WSRA

WELSH SEA ROWING ASSOCIATION

CYMDEITHAS RHWYFO CWCH HIR CYMRU

Rowing Technique and Rigging

Workshop Organized by the Welsh Sea Rowing Association

CYMDEITHAS RHWYFO MÔR CYMRU

WELSH SEA ROWING ASSOCIATION

Learning outcomes

Basic concepts

Information about the stroke cycle and phases of the stroke

Identify the muscle groups involved

Power

How the oar behaves

Rigging

Hull speed

Introduction

Rowing technique and rigging adjustment are intimately linked.

Change the athlete to suit the boat

- **Technique**

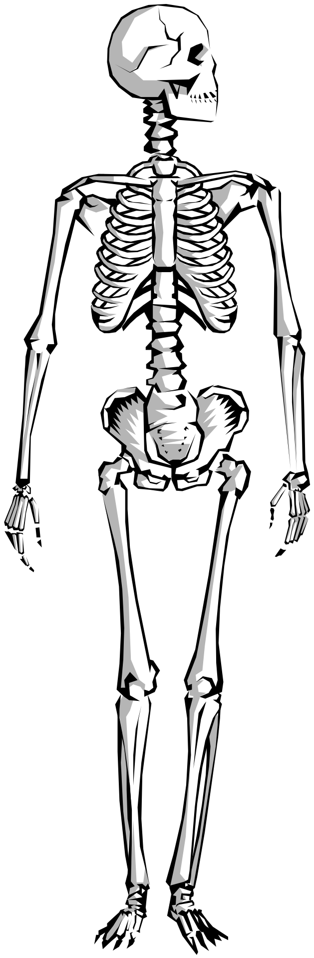
or

Alter the boat to suit the athlete

- **Rigging**

Ideal Body Size and shape

MEN



Height

194.1 cm (6ft 4ins)

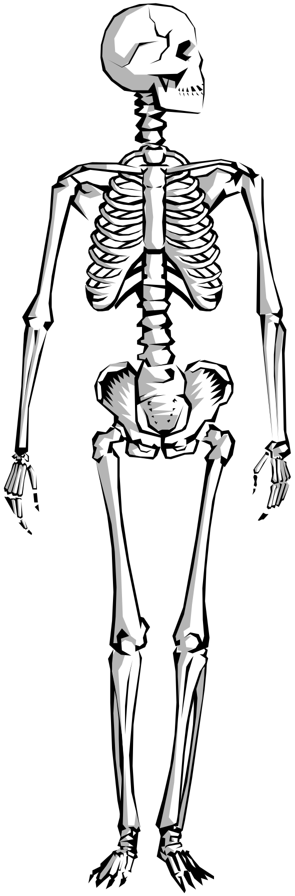
Weight

88.1 kg (13st 12lbs)

Body fat - 8.7%

Age 26

WOMEN



Height

178.6 cm (5ft 11ins

Weight

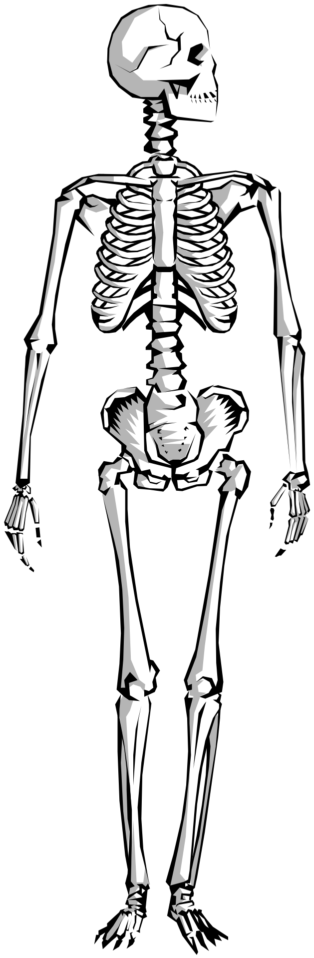
73.6 kg (11st 8lbs)

Body fat 15.4%

Age 24

Ideal Body Size and shape

MEN



Height

194.1 cm (6ft 4ins)

Weight

88.1 kg (13st 12lbs)

Body fat - 8.7%

Age 26

ME

Height

Far too small

Weight

Amazingly too light

Body fat – Far too fat

Age Far too old

Ideal Performance

Olympic times on Ergonometres

Men - average time of about 6:02 for 2000 meters (that translates to 6633 meters in 20 minutes).

Women - average time of 7:01 for 2000 meters (that translates to 5701 metres in 20 minutes).

World record for 2000 metres for men is 5:36.6

World record for 2000 metres for women is 6:28.4

95-99 Men John Hodgson Great Britain 10:28.1 2005

90 -95 Women Ernestine Bayer USA 12:07.5 2000

The Stroke

Key Characteristics of the rowing Stroke

1. **The oar is ‘anchored’ in the water and the boat is levered forward**
2. **The distance the boat travels while the oar is in the water is related to the distance the oar handle is moved**

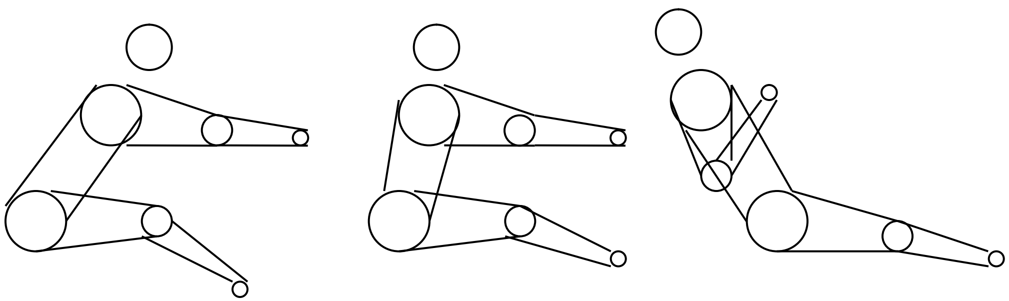
3. **The distance the oar handle moves is made up of up to three components:**

    a) **Leg drive/slide movement (***Not so important in fixed seat rowing***)**
    b) **Body swing from hips**
    c) **Arm movement**

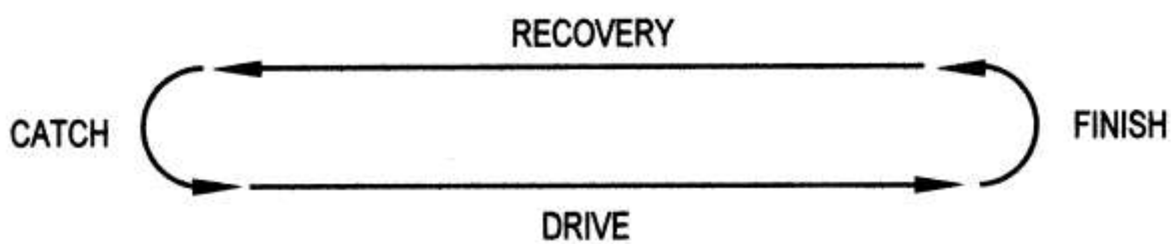
All motions are continuous
Minimize body motions that do not contribute to the rowing stroke
All actions should be as smooth and controlled as possible

The Stroke Cycle

The Catch in which oars are placed in the water
The Drive in which the body opens up to lever the boat forwards
The Finish in which oars come out of the water
The Recovery in which the rower's body moves towards the stern in preparation for the next stroke.



Catch **Drive** **Finish** **Recovery**

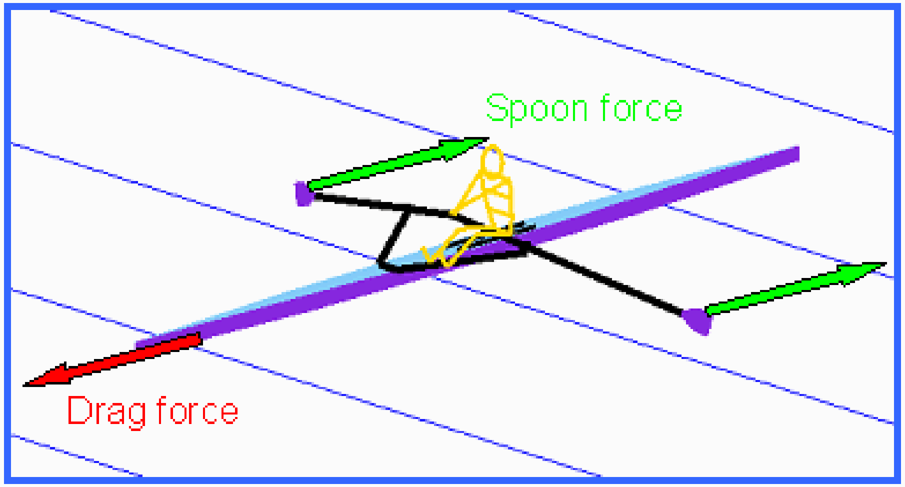


Basic concepts

What does the stroke do? – Some basic concepts

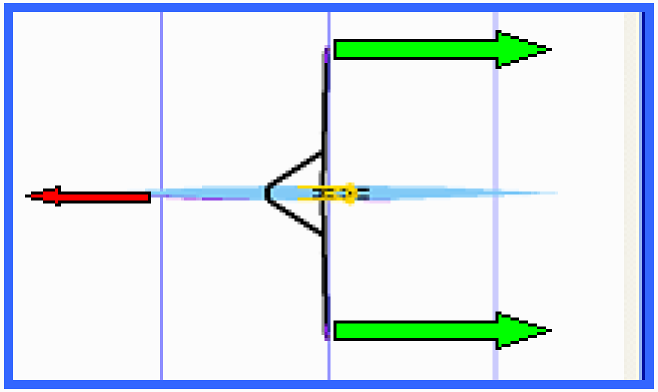
When a force is applied to an object, it changes the speed (velocity) of the object (Newton's first law of motion).

In rowing, there are two key forces that act on the boat and the rower. The first is the force of the water pushing on the spoon. This helps to increase the speed of the boat and rower. The other force is the drag force on the hull. This works against us by trying to decrease the speed of the boat and rower

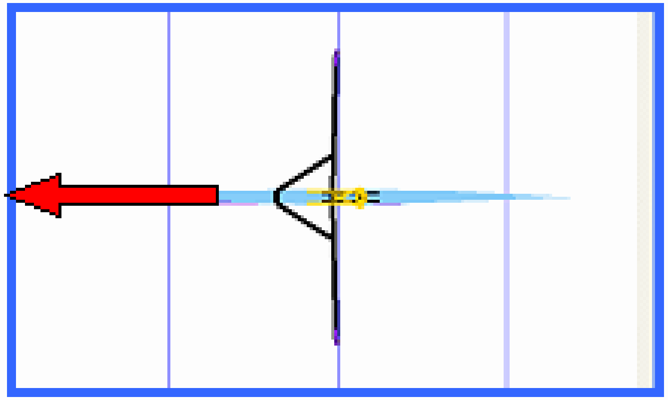


Basic concepts

During the power phase (the Drive) when the rower is pulling on the blade, the force on the spoon is bigger than the drag force and the boat speed goes up

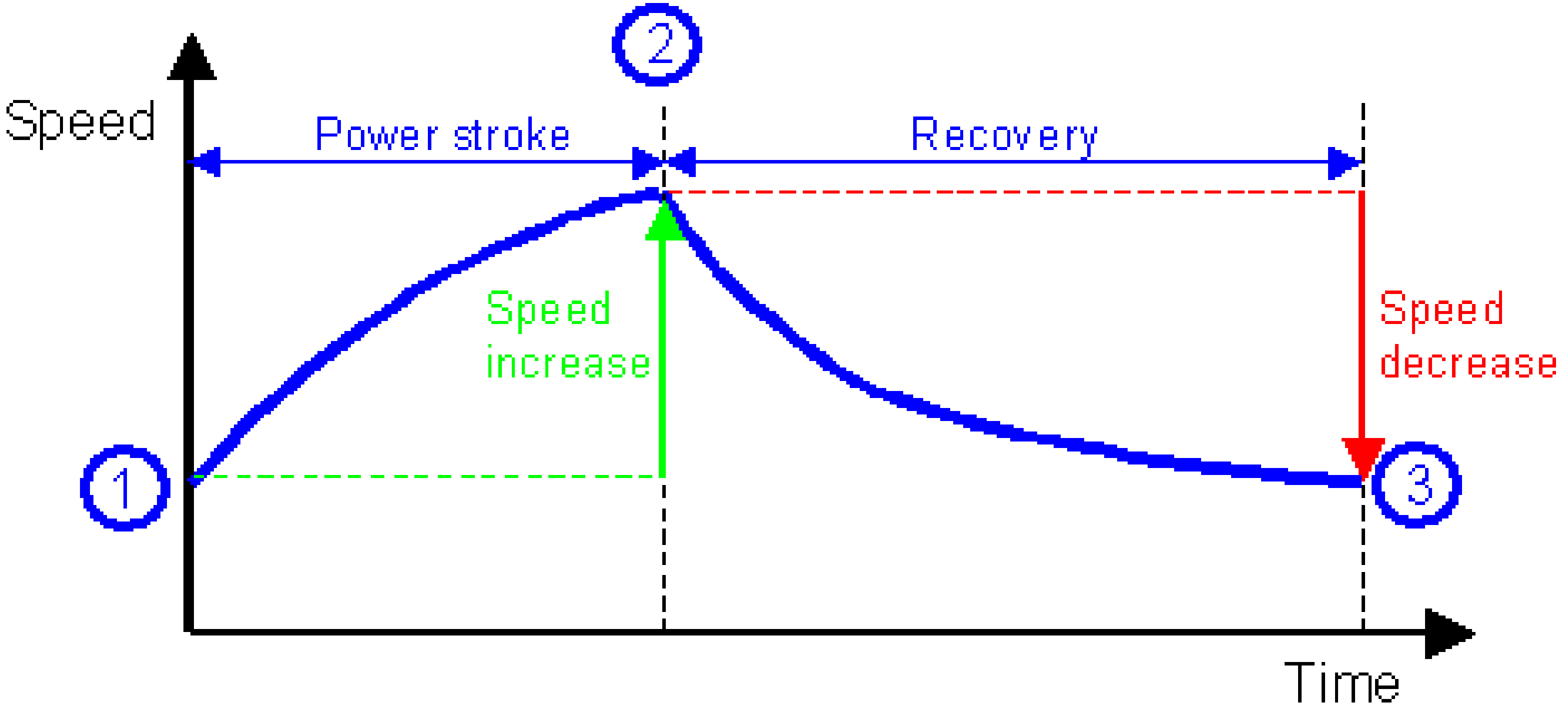


During the recovery, the only force is the drag force, so the boat slows down



Basic concepts

The boat speeds up and slows down during the stroke cycle. This variation in speed is shown below. The horizontal axis is time and the vertical axis is speed.



The Stroke Cycle

- **Propulsive**
  - **Spoon fully buried**
  - **Continuous force**
  - **Spoon removed from water**

Boat speed increases

- **Recovery**
  - **The time between each propulsive phase to prepare for the next stroke**
  - **No direct power is applied**

Boat speed decreases

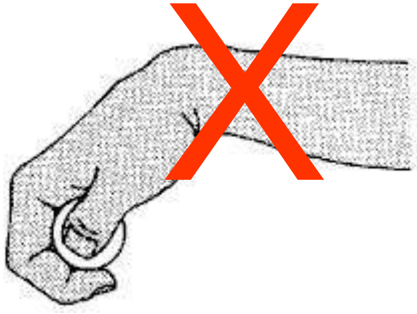
- **Catch and Extraction**
  - **Two crucial phases in the stroke cycle**

The Catch

The athlete utilizes the total body height in a natural position with arms approaching full extension and wrist flat. The blades are squared and ready for the entry.

At the full forward position, hands and arms are raised to generate good blade depth in conjunction with the body weight being completely transmitted to the foot rest.

Hold the oar with the hands 4 to 6 inches apart (1 – 2 hand width apart).
Turn the blade with the inside hand.
Apply power with the outside hand



The Catch

Important things to remember

The faster the blade enters the water the more positive will be the grip, the longer will be the stroke and the faster the boat will travel.

The important points are:

1. Hands guide the blade into the water.
2. Legs apply the power
3. Trunk and arms link legs to blade

The Drive

Body weight is transmitted to the foot rest. The active utilization of the body’s muscles, particularly through the initiated leg drive and body swing, causes an effective transmission of force to the oar blade

The first half of the drive relies primarily on the legs, the upper body has also been initiated but lags behind the leg thrust. During the drive, the back muscles accelerate to catch up to the leg drive with the shoulders and arms finishing. It is important that the body weight is utilized at all times and that the work is transmitted smoothly to the oars.

Power sequence

Legs → **Back** → **Arms**

The Drive

Important things to remember

The Drive is the most efficient part of the stroke

All the muscles are working through their middle range and the blade is at its most efficient point in the stroke.

Make full use of this advantage by beginning the draw with the arms before the back reaches the final position

The Finish

The maintenance of the body weight behind the oars with active and supporting back and legs allows the shoulders and arms to provide the maximum effort at finishing the drive.

The back should be at the '**2 o'clock**' position.

It is important to maintain a good blade depth throughout the drive and execute a smooth, quick release.

Lowering the hands will clear the blades, then feather when clear of the water. - *feather* the blade; this is when the blade is turned from being vertical to being horizontal

The Finish

Important things to remember

Maintain power until the end of the stroke – **No washing out**

Extract the blades **Before** feathering

Outside hand pushes down to extract blade – Inside hand twists the handle to effect the feather.

Don’t lean too far back – keep legs slightly bent – **To protect the lower back**

The Recovery

The recovery is so called because it allows a rower to recover from the exertion of the drive phase and returns the blade to the starting position.

The hands execute a quick and fluid movement of pushing the oars away from the body which will be followed by the forward swing of the upper body.
The upper body swings forward with the advancing hands and, as the body nears the correct position of the entry; the blades are squared ready for entry in the catch.

RELAX

The Recovery

Important things to remember

Relax the hands

This process should be as smooth and controlled as possible, so as not to disturb the run of the boat.

Control the returning blade close to the surface of the water (depends on water conditions)

Do not **Sky** the blade

Sculling or Sweep rowing

FISA advocates that the technique of sculling and sweep rowing is essentially identical although the **asymmetrical movement** of sweep rowing does require an adaptation of the body to the movement of one oar.
This adaptation requires the upper body to rotate in the direction of the oar movement, particularly as the oar is extended forward for the entry. In effect, the athlete will continue to face the oar, by allowing the body to rotate at the hips, and swing away from the centre line of the boat.
It is important during the forward reach that the athlete maintains a good position to transmit the body weight to the foot rest and to avoid over extending the upper body.

Working as a team

Timing (Catch and Finish)

Common oar depth

Similar body movements

Similar oar height on return

Exact timing of the feather

Balance power

Listen to the Cox

Summary

Characteristics of good technique

- consistent pattern and length.

- good blade depth

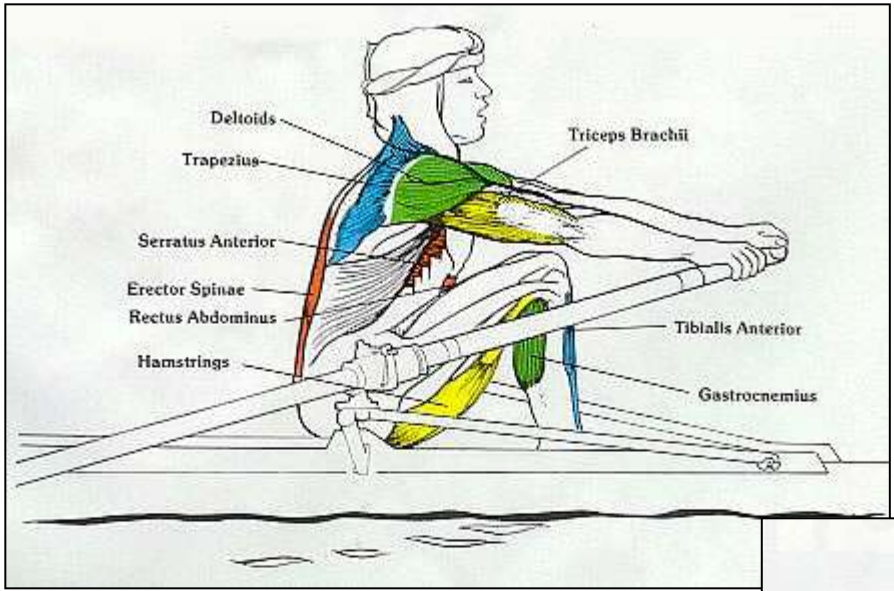
- firm, direct and consistent action of the blade.

- relaxed, but controlled, body movements during the recovery.

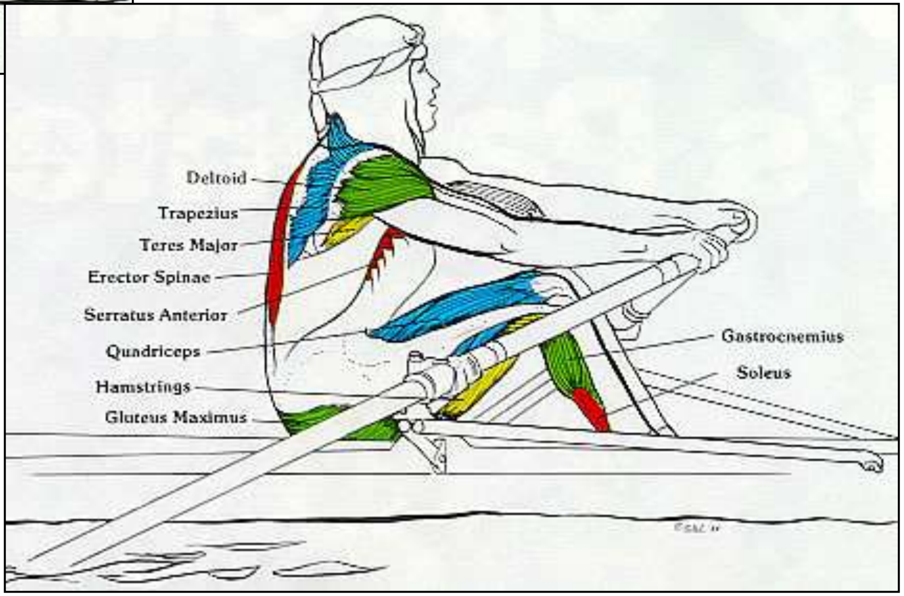
- powerful, but fluid, body movements during the drive

- an overall impression of coordination, rhythm and economy of motion.

Muscle groups

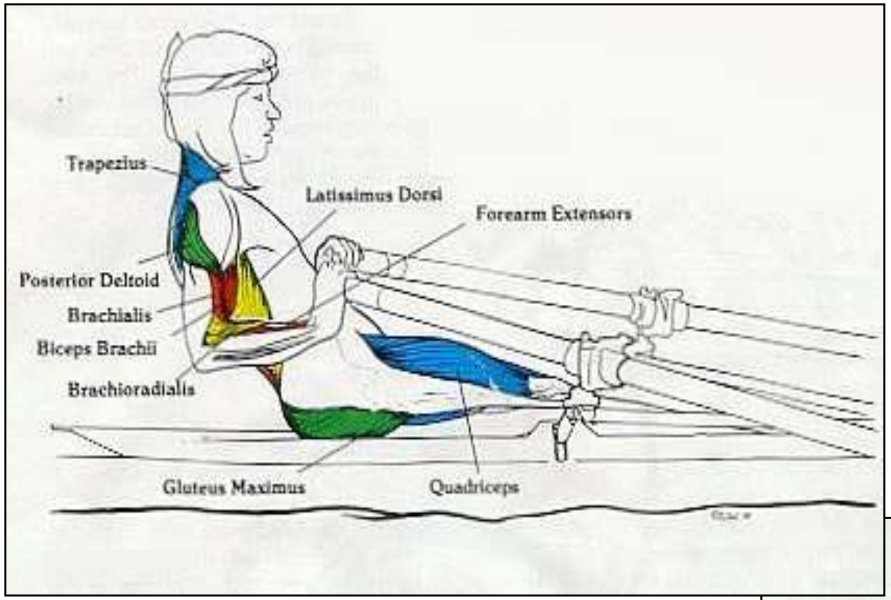


The Catch

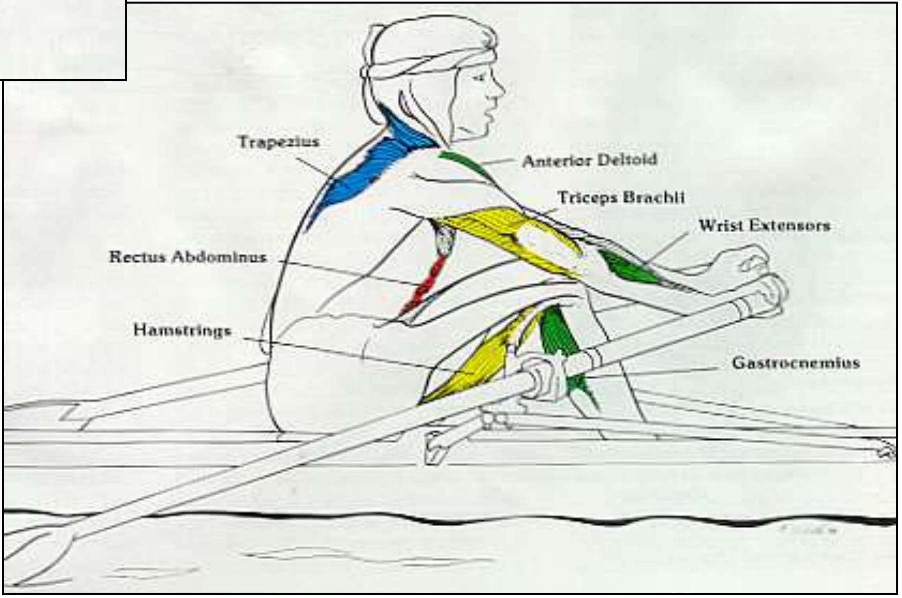


The Drive

Muscle groups

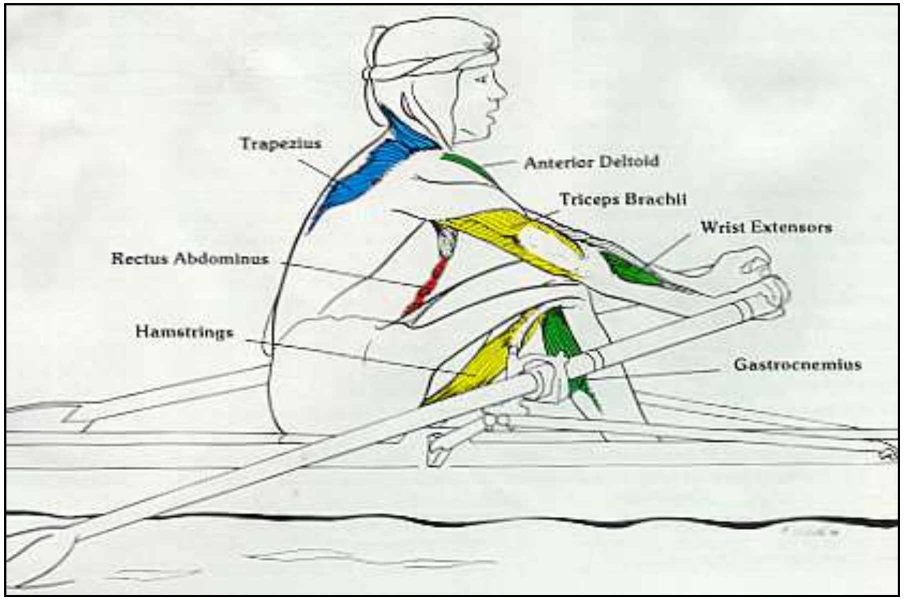


The Finish



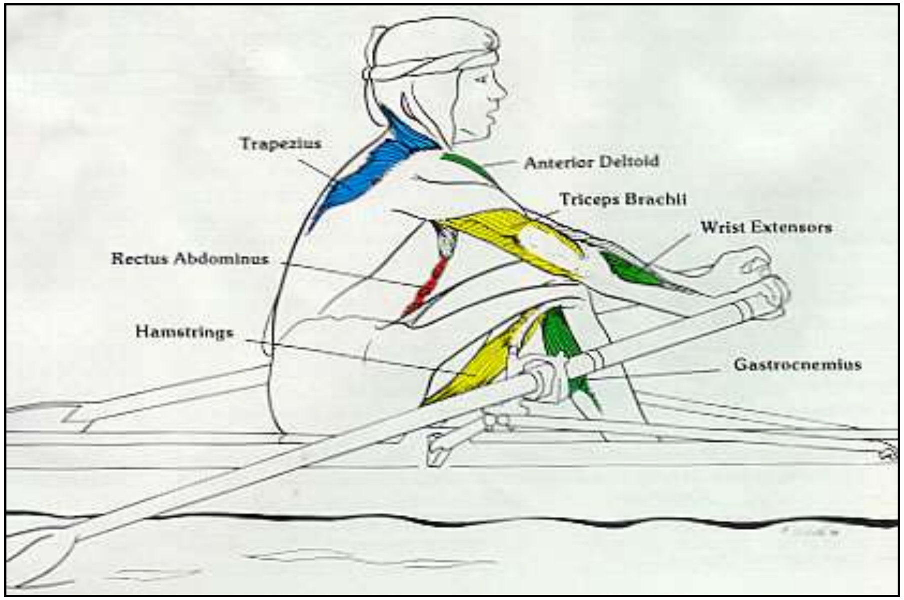
The Recovery

Muscle groups



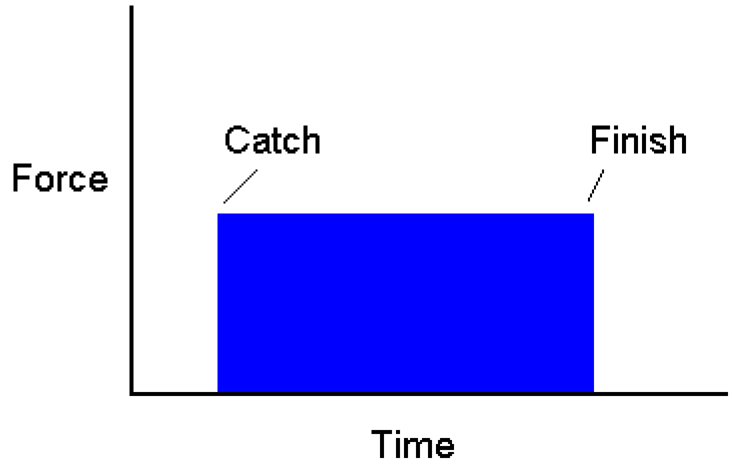
Kinesiology of the rowing stroke, NSCA Journal, Volume 10, Number 2, 1988, Thomas Mazzone, M.D. Wyoming County Community Hospital, Warsaw, New York

Muscle groups

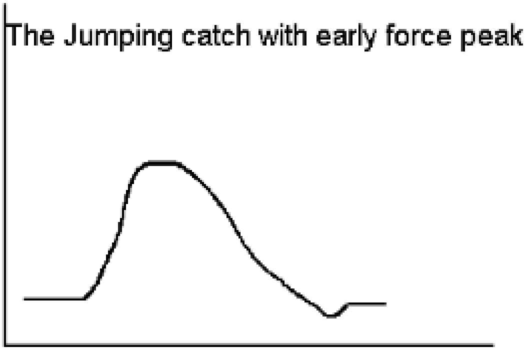


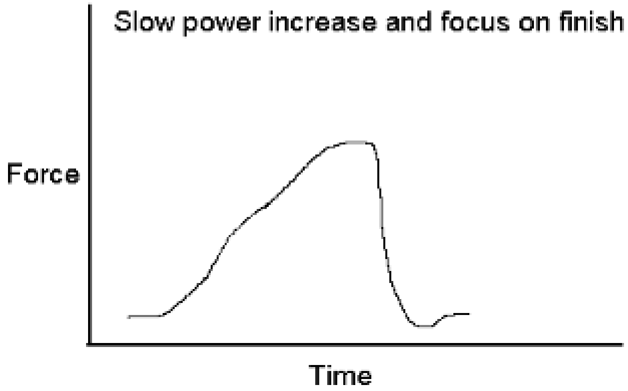
Kinesiology of the rowing stroke, NSCA Journal, Volume 10, Number 2, 1988, Thomas Mazzone, M.D. Wyoming County Community Hospital, Warsaw, New York

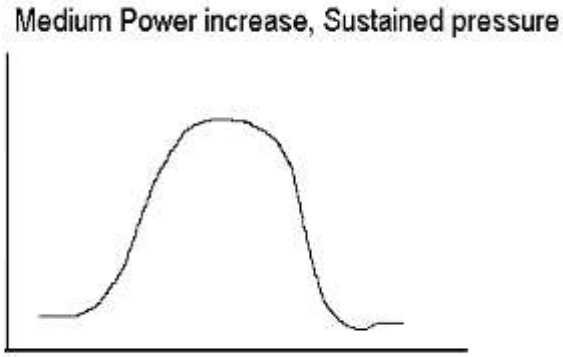
The Perfect and Impossible Rowing Stroke



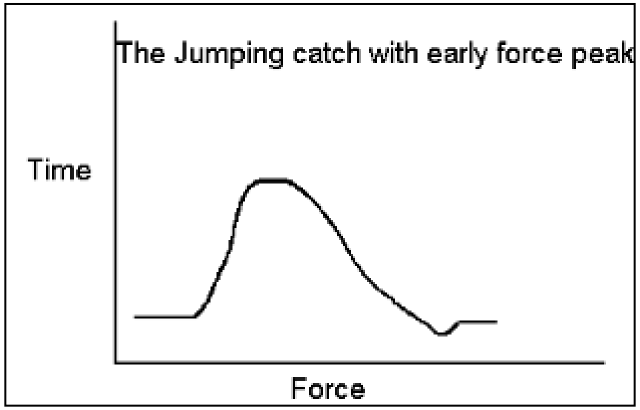
Three Approaches: The Hard Catch, The Hard Finish, or the Fat Middle







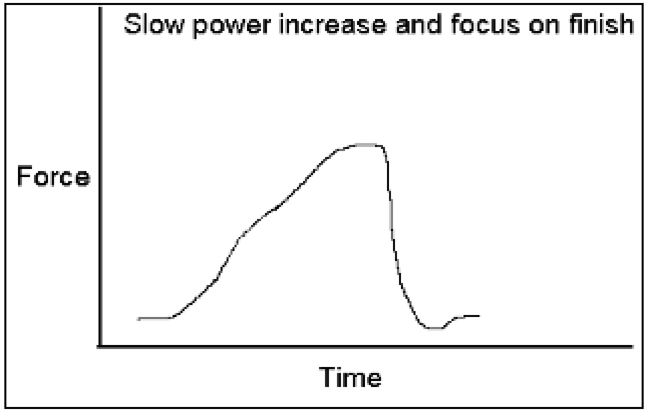
The hard catch



Poducing very steep force-time curves is VERY energetically costly. Uses ***Fast twitch Fibres*****.** Consequently, for the same IMPULSE, the rower accumulates lactic acid rapidly.

This reason makes the jump catch ineffective for more than a 10 or 20 strokes, or a 500 meter sprint at best.

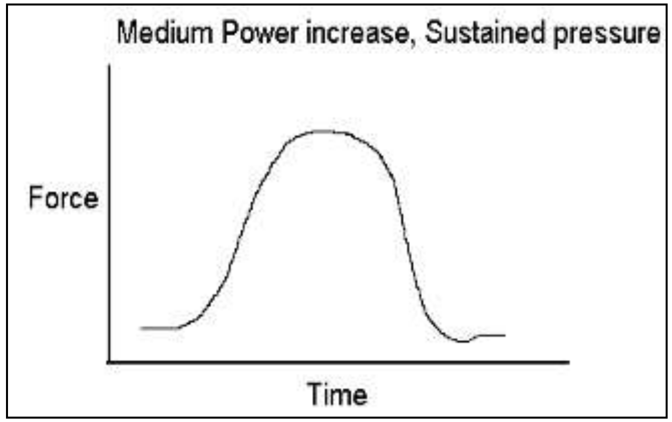
The Big Finish



A force-time curve based on the "**Big Finish**" creates similar problems. This time the physiological consequence is a focus of loading on the muscles of the back and shoulders. So, the **IMPULSE** is the same or a bit smaller, but the quantity of muscle mass generating the force is reduced, and local lactic acid production increases.

This stroke pattern is never effective, even for a few hundred meters!

The Fat Middle

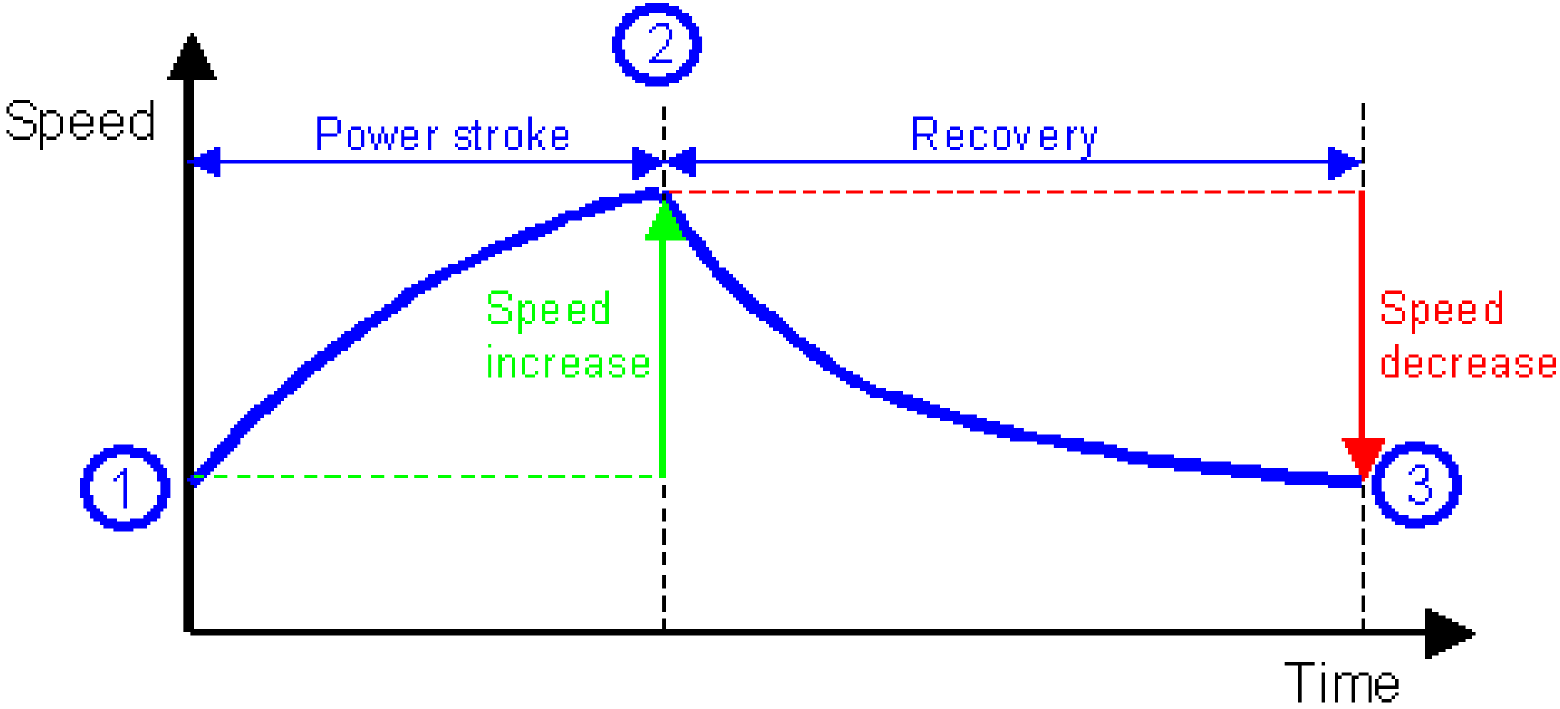


The Fat Middle Drive represents a happy medium. Even distribution of force application and lactate production over the entire rowing muscle mass is emphasized. Every muscle group is contributing in proportion to its mass and leverage. The rower must be "**equally fit**" in all the rowing muscles to achieve this.

This stroke pattern is the most effective and therefore the most sustainable

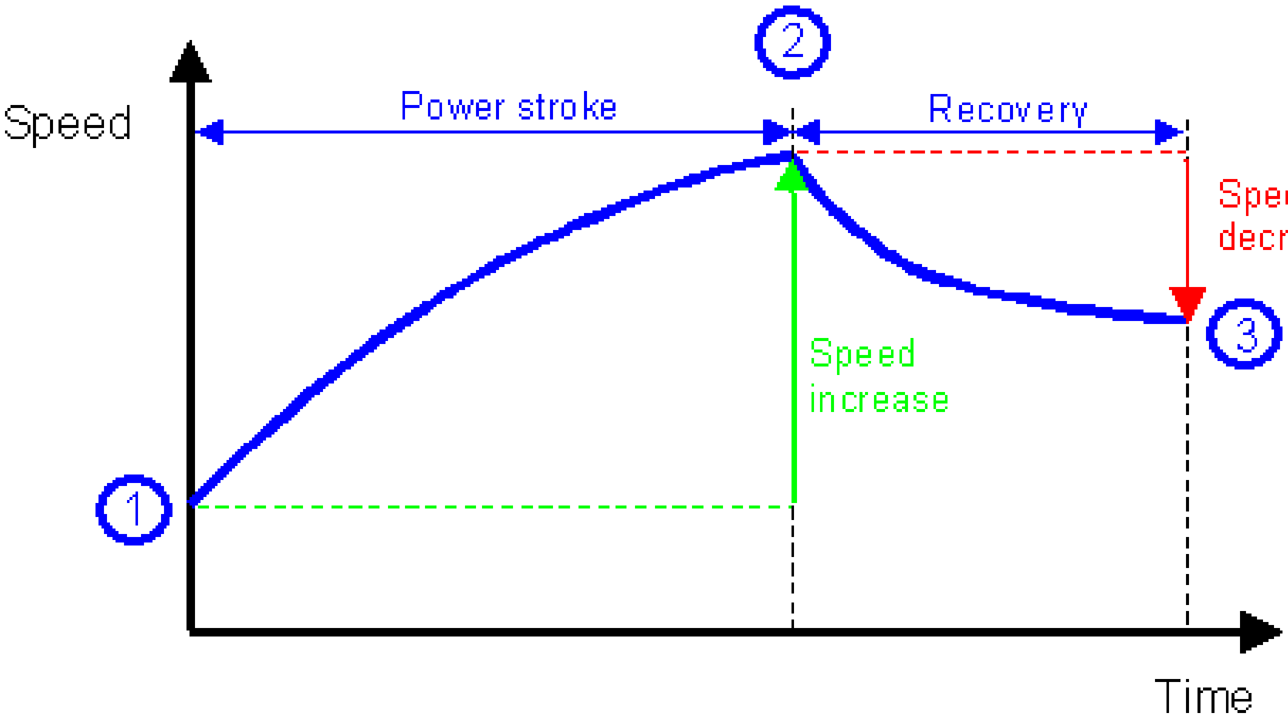
Back to Basics

The boat speeds up and slows down during the stroke cycle. This variation in speed is shown below. The horizontal axis is time and the vertical axis is speed.



Basic concepts

To increase boat speed the speed at the start of the next stroke (point 3) must be higher than the speed at point 1. This is because the energy that the rower has used is higher than the energy that the boat has used to move through the water so there is an overall increase in speed



Basic concepts

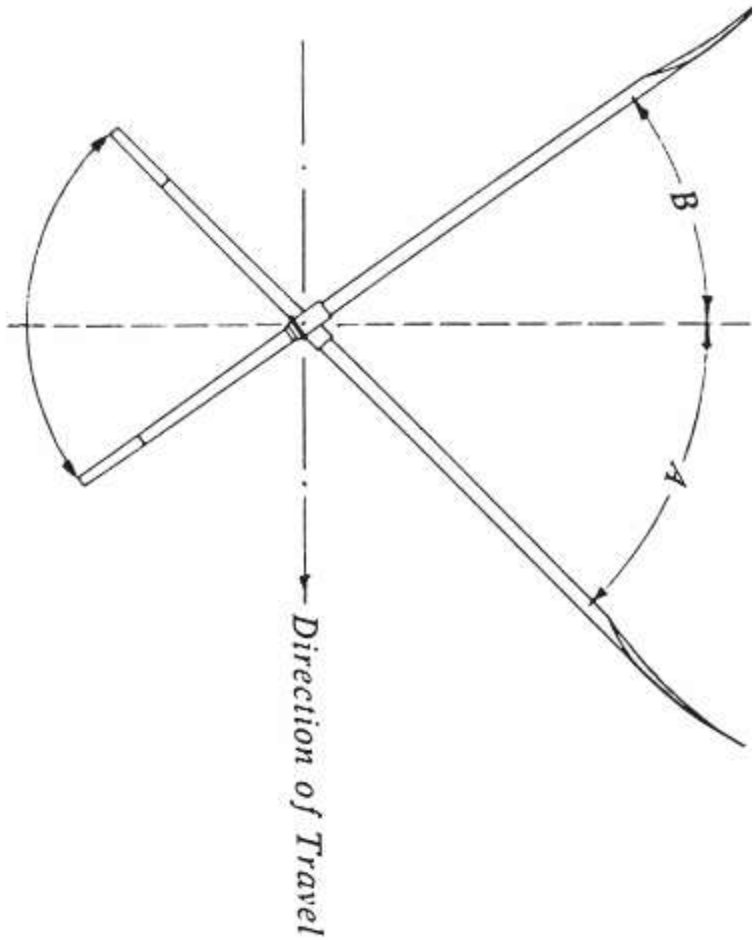
This does not mean that the ‘best’ stroke is to pull as hard as possible for as long as possible.

This does not mean the ‘best’ stroke is at the highest rating and hence the shortest recovery time.

The optimum stroke
Is a combination of;
Rating – Strokes per minute
Stroke ratio – Power to recovery
Gearing the blade – inboard to outboard ratio - and blade size

Gearing	Ratio	Power stroke time	Power stroke speed	Comments
High	Low	Long	Slow	Slow boat speed
Medium	Medium	Medium	Medium	Optimum
Low	High	Short	Fast	Slow boat speed

How does the oar behave?



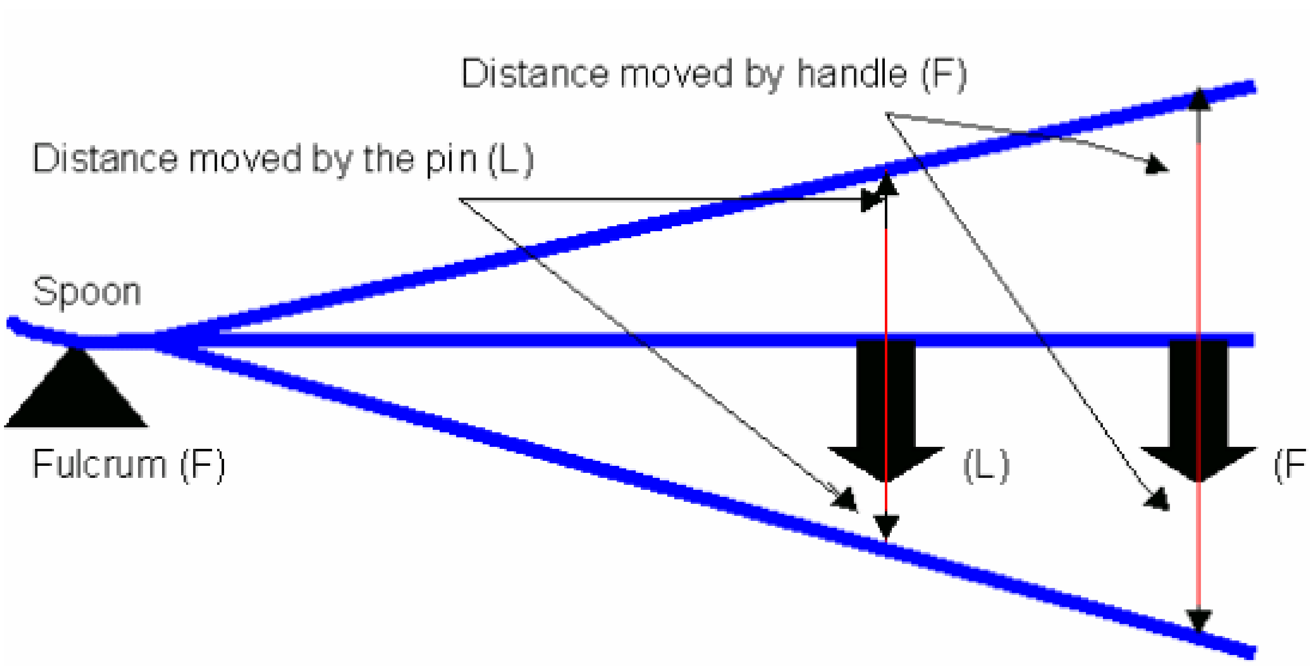
Where is the Fulcrum

How does the oar behave?

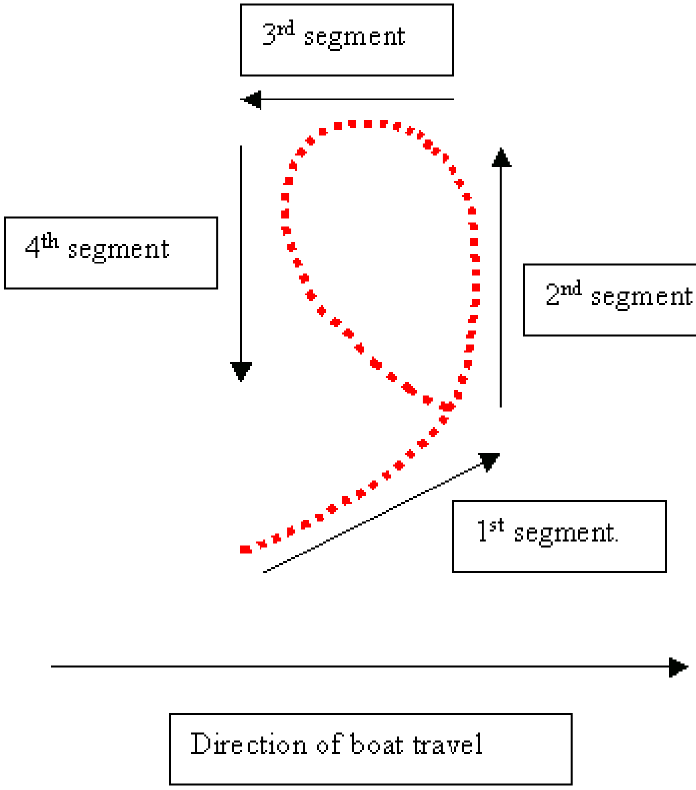
Some basic concepts

The blade acts as a lever and transfers the force that you put on the handle to a force on the spoon

To explain this, imagine that the spoon doesn't move and the blade pivots around the spoon (this is not quite true because the blade slips at bit through the water).

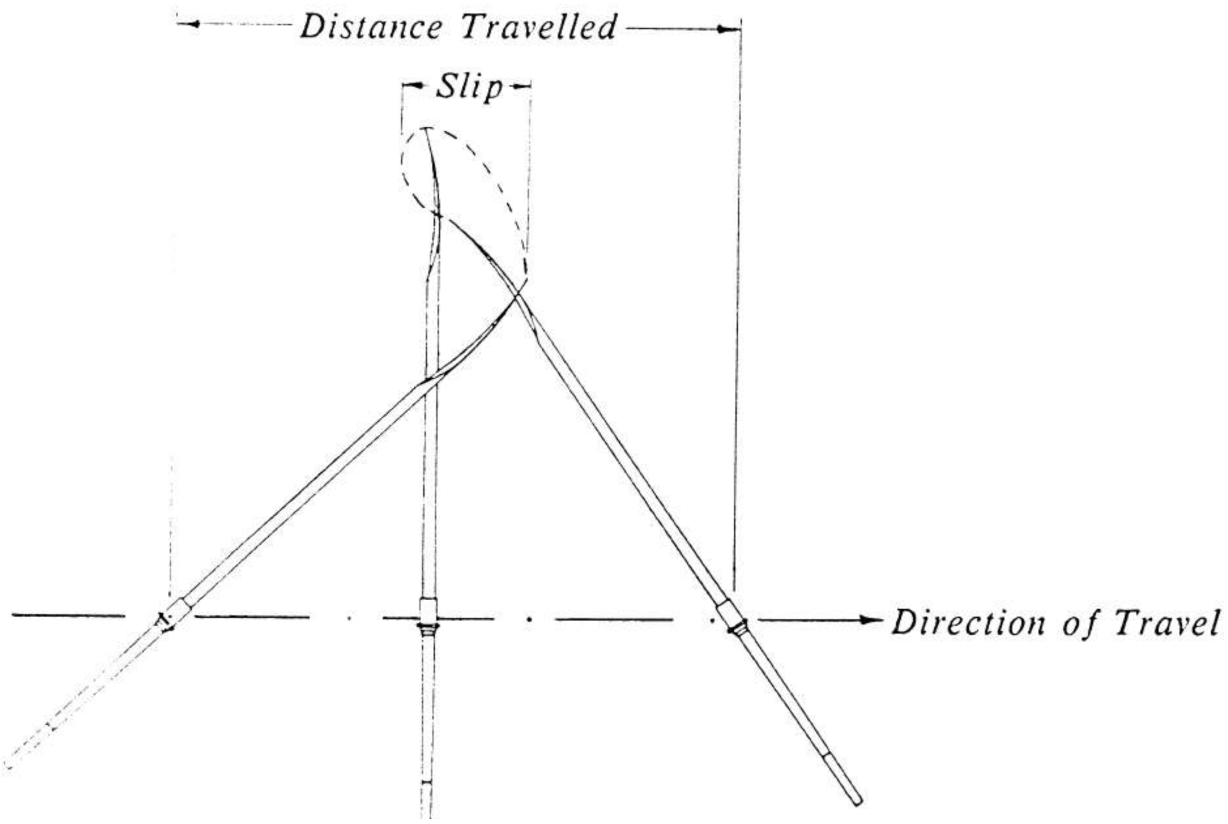


The spoon delivers the power



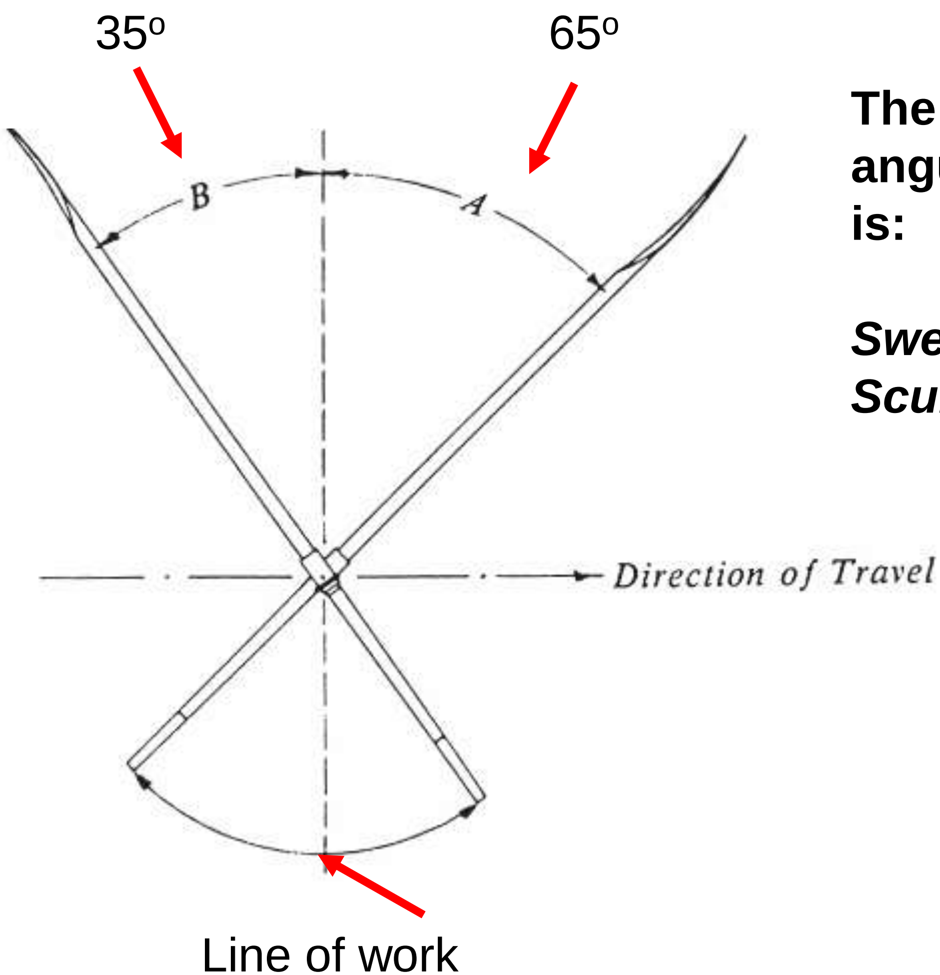
The spoon delivers the power

Most of the movement comes from the boat moving past the spoon not from you pulling the spoon past the boat



When a blade disturbs water the resulting work done is lost in turbulence and heat. A blade of 100 percent efficiency disturbs no water whatever

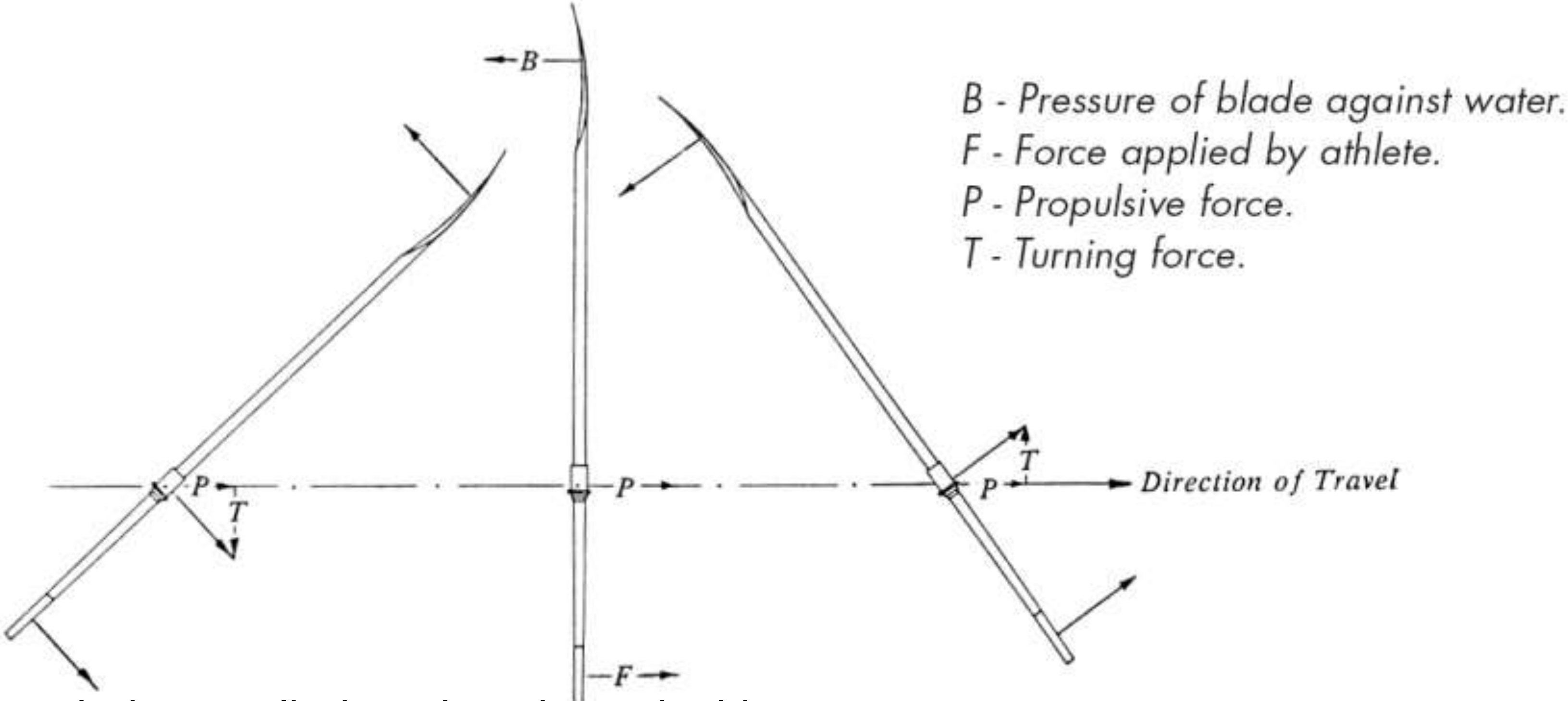
The Oar provides the arc



The recommended arc of angular movement in degrees is:

Sweep rowing	***80-90***
Sculling	***85-110***

The forces on the Oar



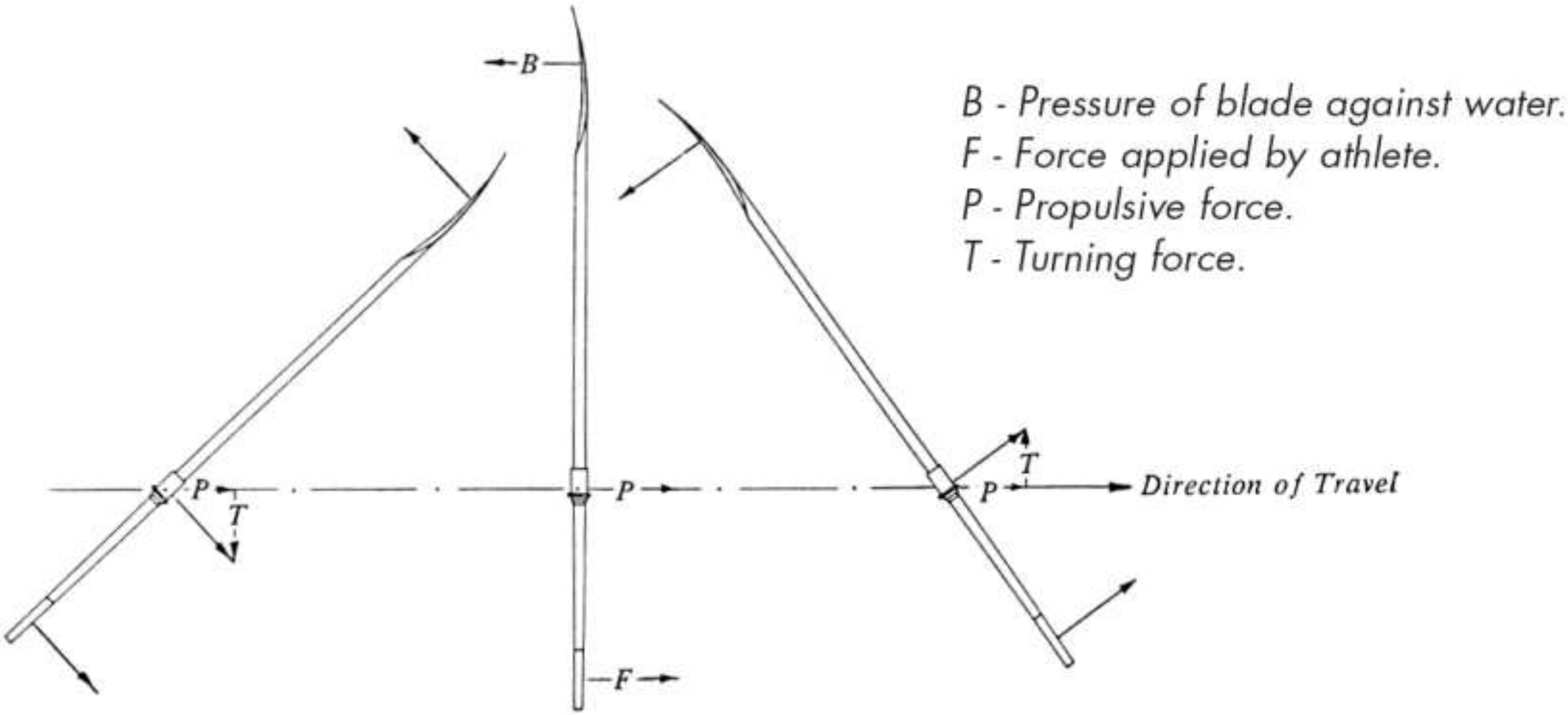
The force being applied against the swivel has two components:

The propulsive component provides force in the direction of travel and reaches its maximum before the oar is 90 degrees to the direction of travel.

The turning component affects the direction of travel by providing a force acting to offset the direction of travel.

These forces dictate the limit of the arc of the angular movement that the athlete may use effectively.

The forces on the Oar



To exceed these limits will only increase the turning force and not maximize the propulsive force. Thus, the oar is most effective in propelling the boat when it approaches and shortly after it passes the perpendicular position; it becomes progressively less effective as it nears the limit of the arc.

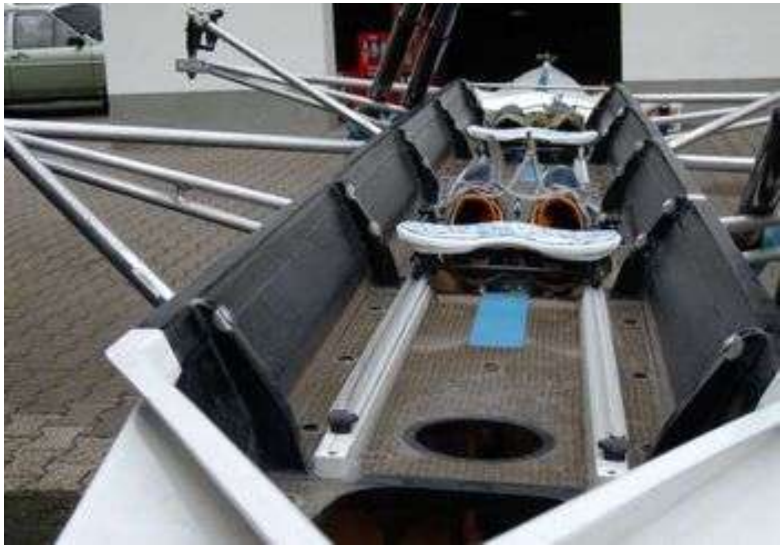
Basic Rigging Principles

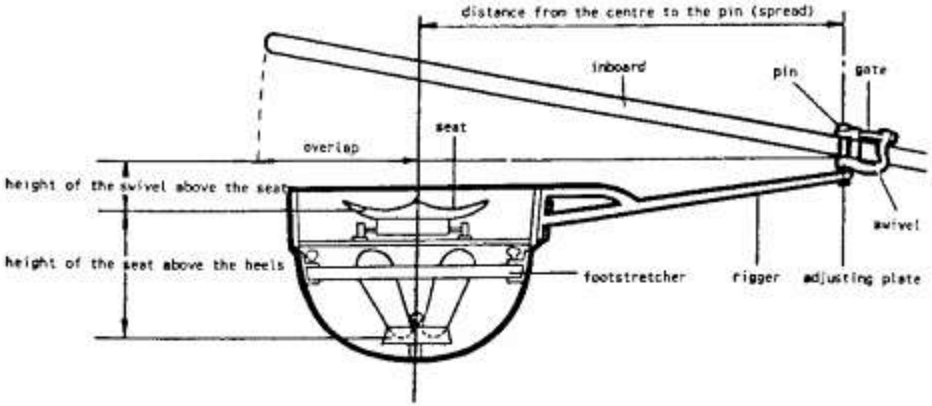
The primary purpose of rigging is to provide the athlete with a comfortable work position from which the most effective power application to the boat by the oar can be performed.

- **Stroke Length**
- **Catch Position**
- **Finish Position**
- **Blade depth through the stroke**
- **Spoon angle through the stroke**
- **Gearing of the Oar**
- **The arc of the oar**

Rigging

Rigging a sliding seat boat is complex





Rigging

Rigging a fixed seat boat is much less complex.

But the lack of adjustment can be compensated for by a flexible approach to the stroke

Fixed seat?

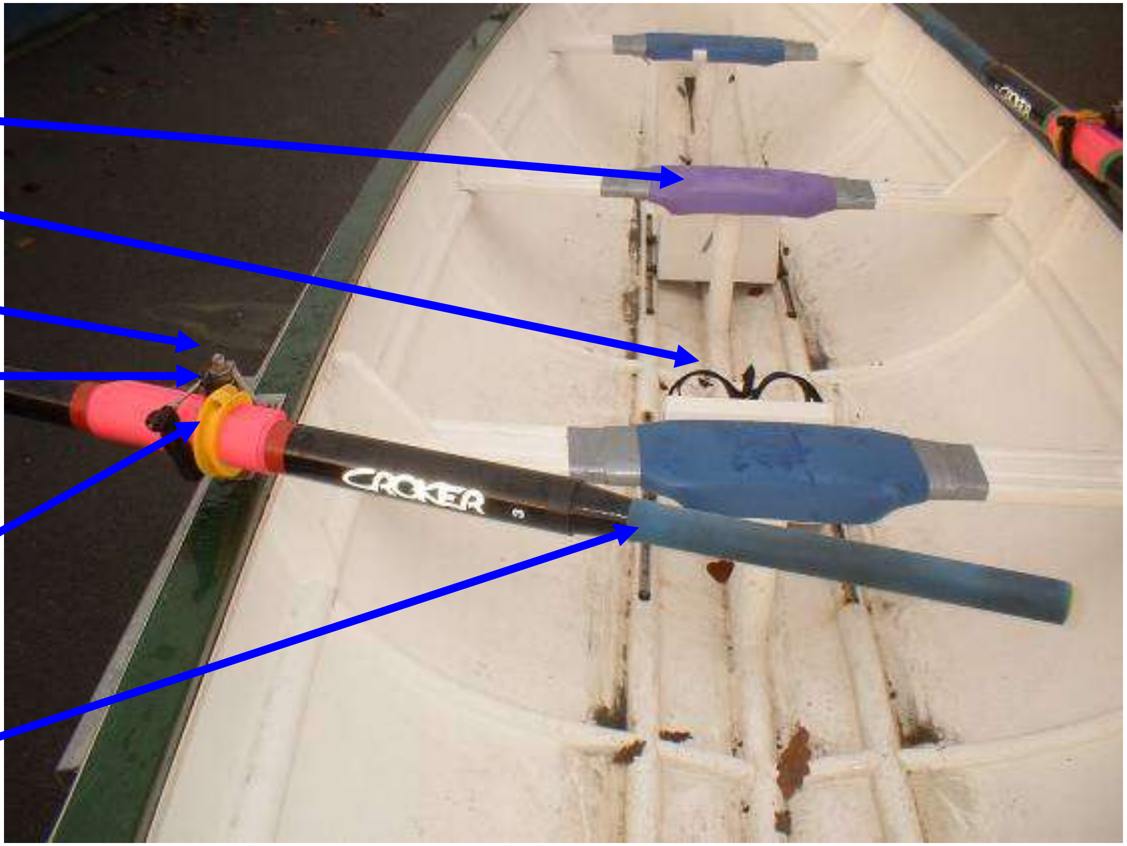
Foot position adjustable

Pitch of oar adjustable

Height of gate

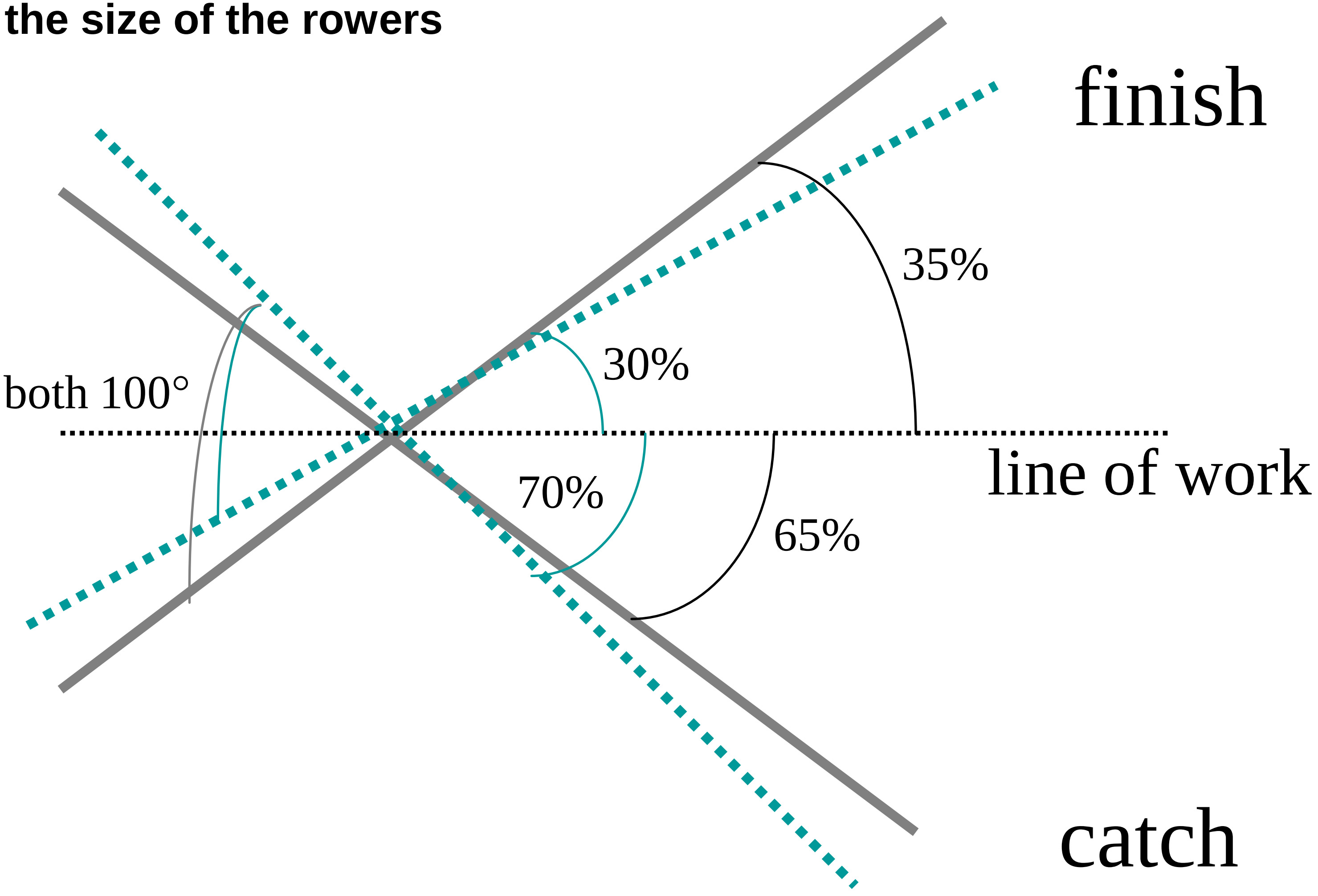
Collar position and thus gearing adjustable

Inboard adjustable



Rigging – The Seat

Our boats have fixed seats - Vary position on the seat
Or
Vary the size of the rowers



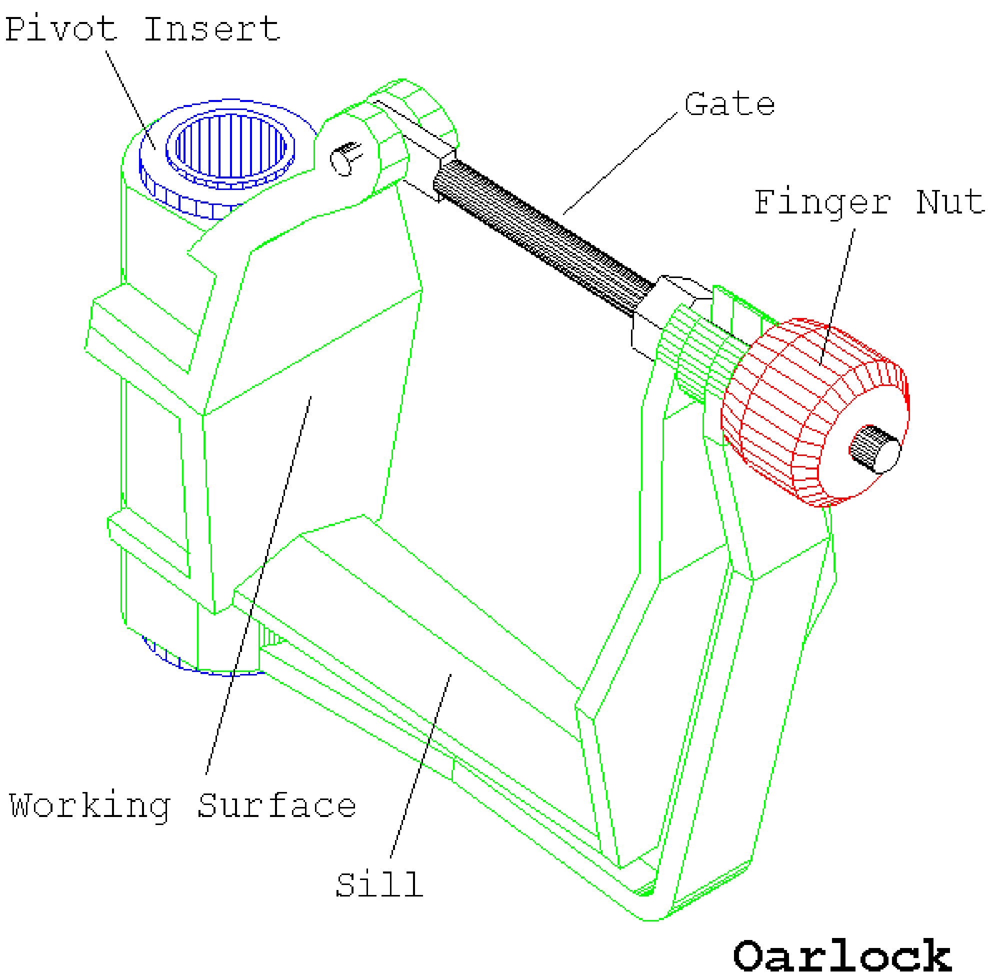
Rigging – The Footrest

The footrest is adjusted to give the best leg position and to provide adequate height of the oar above the knees.

Legs should be slightly flexed at the finish.

Length and angle varies with the seat position

Rigging – The Gate

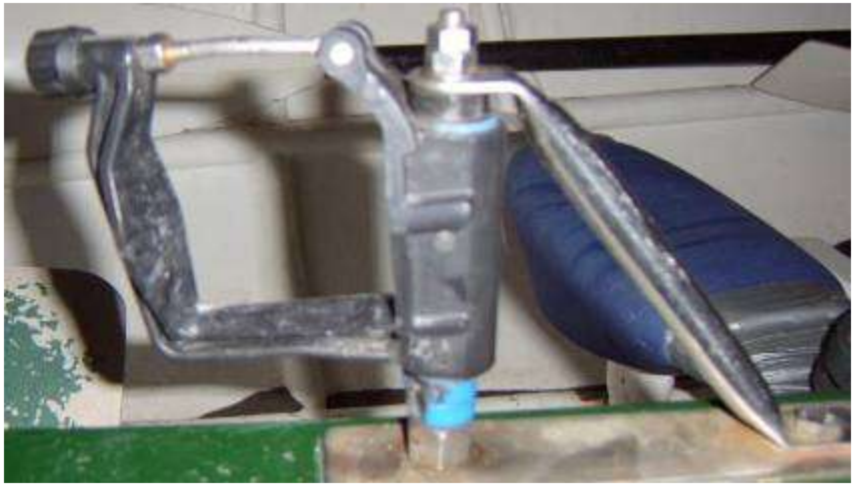


Adjustments to the Gate Vary

Height of the gate

Angle of the Working surface which alters pitch

Rigging – Height of the Gate



Determines the level of your hands during the Drive, when the blade is just buried.

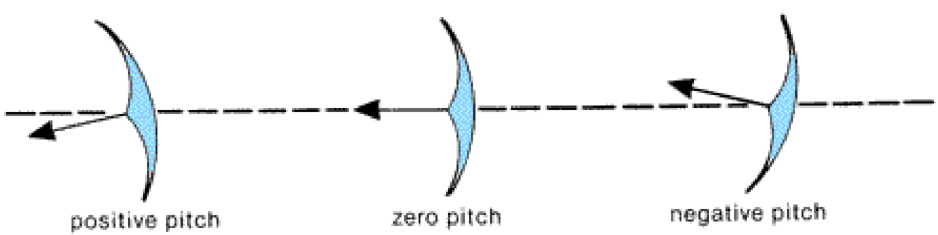
Too low, you will not have room to manoeuvre and feather your oar.

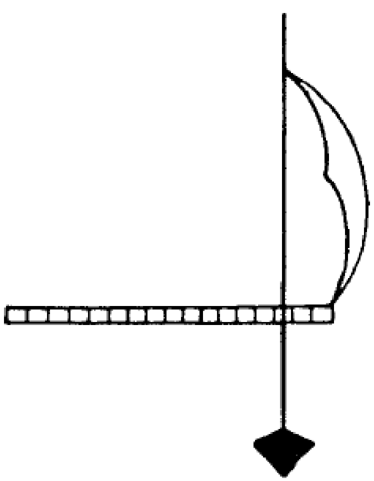
Too high, you will feel uncomfortable as you pull through the water, and your oars may tend to wash out during the stroke.

Rigging – Pitch of the Gate

This changes the angle of the blade during the stroke
The pitch of the oar varies with position in the boat

Setting The Pitch
The actual pitch of the pin should be zero in both directions. An overpitched blade will encourage the fault of washing out, whilst an underpitched blade will act like an anchor diving the blade deep into the water.





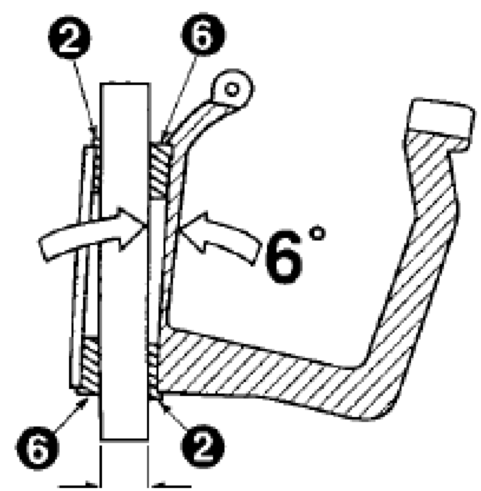
Rigging – Pitch of the Gate

The total pitch is the sum of the pitch set in the oar plus the pitch in the oarlock.

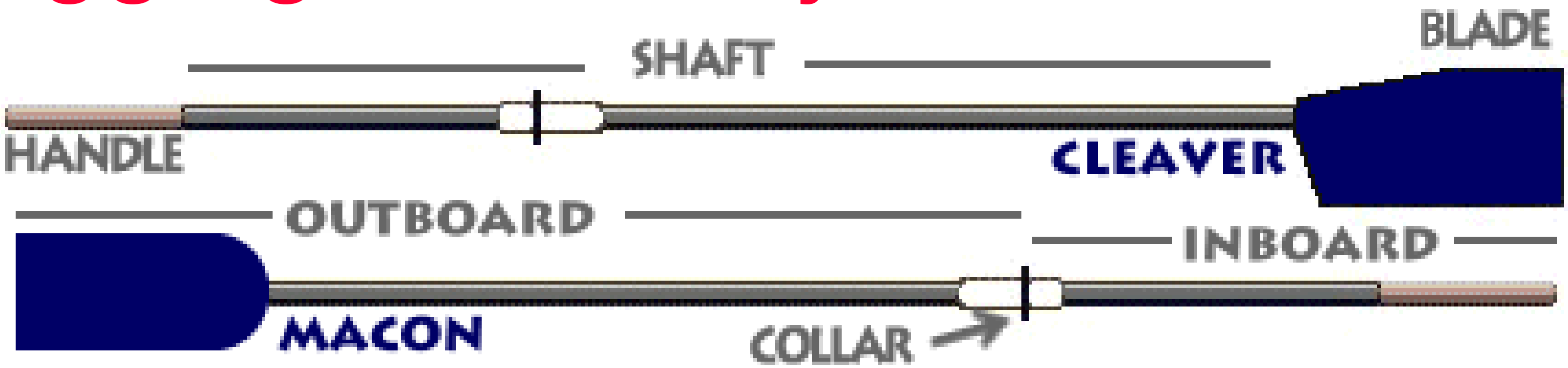
Nearly all oars come with zero degrees pitch set in the oars .

INSTRUCTIONS FOR USING
THE BUSHINGS TO ADJUST PITCH

Adjust oarlock pitch from 1 to 7 degrees by selecting two bushings with the desired pitch (which is imprinted on the bushing) and inserting them in opposite directions as shown in the drawing. (If replacing existing oarlocks, keep in mind that most non-adjustable oarlocks have a built-in pitch of 4 degrees.)



Rigging – Oar Adjustments



1 2 3 4

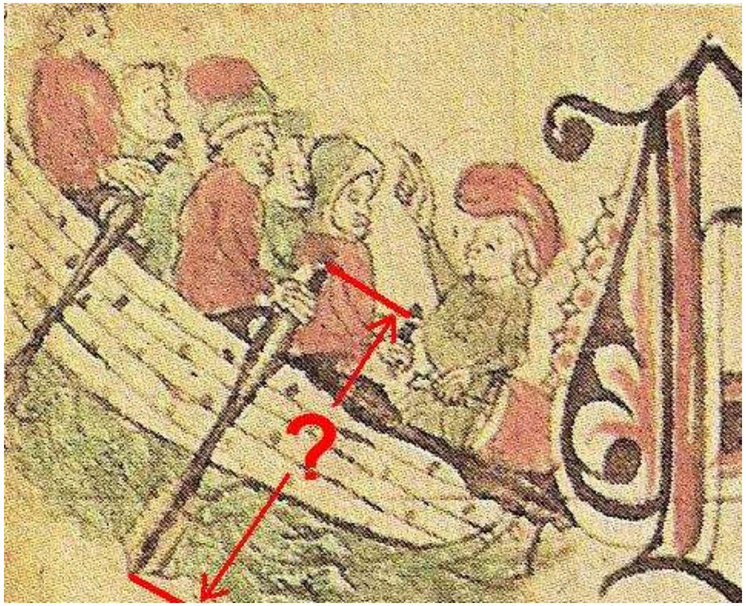
Blade or Spoon

Various spoon shapes are shown at right - left to right they are:

1. a carbon oar with a ribless cleaver (called a "slick" or a "smoothie")
2. a carbon oar with a ribbed cleaver
3. a carbon oar with a standard spoon (called a Macon)
4. an old wooden spoon

Rigging – Changing the gearing

The gearing is calculated by dividing the outboard length of an oar by its inboard length. Or the ratio between outboard length and the inboard length.
The borderline between the inboard and outboard being the oarlock.



For a given rower's strength- as measured by the **peak force** of his oarhandle pull- there is, for every oarhandle length (inboard lever), an **optimum outboard lever**. If the outboard lever is long the propulsive reaction is weak, but the wasteful blade slip is also low; and if short the blade slip loss is high but so, too, is the propulsive force. There is therefore an optimum lever which balances propulsion and slip.

Rigging – Changing the gearing

Low gearing
At low gearing, a short oar outboard compared to the inboard: The force at the oar blade is high.
So You would think You can row fast.
But the distance the boat travels at every stroke is short.
So to row fast You have to row more strokes per minute.
Which wears You down.
However if slower pace is ok, You have great force to go against wind or waves.
But there's really no way to row fast.

High gearing
At high gearing, a long oar outboard compared to the inboard:
The distance the boat travels at every stroke is long.
So You would think You can row fast.
But the force at the oar blade is low.
So to row fast You have to pull harder.
Which wears You down.
However, if slower pace is ok, You have peaceful going on flat water and calm day.
But against the wind and waves You're in trouble.

Rigging – Changing the gearing

Optimum gearing

Obviously, there has to be some kind of optimum "somewhere between".

And equally obviously, there cannot be a single optimum.

There might be a single optimum for a given person, for the given boat, for the given wind conditions, for the given wave conditions and for the given journey.

But all of these change from time to time and place to place in real life.

Not in Olympic class racing, however. There water is always flat, wind is neglicible, courses are straight and distances fixed.

Note: this is a big difference between fine and sea rowing!

But luckily, human beings are extremely adaptable.

And not all "optimums" are "sharp".

By this I mean, that there may be cases where if the "optimum" means 100 % performance, the "slightly less than optimum" may only mean 20 % performance.

But luckily in many real life situations, and oar selection is one of them, the "the less than optimum" may mean 90 % performance. Which is pretty good even compared to the full 100 %.

So don't worry much :-)

As it happens, a good **"optimum" gearing seems to be in the range 2.5 to 2.7.**

Rigging – Changing the gearing

The gearing defines how hard the crew has too work in order to pull the blade through the water. It is controlled by the ratio of inboard to outboard and this is controlled by the position of the button.

Moving the collar toward the blade will shorten the outboard lever and lengthen the inboard lever which will change your leverage and lower your gearing.

levers and gearing: pin position

Light gearing

blade >------< pin <----------------------> rower

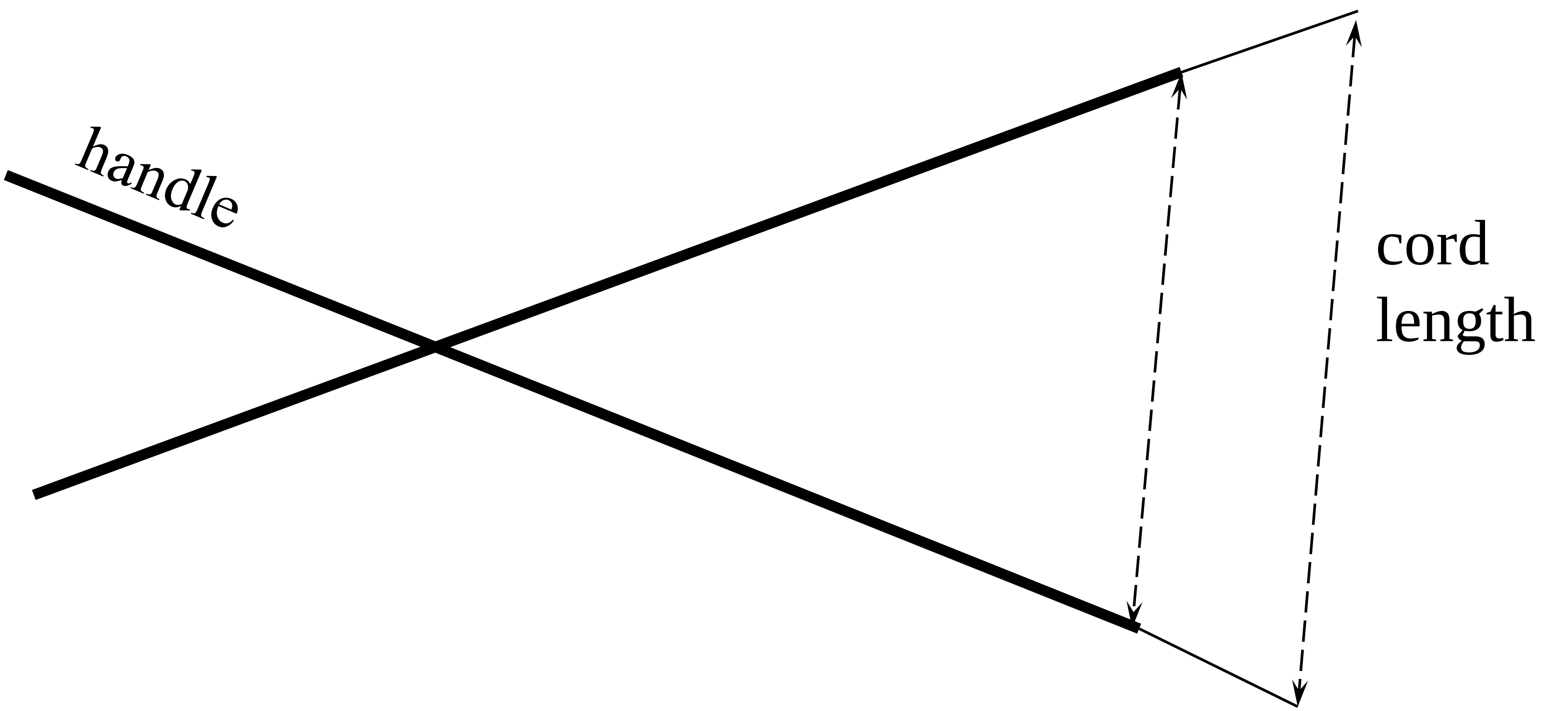
Heavy gearing

blade <----------------------> pin >------< rower

A lightly geared boat requires more strokes to move the same distance as a heavily geared boat but the strokes for a heavily geared boat are harder to make.

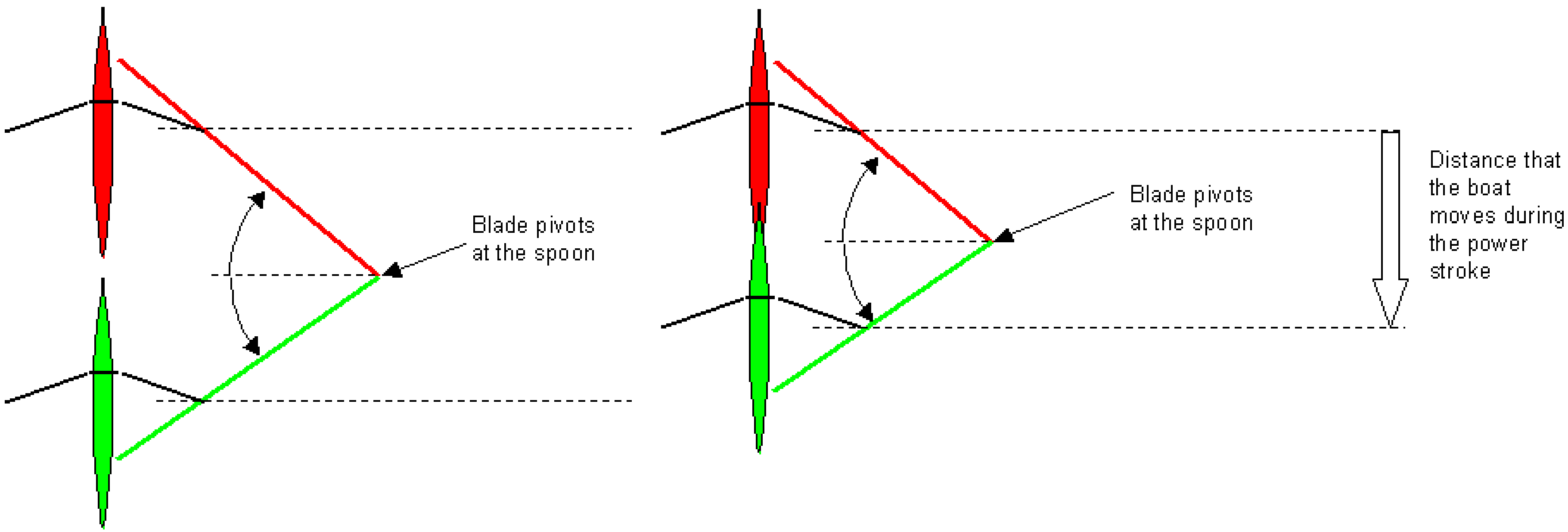
Rigging – Increasing outboard

Lengthening the outboard - Increasing outboard (only) increases the distance the boat travels per stroke



Rigging – Increasing outboard

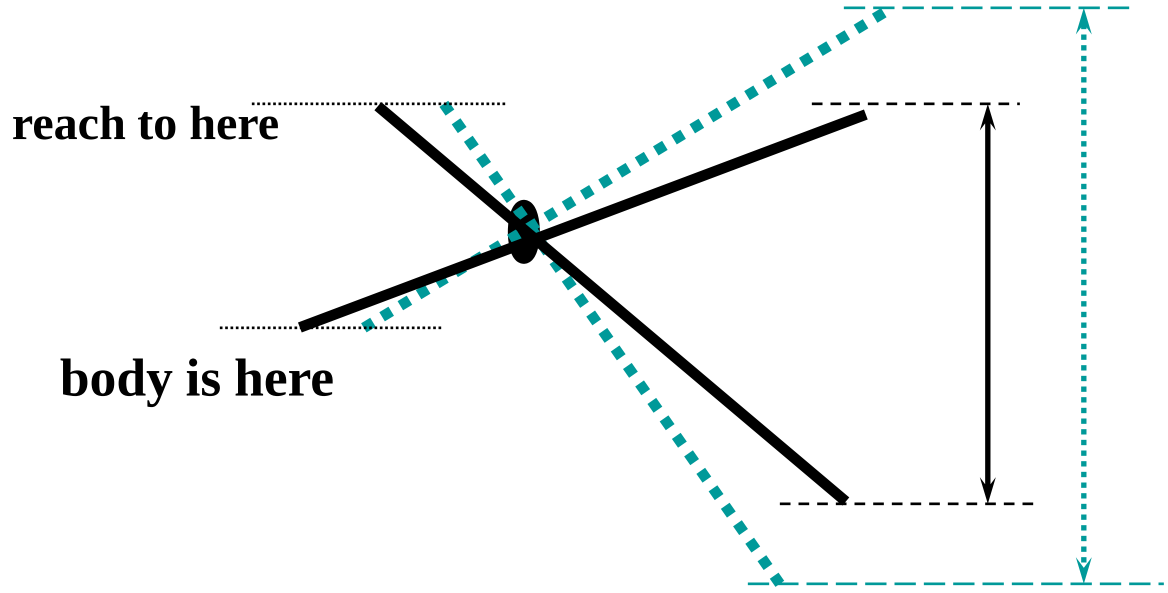
Lengthening the outboard - Increasing outboard (only) increases the distance the boat travels per stroke



Red boat represents the catch
Green boat represents the finish

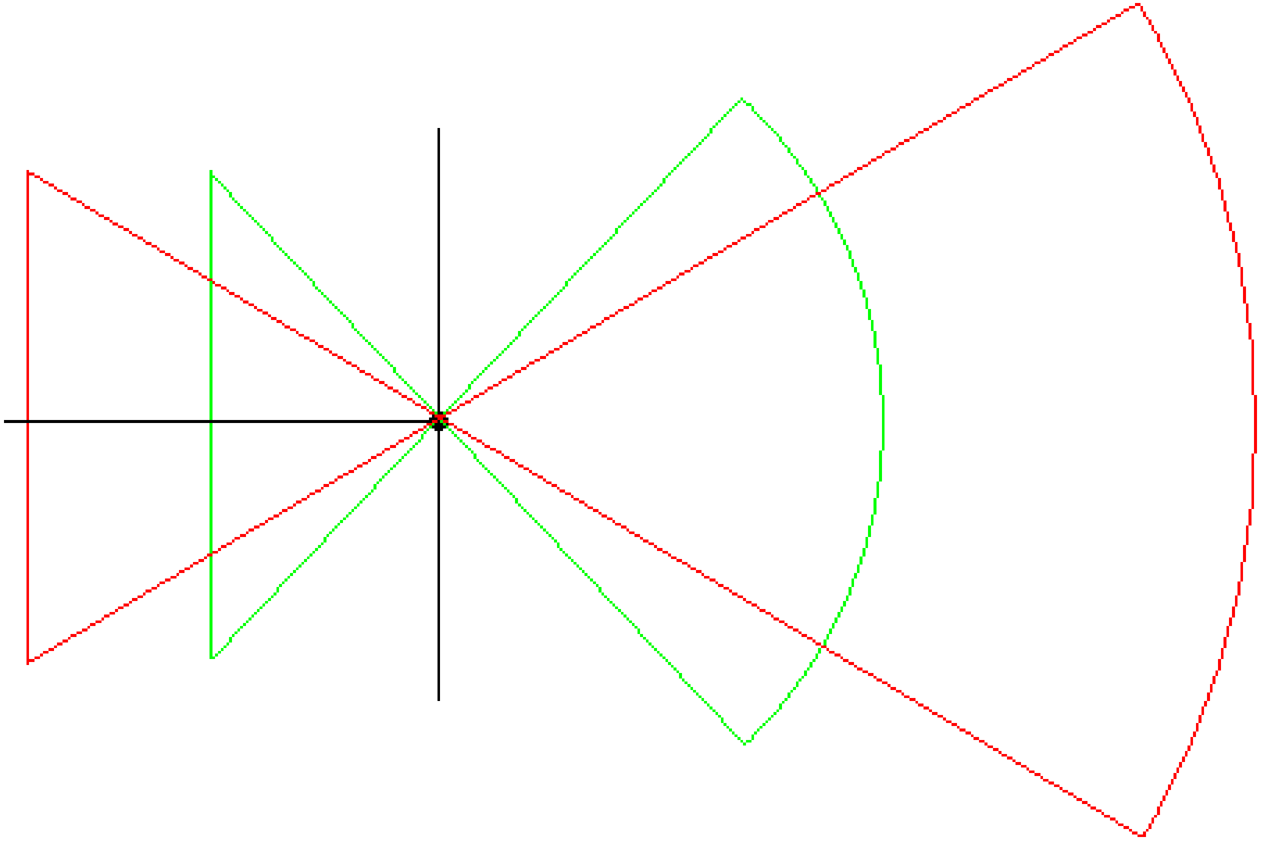
Rigging – Decreasing Inboard

Decreasing the Inboard
Increases distance boat moves per stroke (up to a point)
Outside hand may not reach at catch
Outside hand may not be able to pull at finish



Stroke length and angles affected

Rigging – Changing oar length

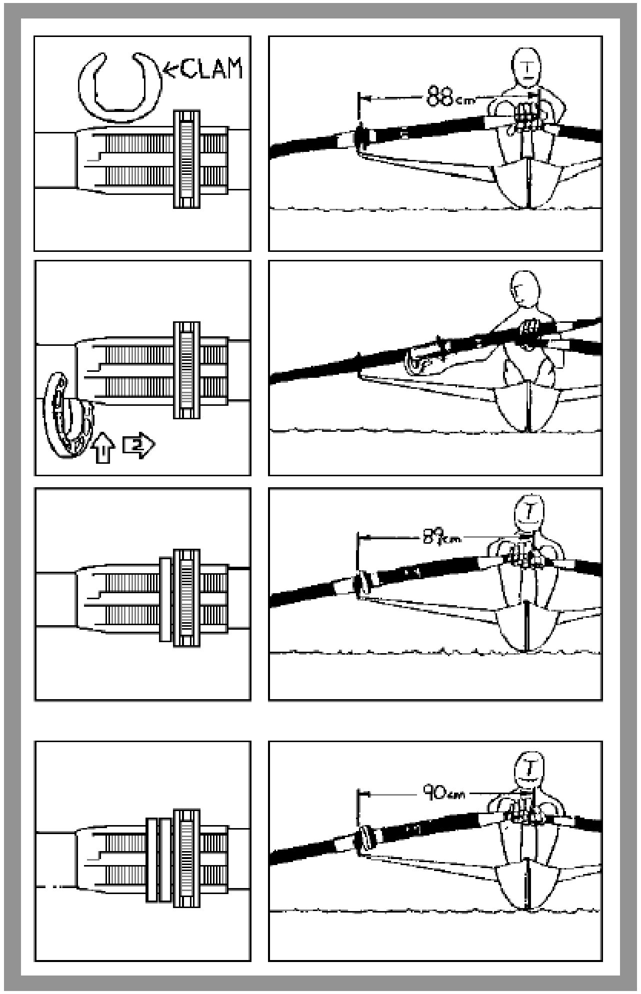


Rigging – what do I move

This is the important bit, where theory is put into practice and coaches and crews can experiment to achieve the best outcome.

1.Changing the spread (moving the pin) is the most important adjustment you'll make. There are two reasons for this:
the location of the pin has the most effect of any of the leverage dimensions; and changes to the pin affect all the other major rigging measurements.
>>>*The tighter the spread the heavier the gearing.*
2. Changing the oar length is the next most important adjustment in terms of leverage.
>>>*The longer the oar the heavier the gearing.*
3. Changing the inboard is the next step, as this will adjust the length of time the blade is in the water.
>>>*The smaller the inboard the heavier the gearing.*

Rigging – Changing the gearing



What is a C.L.A.M.?

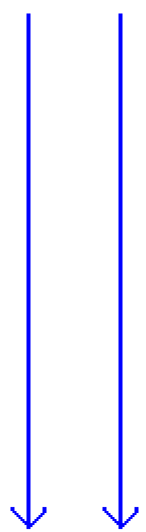
C.L.A.M. stands for Clip-on Load Adjusting Mechanism. It is designed for use on the current Concept2 sleeves only. (They may not fit properly on other sleeves.)

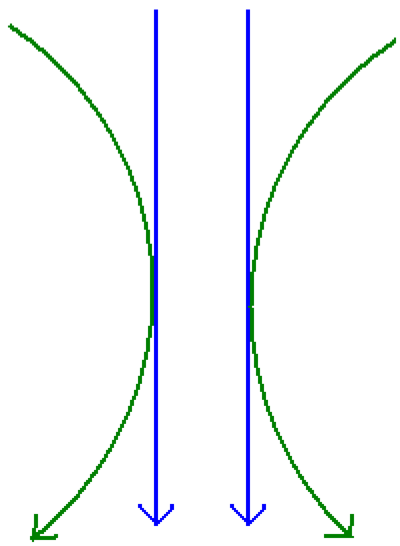
Just clip a C.L.A.M. onto your sleeve and you have instantly made a load adjustment without requiring any tools. You can even do it on the water.

1 C.L.A.M. = 1 centimeter of inboard.

Rigging – Rower efficiency and comfort

A human being is designed to pull, wit
hands that is, towards her/his body.

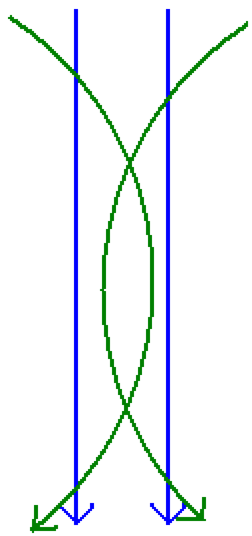


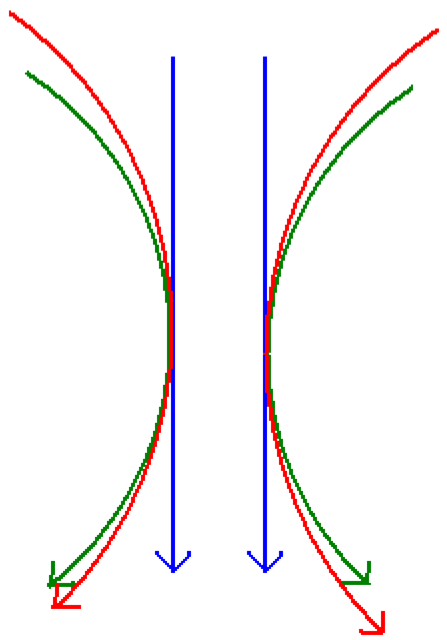


Because oars are hinged at oarlocks, the handle trajectories form arcs of a circle.
If oar handles are apart in the middle of the pull, the end of the pull turns away from the rower's body.
Not towards, as would be efficient.

Rigging – Rower efficiency and comfort

This can be overcome to at least some extent by overlapping the handles at the middle of the pull

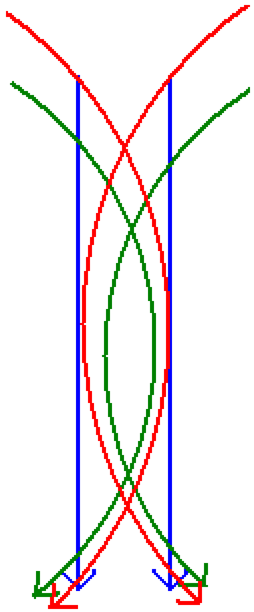




If the rower has longer reach, i.e. longer pull, due to a sliding seat or longer arms

Rigging – Rower efficiency and comfort

The overlap in the middle of the pull needs to be more to bring the end of the pull towards the rower



With no overlap, handle-ends are close together there is a real danger of your fingers or other body parts getting caught between oar handle ends and getting crushed.

It is handy to be able to hold both oars simultaneously out of water with just one hand, while attending to
Your fishing gear,
scratching Your head
or picking Your nose

Hull speed

Displacement hull speed is an important indicator of how fast a displacement-type boat will go. It is the speed at which a boat begins to climb it's own bow wave, essentially going uphill. It is calculated by the formula:
velocity in knots=1.35 x $\sqrt{\text{waterline length}}$

(Note that this hull speed formula does not apply to needle-like hulls such as racing shells).

William Froude **(born Nov. 28, 1810)**
Nowhere did Froude make reference to a maximum speed or an unattainable speed based on the waterline length.

The only limit to a boat's speed is power.
Wave-making resistance is extremely important and it increases dramatically with speed

Large increase in power to achieve a small increase in speed

Hull speed

Waterline length in feet	Hull speed knots	Hull speed mph	Hull speed kmph
8	3.8	4.4	7.0
9	4.0	4.7	7.4
10	4.3	4.9	8.0
11	4.5	5.2	8.3
12	4.7	5.4	8.7
13	4.9	5.6	9.1
14	5.0	5.8	9.3
15	5.2	6.0	9.6
16	5.4	6.2	10.0
17	5.6	6.4	10.3
18	5.7	6.6	10.5
19	5.9	6.8	10.9

Waterline length in feet	Hull speed knots	Hull speed mph	Hull speed kmph
20	6.0	6.9	11.1
21	6.2	7.1	11.5
22	6.3	7.3	11.7
23	6.5	7.5	12.0
24	6.6	7.6	12.2
25	6.7	7.8	12.4
26	6.9	7.9	12.8
27	7.0	8.1	13.0
28	7.1	8.2	13.2
29	7.3	8.4	13.5
30	7.4	8.5	13.7
31	7.5	8.6	13.9

Conclusions 1

For every rower there is a best oar length and lever ratio depending upon the rower's peak strength thus providing a rational approach to the optimization of rigging arrangements.

Information suggests that it seems better to pull hard at a lower rating than to ease up at a higher rating; all while doing equal rower total work.

Pulling hard at a high rating will exhaust the rower and this will result in Bad Technique.

Conclusions 2

Fitness gives a rower the potential to apply maximum power.

Technique gives the rower the ability to deliver the power as effectively as possible.

Rigging provides the most efficient machinery for an individual to deliver power and maintain technique.

Choose positions to suit body characteristics

YOU NEED ALL THESE TO WIN RACES

Caution

Newton’s first law

Bodies "keep on doing what they're doing" - unless acted upon by an unbalanced force.

Newton's First Law has an important training correlate.

A body trained in one technique for years likes to continue training that way, and resists outside efforts painfully!