Swimming Freestyle Technique Analysis

Freestyle swimming is the most efficient stroke for athletes to move through water. Fish travel much faster through water than humans and use a propulsive (snaking) motion in combination with a very streamlined body shape to effectively achieve these high speeds whereas humans have to resort to a paddling motion using our arms and legs to provide propulsion. There are basic paddling movement patterns that allow faster more efficient stroke style, however swimmers demonstrate some basic and subtle differences in their strokes that work better in either shorter faster verses longer endurance swimming events.

You know that not everyone has swims with the same style or rhythm in freestyle. This video provides a great breakdown of the different freestyle techniques. There's more than one way to swim, and any coach that tries to tell you that there is only one is incorrect.
The technique that is right for you will be found in the Mastering Freestyle program. Swim Smooth is a great reference site http://www.swimsmooth.com/visualisation.php and Speedo https://speedo.com.au/speedo-fit/improve-your-technique/freestyle-stroke has some good videos.

These are the three types of swim technique and then we will describe the two most common swim types:

1. **Hip-driven technique:** Hip-driven freestyle is used by Ian Thorpe, Grant Hackett and Libby Trickett and is a slower-stroke-rate freestyle. It is typically swum at 60 to 70 strokes a minute over shorter distances. The hand reaches further forward on entry and holds the water in front after the entry before beginning the propulsive motion backward. The slower time of the arm pull cycle allows the swimmer to get a bigger hip turn and generate a larger counter force to pull against. This increases the distance from each stroke. The swimmers body rotates which allows recruitment of rotary power generating hip, trunk and scapula muscles. The right amount of rotation facilitates the stroke recovery as the arm does not need to be lifted as high out of the water at the shoulder and decreases rotator cuff muscle load. This may be 45-60 degrees of pelvis and trunk rotation along the long axis of your body. If a swimmer over-rotates their body it creates higher turbulence, causes a loss of balance which results in a messy scissor kick which creates more turbulence, and drives your propulsive arm deeper into the water pushing downwards rather than backwards. Hip driven technique is better swum in distances over 200 meters and a strong six beat is needed to swim it fast. In longer events such as triathlon it is a far more efficient stroke as you can use more muscle less demandingly for less fatigue. However you will probably use your legs less with a slower beat kick.

2. **Shoulder-driven technique**: Shoulder-driven freestyle is used by Peter Van den Hoogenband, Janet Evans and Alexander Popov and is a higher-stroke-rate technique over very short diatances. It's swam at 80-110 strokes per minute. The entry hander catches quicker and the release is done sooner which results in a faster stroke rate but less hip rotation. Not as much power is generated from the pull but because there is more strokes it makes up for the power difference. The shoulders typically rotate more than the hips in this technique. Two beat and six beat kick are both acceptable, though only a six beat kick should be used when sprinting

3. **Hybrid technique**: In recent years a number of swimmers are drawing on elements of both techniques. It is becoming increasingly popular for middle distance swimmers (100, 200 and 400 meters) who draw on the advantages of both techniques and opt for a hybrid freestyle. They use one arm with shoulder-driven technique and the other arm uses a hip- driven technique. It has become popularized by Michael Phelps. It requires a very strong kick and breathing to one side and can be used in open water swims if you have a strong kick.

a) "Smooth" swimmers have a very efficient controlled long stroke with no dead spots at the front end of the stroke and a full complete back end. They avoid overgliding and have a high elbow recovery cycle. They typically are good pool short to moderate distance swimmers (Ian Thorpe)

b) “Swingers” do just that with their arm. There is less reach at the catch and a choppier catch and pull and typically a faster stroke cadence. They typically are better open water and long distance swimmers (Shelley Taylor, the Brownlees). We will look more closely at the movement components that make up these more common swim types.

The Little Things That Make A Big Difference

It’s because of ‘one percenters’. Comparatively speaking swimming is very technical. Run technique changes and bike tweaks often help a lot with injury management but not dramatic performance enhancements which in these disciplines come from physiological adaptations to training loads. Water is a very viscous medium compared to air, so drag and turbulence (resistance) are much higher in water. With fluid and aero-dynamics there is also a critical speed at which resistance increases dramatically. Thus a swimmer travelling at 2m/sec (25sec per 50m lap – fast!) experiences significant pressure drag from trailing eddies in his wake, but provides a great tow for a swimmer in his turbulent flow, however, a trailing cyclist would not notice any difference at 2m/s (7kph) through air.

Your technique and position make a great impact on how much resistance you are working against. Swimming technical changes can produce noticeable immediate changes. The little things that make a big difference….it doesn’t take much extra effort but the impact it has reaps major improvements.

There are positions that affect your technique at various stages of the stroke, or arm cycle. Each arm performs a stroke followed by a recovery. The ‘catch’ of water by the hand initiates the stroke. The arm entry into the water and initial pull and analysis of the shoulder motion occurs at the ‘front end’ of the stroke. The second half of the stroke and recovery arm motion as well as the pelvic, hip and leg kick occurs at the ‘back end’ of the stroke. Swimming action can be viewed from the side, above and in front to give information about the way the arms, head, shoulders, trunk and legs put the stroke together.

Swimming also has it’s ‘one percenters’. Small things that you can do in training to make yourself that little bit quicker than your competition. Often it is the right cue / instruction / drill or mantra that can make your technique smoother and more effective. Let’s take a look.

There’s only two ways to swim faster – You can either increase your stroke rate (the number of strokes you take per minute, or frequency) or you can travel further for each stroke you take (also known as distance per stroke, or stroke length). Don’t complicate things. They are the only two ways to swim faster. To travel further for each stroke you need to generate more power, or to decrease your resistance through the water. If an increase in your stroke rate does not decrease how far you travel with each stroke (by creating turbulence or inefficient movements) then you will swim faster.

There is one way to swim slower which is to create drag, or turbulence, by not having a smooth streamlined stroke. We will look at these influences more closely.

Rhythm, Timing and Stroke Rate!!

A higher stroke rate is one of the easiest ways to speed up! Particularly if you have short arms (a negative Ape Index). Just don’t measure how many strokes per lap you do, fewer strokes per 50m may mean you are becoming more efficient (more distance per stroke) but only if you keeping the same speed up. A higher speed may be achieved by a faster stroke rate if this improves your body position in the water!! A faster stroke rate can hydrofoil your body shape and give you more lift in the water. An overly long / slow stroke rate or overgliding may introduce pauses and dead spots in the stroke.

Swimming is an even cyclical motion like cycling and running, without pauses. For longer

distances swum in triathlon, most coaches recommend a 3 stroke to 1 breath or bilateral breathing pattern which often optimizes a smooth rhythm of stroke and minimizes turbulence, and commonly keeps you in a straighter line as movements are more balanced. It probably keeps you neck joints and muscles in better balance. Open water swimming or mass starts in triathlon racing may vary the pattern to a shorter breath pattern.

Good Propulsion, Even Glide, Low Drag

Hold, Pull, Push! Ultimately with the perfect stroke and negligible drag, if your catch of the water is firm, you hold the water well through the stroke and stroke water exit is solid, then your hand position relative to its position in the pool should stay roughly the same, ie your body has been propelled up the pool by one stroke length. As your arm is about half your body height this means your stroke length should be your body height with a full reach into the water and full extension exit. So a 2m tall person should require only 25 strokes per 50m lap. At 1 stroke per second that is a 25sec lap. Perfect world!!

With hip driven swim technique particularly, as you recruit your scapula and trunk muscles to pull your body through the water and up the pool, your body will need to be stabilized to prevent it bowing/collapsing/bending towards the propulsive side. You need a strong torso (core stabiliser) muscles to prevent your body following a snaking motion through the water. If you don't recruit these important muscles then this is also one reason your hand crosses to the midline to keep the propulsive forces midline and under your body. This is not as effective for propulsion.

The human body is not that hydrodynamic through water which makes it hard to maintain speed as drag is high. Any dead spot in your stroke will slow you down quickly. There is an optimum timing of take up of load in the lead hand (catch) when the exiting hand leaves the water that keeps the glide smooth through the water. Overgliding at the end of a stroke can slow you down considerably. A higher stroke rate and emphasis on early catch eliminates this. A good measure is when your out of water recovery arm overtakes the underwater stroking arm just in front of your head.

Head position determines body position. Your body will follow where you head goes. Therefore keep your head stationary. If you're hips are sinking, it's likely your head is too high and looking forward. Use the angle of your head to control where your body sits in the water. Look down and switch your core on to keep your head low and hips up. This also helps to position your lung (flotation) centre of buoyancy backwards to the hips to help keep your legs up. Try looking at your feet for a few strokes off the wall. Throwing your head side-to-side will cause you to 'snake' in the water and your arms will cross over the midline on water entry. Arm crossover results ion loss of balance in the water and the tell-tale scissor kick. Keep your head steady, down and smoothly rotating bilaterally! It is tricky to keep the body rotating and the head steady!

Recognize the most common problem in swimming stroke is the elbow dropping just after the catch when you take up the water tension for the stroke. This is usually because the lead arm enters the water too late and your arm is fully extended. Incorrectly the initial propulsive effort is downwards not backwards. Pushing downwards not backwards sinks your legs. Pushing down creates more pressure on your hand but in the wrong direction!! Pushing backwards with your palm with a high elbow results in you trying to help the water on its way behind you! Enter the water too early and you usually drive the arm down too sharply and create drag on the arm. Porpoise-dive your hand slicing forward into the water to increase your stroke length. Fingers below wrist, wrist below elbow, elbow below shoulder. Think that you are pulling yourself along a horizontal ladder up the pool. Lots of bubbles off your hand and arm during the propulsion stroke on video reflects a messy hand entry. Also look that you are not entering the water thumb first, this overly rotates the shoulder inwards and will result in a painful impingement injury.

Kick within your body shape. Your kick is used for two things. Propulsion and body balance. Kicking only adds about 10% to your propulsion, but helps keep your legs up and therefore your

body more hydrodynamically positioned. Kicking your legs outside the shape and alignment of your body creates drag. A wide scissor kick reflects poor balance through the water and uncontrolled body rotation. Firstly you kick from your hips, accelerating the leg on the downkick. On the more powerful downkick your knee extends a little as well but needs to keep good shape. Your ankle then follows the shape of the kick and gives a relaxed propulsive flex. The upkick is relaxed and the knee bends slightly. Keep your ankles and therefore your kick relaxed but small and tight. Think "feet flutter" and keep the toes pointed backwards to reduce drag. At the strong finishing 'push' of the stroke there is balancing kick of the same side leg to assist body roll to get the breath to that side and the drive of the opposite arm (performing the next stroke) into the water to commence the next stroke. Use Pull Buoys between your thighs and pull buoys between your ankles in drill work. Assist the kicking action with fins and kickboard laps.

Another very common error is the arm should not cross the midline of the body on water entry and should reach forward for a longer stroke. The early stage of the catch requires elbow bend (elbow bent about 60 degrees, hand pointing to pool bottom, and pushing backwards with the hand, not down. Pushing downwards may make help you feel as if you are floating instead of sinking but this causes turbulence and slows you down. At the end of the stroke your hand should exit facing backwards and at hip level for a full stroke, with the thumb almost flicking your hip. Try swimming with tennis balls in your hand (or a closed fist). During the recovery arm cycle, lead with the elbow! Keep the elbow high, elbow bent, think of the fingertips dragging just above the water surface and entering the water in a gently spearing action that should not carry much air into the water (which will bubble off the hand on the propulsion cycle of the stroke). Your hand should then flex and stay cupped, as in catching and holding as much water as you can through to the back end of the stroke.

Breathing technique

Breathing pattern consists of an inhalation phase on the recovery arm cycle and exhalation phase during the 2/3/4 stroke propulsion phase. Breathing in sport is primarily to expel carbon dioxide from your body as well as bring fully oxygenated air into your lungs. Inhalation is quick, not forced, and in the mouth as the rate of air movement is greater and you can control turbulent water better with your mouth than your nose. Don't lift your head, rather breathe "in your armpit" which is where the water is lower in a trough due to the 'bow wave' effect of your body moving forward through water.

Exhalation is a little more technical. Your head is steady looking down not forward so the water almost covers your cap. Exhalation most importantly needs to be relaxed, through the mouth and nose; if forced you whole body tenses up and you will never have a smooth relaxed stroke. Water pressure helps exhalation. Hold your breath too long and your body tenses up. Learn to sink before you swim by practicing sinking drills, float, exhale strongly and relax!! As a rule of thumb exhalation time is twice as long as inhalation time. Thus for a 2 stroke unilateral breathing pattern, exhalation is immediate after returning your face into the water to allow full discharge of air from your lungs. However with a 3 or 4 stroke per breath pattern there may be an advantage to keeping your breath in for an optimum initial period to facilitate gas transfer in your lungs, keep buoyancy in your body and use your diaphragm to maintain stability in your trunk during propulsion. Let's look at this further. Firstly as you comfortably hold your breath after full inspiration the volume of air in your lungs is at its maximum which raises buoyancy. Secondly with the diaphragm braced (the Valsalva Manouvre) the trunk is stiffer and a more effective platform for the arms to generate power for the first stroke and "catch" of the second stroke and kick of the legs, whilst exhalation through the 2nd stroke and 3rd stroke completes just before your face rotates out of the water. Thirdly with full lungs there is better gaseous exchange across the alveoli walls as the surface area and gas volumes are higher to transfer CO2 across the concentration gradient. However, there may be quite a few minor trade-offs here and the most effective and relaxed breathing pattern probably develops with long term training.

Doing these small things can add up to seconds over a 50m lap and the correct swimming

technique can drop your times dramatically over an Ironman distance.

Break your swimming into degrees of effort. This can be measured by strokes per minute (spm);

- Easy 50-55 strokes per min
- Steady 60-65 spm
- Tempo 66-70spm
- Fast 70-75 spm
- Sprint 75-85spm

or by lactate threshold similar to running. This is harder to replicate in the pool as technique rather than effort dictates speed in the pool, but think of a Critical Swim Speed (CCS) as your lactate threshold pace, swum over intervals with a recovery period;

- 6x200m (20 sec recovery) at CSS

All 3 triathlon disciplines have a optimal physiological adaptation effort, usually termed threshold effort which is pretty much at your lactic threshold (say a 13.5-14/20 effort or when you feel you need to throw in an extra breath into your usual bilateral breathing pattern). Your quality pool session may be something like 6-8-10 x 200m with 20 sec recovery at threshold at tempo/fast stroke rate.

Drills (+/- kickboards, fins, snorkels)
Side kick (head to pool bottom)
Side strokes
Side kicking Shark fin
Sculling arms in front to develop catch and feel for the water
Finger Drag drill on recovery stroke (or Shoulder Tap if stiff in the shoulders)

A triathlete may need to do 3 swim sessions per week. For an intermediate swimmer you want to improve in these 3 key areas;
Your Stroke Technique (e.g. improving body position, alignment, catch and pull technique, stroke rhythm)
- **Your Swim Specific Fitness** (with an emphasis on distance swimming sets)
- **Your Open Water Skills** (e.g. wetsuit buoyancy, drafting, sighting, swimming straight, open water confidence)
One session of each of these per week will equally improve your time over longer triathlon swim distances

Sessions

Plan a Total Distance swum
800m warmup and drills
Mirror each side of your body for 50m

- Shoulder and hip rotations
- Head down, side to side even
- Hand and arm entry and reach
- Arm carry over the water in the recovery strokes
- Elbow higher than wrist, wrist flexed
- Leg kick pattern and from hips

Variations for drills

- Hand Paddles
- Kickboard
- Pull Buoys
- Fins
- Swim snorkels

- Finis TempoTimer

Work out a time per 100m (@1:50 on 10 (sec recovery) depending on your threshold

Breakup sets of 50m/100/400m etc repeats at your CSS

- 6x200m (20R)
- 3x400 (45R)
- 4x 200/100 (10R)
- 12 x 100 (10R)

Work at various stroke rates