Some Ideas for Improving Open Water Swimming

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Introduction

In a previous article ‘Some ideas for coaches of pool, surf, and open water freestyle swimmers’ were presented.

In this article we look further at the principles governing performance in swimming in the light of the specific requirements of open water swimming. Clearly, open water involves a range of swimming conditions and demands that differ from pool swimming. Conditions in open water may range from those of a 'glass-like' fresh water lake to a swirling mass of waves off the beach, to swimming on your own or tightly positioned in a pack of competitors. The degree of choppiness of the water may change with wind strength and tidal movements. Courses may be point to point, or around a set course navigated by buoys that need to be rounded.

In many ways, swimming in open water requires a variety of skills that can be very different from swimming in a pool. In fact, a given swimmer needs to adapt a range of skills to different race conditions. Swimmers even need to modify their swimming technique within a race such as when negotiating a triangular shaped course where the wind and swell may be in the direction of swimmers in one leg, but against and/or to different sides in the others segments. Thus, swimmers need a technique that is not only adapted generically to open water swimming but also need to be skilled at adapting that technique to suit the conditions. This is very different from the case of pool swimmers who refine their techniques to be very consistent because the environment they race in is standardised.

From our personal experiences as a veteran surf swimmer and triathlete (respectively), the relationship between pool swimming and open water swimming ability appears to be 'strong' but not 'very strong'. For example, the first author had a training partner who had similar speed in still water but was clearly superior at taking advantage of a following chop in rough seas. In contrast, the first author was faster in choppy water, particularly when the chop was coming from the side, than some members of the training group who could maintain a faster pace in a smooth water environment. Many very strong pool swimmers find it harder to be competitive in the open water, without having to modify their strokes somewhat.

In the previous paper it was recognised that sustainable speed was related to the ability to maximise propulsion, the ability to minimise resistance, and the ability to do these in ways that are physiologically economical. Principles relating to each of those areas were discussed. In this paper we consider the principles in the light of the demands imposed by open water swimming and the implications for adapting technique to suit those conditions.

Maximising Propulsion

Swimmers are propelled by the force of the water acting on their propelling body segments (limbs and trunk). This depends on:

- Speed of the body segment (with respect to the water)
- Surface area of the body segment
- Shape of the body segment
- Orientation of the body segment
- Direction of the force
- Duration of the force

Most of these apply to open water swimming as to pool swimming. However, the first concept 'speed of the body segment' may not be as straight-forward. Whereas in competitive pool swimming (and in training, unless athletes have no choice but to follow less than 10 seconds behind other swimmers) one can expect the body segments to find still and undisturbed water, the majority of times in open water swimming one is trying to apply forces to water that is moving in unpredictable directions and is turbulent. This is particularly the case at the starts of races, when rounding buoys, and when drafting in packs. In these situations the timing of hand movement and its path can be upset. The swimmer has the disturbing sensation of losing the 'feel for the water' and of 'spinning the wheels' due to a lack of 'grip' on the water. Rather than a smooth pattern of increasing and decreasing force, the 'pressure' pattern felt by the open water swimmer is very unsteady. It may feel in the early parts of the pull phase like the effort to move the hand through the water is wasted as the water keeps 'falling away' in a similar manner to sand giving way as one tries to walk up a sand hill.

Hence, when considering open water swimming there is another very important variable to be included:

- Density of the water

The density of the water is greater in salt water than in fresh water. Thus, greater force can be produced in salt water than fresh water when the hands are moved at equivalent speeds, relative to the water. Whether this is an advantage to competitors in salt water is unknown, and may depend on the strength of the individual. If one wishes to maintain the same stroke frequency in 'still' salt water then either the forces must be greater, the stroke shorter, or the hand must be oriented to 'slip' more. If one is strong enough and fit enough to apply greater forces (propulsive impulse) then this type of swimmer may have a distinct advantage when swimming in smooth salt water. Whether this could then translate to increased stroke length and therefore velocity is problematic as there are other factors affecting the outcome. One is that the increased density also affects the resistive drag. However, the swimmer is more buoyant in dense water and the energy required to maintain good alignment, for example, the amount of kicking required to 'keep the legs up', may be reduced. It may be that swimmers who have a tendency to 'sink at the legs' may gain an advantage relative to swimmers who already possess satisfactory leg flotation. Nevertheless, the effect of increased density is complex and the relative advantage or disadvantage may depend on the characteristics of the swimmer.

It must also be recognised that turbulent aerated water is less dense than still water. Thus, one finds it harder to generate propulsive force when in turbulent water in the wake of other swimmers. In the 'washing machine' environment at turning buoys one might find it hard to 'power on' at a time when one would really like to pull hard to escape the wash and clear the crowded and disturbed water. Further, with the reduced density as well as the downward forces applied from contact with other swimmers, one finds that energy is being expended to keep afloat and maintain level alignment.

In pool swimming the principle of maximising the time of application of force is applied by developing a 'long pull' by reaching the hand well forward after entry and then 'making the catch' while the hand-forearm 'paddle' is still well forward and the elbow close to the water surface. When swimming in choppy conditions other than when the chop is coming from behind, the motion of the recovery arm may be 'rounder' and enter further in front of the body. The swimmer deliberately needs to clear the hand over the chop rather than slicing the hand through it. That is, the hand is not pushed as far forward underwater, but instead enters more forward and is directed more steeply than in pool swimming. This action enables the swimmer to avoid pushing the hand and arm through chop and encountering increased resistance compared to smooth water swimming. Such an adaptation may involve changing from a high elbow stroke with hand not far above the water level, to a much straighter arm recovery, with hand well above the surface of the water. In practice, this is especially the case when competitors wear full-length wetsuits in cold environments. In this case, the type and thickness of material in the wetsuit does not lend itself to a bending of the elbow. There is likely to be a greater energy cost associated with this sort of stroke.

This modified 'front end' of the stroke has implications for the timing of the stroke and inter-cycle variations in velocity. While entry may be longer and steeper than still water swimming, it must be pointed out that to avoid resistance from the steep entry and to take advantage of the established motion (momentum) of the arms, the swimmer needs to pull immediately after entry to make the catch. Effectively, we are ensuring that the back of the arm does not act as a 'brake' to the on coming water. The pause that usually accompanies the forward push (extension) of the hand in smooth water conditions is eliminated. As a result, the stroke frequency effectively increases because much of the 'glide' phase of a distance freestyle pool stroke has been replaced by an extension in air (above the water), and the distance per stroke decreases (by a small amount). This is also likely to help minimise the deceleration of the body between strokes compared with a stroke that includes significant 'gliding', as it appears in practice that gliding in disturbed water is not as effective as in still water. Furthermore, many ex-elite pool distance swimmers who venture into the competitive open water environment comment on how they need to change to a higher tempo and longer entry point in the new conditions to be competitive.

Anthropometric factors such as body length and shape must also be considered. Certainly, athletes that are not well suited to gliding need to reduce the portion of a stroke that does not contain some form of propulsion is crucial to reducing energy cost of re-accelerating the body in water. We already see such modifications when we observe the swim styles of the most successful pool based distance freestyle females and males of smaller stature and this is just as prominent in open-water conditions.

Other aspects of maintaining swim performance in open water include the size and position of the 'paddle' we use to provide propulsion. With a decreased density of aerated water in open water pack situations, it would appear even more important to present the greatest surface area possible to generate propulsion. Likewise, an ability to capitalise on the still water, whenever it is found during the stroke cycle, is a priority. The path of the 'paddle' from all views may therefore not be consistent with still water conditions, as slight direction changes may be required to 'search' for still water. In practical observations however, most competitive open water swimmers clearly optimise the shape of the 'paddle' with shoulder width entry point, internally rotated upper arm and underwater elbow bends near 90% as the arm passes the head and a hand position close to the centreline of the body, as seen from a front view. From the side, the entry is generally near full stretch, moving quickly into a catch with the forearm and hand 'square' to the desired direction of travel to maximise effective propelling area and to produce forces that are predominantly in the desired direction, and a quick pull with the path of the hand and forearm almost parallel to the surface of the water for most of the stroke. Relatively little lateral sculling action appears to be initiated by the swimmer, other than the small amounts of lateral movement which result mainly from rolling the body about its long axis as the stroke progresses (mainly at the back end of the stroke).

Clearly, in non-turbulent water, the athlete may find undisturbed water much the same as in the pool. In this case, the pull phase of the stroke generating significant amounts of propulsion can begin well in front of the head (if the athlete is capable). In moderately turbulent water, aeration and hence less dense water may be present for 30-40 cm of the front end of the normal stroke, but still water may then be found to 'press' against.

In highly turbulent water, the swimmer may need to search for some non-disturbed water outside of the 'normal' stroke pattern, by going wider or deeper. Alternatively, they would need to wait longer through the stroke (around mid body) to find still water. Importantly, open-water swimmers need to develop specific skills. In particular the pattern of force generation may change so that maximum forces are produced at the most appropriate part of the stroke. If the water near the surface is turbulent then effective forces may be produced later in the stroke than when swimming in smooth conditions. This may involve 'pushing' harder than usual just prior to exit. The swimmer needs to develop patterns of neuromuscular coordination to suit the conditions.

Minimising Resistance

The factors determining the resistive force acting on body parts are the same as those determining the propulsive force. These are:

- Speed of the body segment (with respect to the water)
- Surface area of the body segment (minimise by entering hand straight on to the water)
- Shape of the body segment

- Orientation of the body segment
- Direction of the force
- Duration of the force

Whether the force is propulsive or resistive depends on the direction of motion with respect to the water and the orientation of the body parts. However, when optimising technique to minimise resistance in open water swimming consideration must be given to the complicating factors arising from the different conditions encountered. Turbulent water that is moving in variable directions and speeds is common where other swimmers have disturbed the water for example, following starts, near turning buoys, and when drafting. There may also be currents due to tidal movement, flow in the case of rivers, and wind chop. All of these, except perhaps river flow that is either directly following or directly coming onto the swimmer, affect the 'feel for the water' and reduce the ability to produce forces to effectively offset or 'balance' the torques tending to rotate body parts out of alignment. Thus, rather than the body being streamlined to present a small area to the flow, the streamline is disrupted with large areas of the body moving against the flow.

Good orientation and alignment of the body is hard to sustain when one is being buffeted by chop. One tends to increase the magnitude of body roll to the breathing side to ensure that the mouth is clear of the water when inhaling. This affects the timing of the stroke, the path of the hands through the water, and disrupts alignment and streamlining. Usually, chop is at an angle rather than coming straight on or directly from behind. Swimmers who are able to breathe bilaterally have an advantage as they can breath comfortably to the side away from the chop thereby avoiding excessive body roll, minimising disruption to technique, and swallowing much less water!

A strong awareness of body alignment, and good core stability are thought to help minimise the amount of mal-alignment the body may encounter when being buffeted by swell or turbulent water. Swimming about the T (shoulders pushed into the water) may be important, as well as using the mid-torso muscles to maintain a streamlined body position, rather than allowing the body to become 'loose' at the midriff. In a race where athletes wear wetsuits up to 5 mm thick, 'banana' shape swimmers are often observed. The additional buoyancy of the suits keeps the feet high even when the head is high (while breathing and sighting). In addition to core body control and upper body position, modifying the density of the wetsuit material covering different segments of the body, to allow for an individual's own buoyancy (body density) characteristics, may assist in the quest for good alignment and streamlining.

When drafting, the turbulent water, some of which is moving in directions that assist forward motion of the swimmer, offers less resistance than still water. It is well known that drafting can reduce energy expended at a given speed, and attempts to give information on the optimal position (distance) behind or beside a swimmer should draft another has been attempted.

It is difficult to minimise resistance of the hand and arm at entry in choppy conditions. Thus, a change in technique is required. This has implications for the propulsive phase of the arm action with 'flow on' effects on timing, stroke frequency and stroke length as discussed in the previous section. Competitors swimming in packs may find that the hand 'slips' a considerable distance through the disturbed water (perhaps as far as mid stroke length) until they eventually find undisturbed water. As suggested earlier, the 'back-end' of the stroke may play an increasingly important role in some open-water conditions. Methods of training to develop specific strength and power for the latter half of the pull require further investigation in addition to research into optimal cadences.

While all swimmers encounter difficulties adapting technique to optimise performance in the myriad conditions encountered in open water swimming, swimmers who have deliberately practised in a range of conditions will adapt more successfully than those who train predominantly in a pool environment. Clearly, the pool environment is not sport specific, and may cause significant problems for athletes trying to improve their performances in open-water environments.

Maximising Economy

Principles applying to pool swimming apply in open water swimming also. These are:

- Continuity of movement
- Resting muscles during recovery
- Using appropriate joint angles and levers
- Using the large muscles of the body

When swimming in chop there are fluctuations in velocity additional to those occurring in flat water. For example, in very rough water when chop is coming from behind, the swimmer increases speed and 'rides' the wave but then slows down as the crest passes underneath. Skilled open water swimmers can time their pull to maximise the duration of the 'ride'. This may be assisted by kicking to keep the legs high and the body angled downwards on the face of the wave. Thus, the goal of maintaining uniform effort may not be appropriate. Rather, appropriately timed bursts of additional effort to capitalise on the conditions may be more economical. In any case, the swimmer needs to shift to more of a 'catch up' technique (see, for example, the paper 'Total Immersion Strategies - A Closer Look) Ben put a live link to that article from here.) when swimming with a fast following chop than with an oncoming chop.

A 'catch up' technique is also appropriate when seeking good economy in flat water. A relaxed recovery with a forward stretch and glide following entry is economical while providing the opportunity for a long and strong pull (see, for example, the paper 'Total Immersion Strategies - A Closer Look) Ben put a live link to that article from here.). As discussed in the foregoing sections such an action does not work as well in choppy water due to the resistance encountered by the hands and arms entering through chop. However, other principles of economy can be applied when utilising the higher arm recovery in open water swimming. The rounder action applies the continuity of movement principle as the arms make more circular motions. There is no pause after entry, the motion established is simply redirected. Thus, the momentum of the arms at entry can be used to commence the pull. Indeed, the same principle is being applied successfully by some swimmers in pool swimming (i.e. female distance freestyle medallists at recent Olympics and World Cups). For some swimmers maintaining a more even velocity is thought to reduce energy costs of movement, despite the theoretical additional cost of having a higher stroke rating (i.e. the energy cost of moving limbs more times per minute).

The need to compensate for perturbing influences such as turbulence and chop as well as to use bursts at particular times such as rounding buoys and riding waves means that swimmers need to train specifically. Muscles that are not used or are used minimally in flat-water swimming may be used to compensate for perturbations in open water swimming so that good alignment is maintained. The strength and endurance of muscles required for the specific demands of open water swimming is probably best developed by training in those conditions. However, this is a largely unexplored aspect of improving open-water swim performance.

So too is the ability of the open-water swimmer to be capable of swimming straight! While this may seem obvious, a surprisingly low number of swimmers have this skill. Clearly the open water is devoid of 'black lines' and few reference points are normally available, so being able to swim straight, independent of the breathing side, is an important skill. Similarly, good technique in sighting the course buoys or landmarks is crucial. Minimising the disruption to the normal stroke pattern and optimal body position will help with average swim speed. Hence being able to couple a breath with the sighting manoeuvre is an added advantage, and should be practised regularly.

Kicking in long distance swimming uses a great deal of energy and its contribution to propulsion may not warrant that energy expenditure. When swimming in salt water, or in a wet suit that supports the legs, good alignment may be achieved with minimal reliance on kicking. Therefore, economy and performance may be optimised by kicking minimally to maintain balance except when required for bursts such as wave riding and clearing crowded and turbulent areas such as at starts and buoys where maintaining body alignment and momentum is crucial. At these times it may be appropriate to switch from a gentle two beat kick to a vigorous six beat kick.

Summary of Main Tips for Open Water Swimming

- When swimming in choppy conditions other than when the chop is coming from behind, the motion of the recovery arm may need to be 'rounder' and enter further in front of the body.
- When the chop is coming from behind a long glide can be used with a pull and kick timed to 'ride the wave'.
- In highly turbulent water, it may be necessary to 'search' for some non-disturbed water outside of the 'normal' stroke pattern, by going wider or deeper. If the water near the surface is turbulent then effective forces may be produced later in the stroke than when swimming in smooth conditions. This may involve 'pushing' harder than usual just prior to exit. The swimmer needs to develop patterns of neuromuscular coordination to suit the conditions.
- Being able to breathe bilaterally provides an advantage by being able to breath comfortably to the side away from the chop thereby avoiding excessive body roll, minimising disruption to technique, and swallowing much less water!
- Good core stability helps to maintain good body alignment in roguh conditions and turbulence.

- Practising in a range of open water conditions helps enables successful adaptation to any conditions in open-water competition.
- Muscles that are not used or are used minimally in flat-water swimming may be used to compensate for perturbations in open water swimming so that good alignment is maintained. The strength and endurance of muscles required for the specific demands of open water swimming is probably best developed by training in those conditions.
- The ability to 'swim straight', independent of the breathing side, is an important skill. Similarly, good technique in sighting the course buoys or landmarks is crucial. Minimising the disruption to the normal stroke pattern and optimal body position will help with average swim speed. Hence being able to couple a breath with the sighting manoeuvre is an added advantage, and should be practised regularly.
- Kicking in long distance swimming uses a great deal of energy and its contribution to propulsion may not warrant that energy expenditure. When swimming in salt water, or in a wet suit that supports the legs, good alignment may be achieved with minimal reliance on kicking.
- 'Bursts' of vigorous kicking to assist 'wave riding' and clearing crowded and turbulent areas such as at starts and turning buoys may be required. Therefore some specific fitness needs to be developed for this.

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