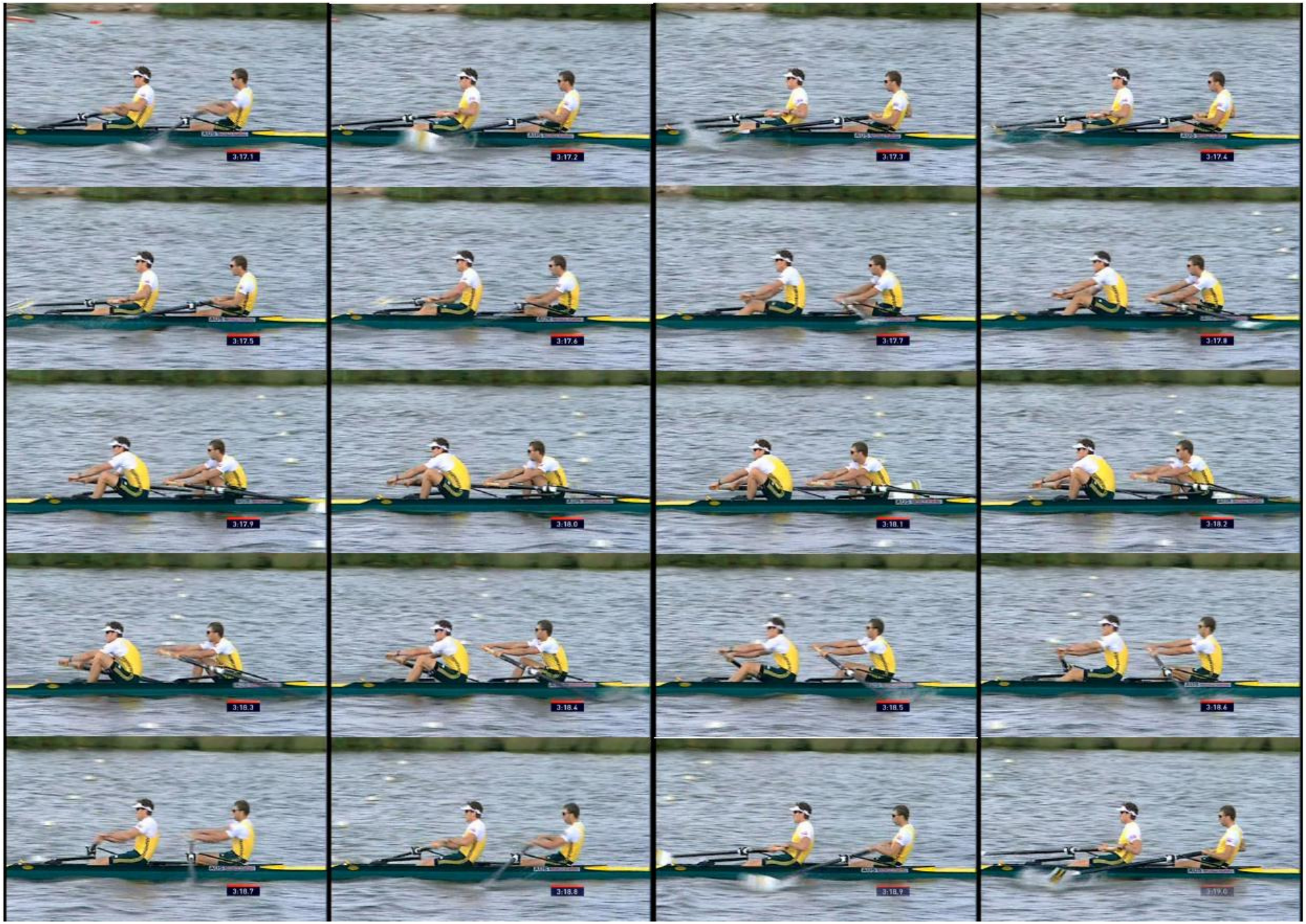
Surprisingly, many coaches seem willing to accept an athlete's reassurance, "My mental game is just fine." Why, when you wouldn't ask the athlete to determine if his technique is "just fine", do you let the athlete avoid working on their mental game for years until a crisis forces them to admit they need work? At the USOC, we are now quite comfortable pushing athletes into doing the mental training work, even if they don't always see the value at first.

9. Like any other skill, mental skills need to be measured in order to maximize performance of those skills.
"What gets measured, gets done." This old expression from business writer Peter Lynch is useful for coaching as well. Just as ski coaches time training runs, or basketball coaches calculate free throw shooting percentages, application of mental skills can be measured. Moreover, they MUST be measured if they are to change. Once you think of mental skills as behaviors to be measured, you can begin to use your own coaching creativity to teach, modify, and increase the use of, mental skills.

10. Coaches need to think about their own mental skills
Most coaches can readily see that the same skills they are teaching their athletes are also useful for their own work in coaching. With the amount of pressure coaches

face, for example, the ability to manage emotions, control arousal, game plan, and simulate pressure are all useful for coaches.

This is an excerpt from the Coaches Guide –Mental Training Manual, USOC Sport Psychology staff. This manual is available from the USOC for $24.95, call 719.866.4517 for more information.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