Speed Development in Swimmers

By Wayne Goldsmith Total Condition Training

Introduction

Competitive swimming is all about swimming fast, and speed, in conjunction with technique, forms the most precious element of a swimmer's make-up. Coaches are, after all, dedicated to one task: preparing swimmers to swim their event as fast as possible.

While some swimmers possess a greater degree of natural speed than others, it is clear that a well planned training program should improve swimming speed and competitive performance of all swimmers.

This article examines three approaches to the development of speed in all swimmers and outlines their coaching and scientific rationale. We then introduce the concept of total condition training, which has the aim of maximising both speed and endurance. Several features of this model are discussed in detail and relevant suggestions on developing speed in swimmers are presented.

What is Swimming *Speed*?

In practice, the operational definition of speed varies from sport to sport and within in a sport, such as swimming, from event to event.
In a generic sense, we can think of speed as the ability to swim a given distance in the shortest possible time.

SPEED can be further divided into four components: as reaction time, acceleration, maximum speed and speed-endurance.

Reaction time in swimming is defined as the start time, which is time off the block from a full racing start to the 5m mark.

Acceleration is the ability to reach maximal speed in the shortest possible time – this is obviously a key factor in the 50m and 100m events.

Maximum speed is the peak swimming speed that a swimmer can reach (and often only sustain for a few meters).

Speed-endurance, or race-pace, is the speed that swimmers can hold over the required race distance. This speed is slower than maximal speed, but the differential between speed-endurance and maximal speed is smaller for the better swimmers.

Apart from the 50m event, it is possible that the swimmer with the highest maximum speed may not necessarily be the winner. Start times, turn times and finish times are often decisive factors and inspection of competitive evaluation reports from national and international meets will bear this out.

The skill and technical aspects of swimming are obviously critical and have been addressed in many articles in Australian Swim Coach (see articles by Bernie Wakefield, Ken Wood and Gennardi Tourestski).

This article will focus on the training considerations for the development of physiological capacities that underpin the various aspects of swimming speed.

Fitness and Technical Requirements of Swimming Events

In order to develop a good speed training program for individual swimmers, it is necessary to examine the fitness and technical requirements of the different events.

For the 50m event, it is obvious that reaction time, acceleration and maximum speed are all critical factors.

For the 100-200m events, all the different aspects of speed (reaction time, acceleration, maximum speed and speed endurance) are important.

For the middle-distance and distance events, reaction time, acceleration and maximum speed are less important, but a highly developed level of speed endurance is critical.

For speed-endurance, most coaches use either 100m and 200m race pace (and occasionally 400m race pace). In this work, the average pace held through a 100m or 200m, is used in 50m intervals e.g. 8 x 50m at 200m race pace (e.g. 32 seconds for a swimmer with 2:08 200m PB) with a 100m recovery swim between each effort.

Measuring the stroke rate and stroke count is a practical method of evaluating (in gross terms) the stroke mechanics of any given swim.

During competition, most 50m and 100m swimmers will reach stroke rates between 50 and 60 stroke cycles per minute. During low-to-moderate intensity aerobic swimming (which forms the majority of the weekly volume) stroke rates usually range between 25-40 strokes per minute.

It is essential, therefore, the ensure that high-intensity sprint work is completed with race specific stroke rates (50-60 strokes/min). If a swimmer is unable to "rate up" to the appropriate level, it may be prudent to hold the speed session over to another day when they are able to complete the workout as specified.

Once these factors are sorted out, the planning of speed training can begin. Initially, the aim is to plan a general training program that addresses the overall needs of the team or group. However, it is necessary to evaluate each swimmer individually to determine the strengths and weakness for each of the different components of speed.

In essence, there are three common approaches used for the development of speed in swimmers:

1. **High-Volume and High-Intensity Training**
2. **Specific Energy System Training** and, **Total Condition Training**.

1. High Volume and High Intensity Training (Broken Egg Coaching)

We refer to this approach as "broken egg coaching", because it is much like throwing a dozen eggs against the wall, and seeing which one doesn't break. The high-volume high-intensity approach has the following features:

- Give all swimmers as much volume and intensity training as they can handle (or can't handle).
- Three weeks out from the meet reduce the volume and do a few sprints.
- Rest one week out by drastically reducing the volume and pray that the speed will come when the swimmers are rested.

This approach, sometimes seen in swim programs with a big feeder system, works on giving swimmers a great deal of non-specific work. If a coach adopts this approach, then they can be confident that the average fitness of their squad will be higher than the average fitness of most other squads, making them very competitive at most levels. Many coaches have been relatively successful using this coaching method.

It is generally accepted that a well-developed aerobic base is necessary for success in swimming at the highest level. Long term success is also dependent on developing a broad range of physiological, psychological and technical skills.

The high-volume and high intensity approach can often produce great age group results and is particularly effective when working with large teams. Coaches who have achieved success using this technique are understandably reluctant to change a tried and proven method.

In the long-term however, neglecting overall development in the effort to maximise training volume and intensity in the hope of short-term goals, is in our opinion, more likely to limit success at older age group and elite levels. Remember, **"many meaningless miles means mass mediocrity"**!

Pros

- Swimmers get very fit and are competitive at most levels of competition.
- Swimmers develop a large aerobic base.
- Easy to control large group of swimmers.

Cons

- Potentially an increased risk of illness and/or injury.
- Does not permit training to be tailored to individual needs.
- Swimmers may become overtrained and burned out.

Performance can be limited at the top level owing to neglect of the full development of all energy systems and swimming abilities.

GOOD
is
not
enough
where
BETTER
is
possible

2. Specific Energy System Training

It is often heard that sprint swimmers do too much volume training, and many commentators cite the principle of specificity to justify their argument. The dynamics of the different energy systems and the principle of specificity suggest, at face value, that sprint swimmers should do less work than currently advocated by most coaches.

In some circles, it was and is fashionable to look for low-volume and high-intensity sprint training programs.

The model of specific energy system training is based on the following rationale:

First, most swimming events last around 2 minutes or less and are consequently highly anaerobic in nature. **Second**, basic physiology and the principles of specificity suggest that swimmers need to perform training at race-specific speed in order to develop the appropriate energy system(s) required for that particular event.

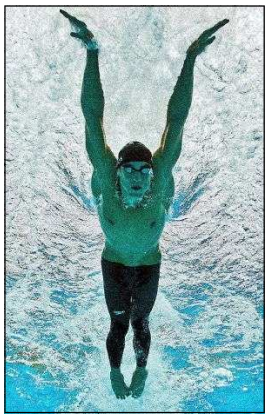
On this basis, it is argued that sprint swimmers should do far less training at submaximal level and concentrate on the development of the alactic (ATP-PC) and lactic (anaerobic glycolysis) energy systems through sprint training.

Among other things, this system-specific approach overlooks the interactive effects of training all the energy system pathways concurrently. It is a fundamental principle of physiology that all energy systems contribute to the energy requirements of physical activity: the contribution of each of the three systems is dependent upon the intensity and duration of exercise.

It is an oversimplification to assume that short-explosive events are totally alactic or that middle and long-distance events are totally aerobic. Every swimming race requires a combination of all the energy systems.

The periodised nature of modern swimming training programs permits endurance, strength, speed, power and technical skills to be developed concurrently. Inspection of most coaches' training programs would show that all these attributes are addressed to some extent during each week of training.

Pros



- ➡ Is consistent with the principle of specificity of training.
- ➡ Develops great speed over short distances.
- ➡ Has proved to be popular with swimmers.

Cons

- ➡ Limited aerobic development in spring swimmers may have negative consequences in lactate breakdown and removal.
- ➡ Increased risk of injury and swimmer 'burnout'.

May limit swimmer's ability to finish off races.

Total Condition Training

A theme which has stood the test of time and is considered the most effective way to prepare all swimmers, including sprint swimmers, is **a balanced and integrated training program** that addresses all the aspects of conditioning.

A fully integrated training program normally follows a periodised format where endurance, speed, strength, power, and all the necessary skills and technique, are developed concurrently.

A periodised approach requires that certain aspects of fitness are emphasized at different stages of the training program, but an underlying feature is that all elements are maintained at an acceptable level.

The current format of the Australian and international calendars, where there are approximately 12-14 weeks between national championships and major international meet, is sufficient time to fully prepare all aspects for all swimmers; hence the title "**Total Condition Training**".

Pros

- Facilitates concurrent development of endurance, speed, strength and skill.
- May lead to higher level performance in the longer term.
- Permits a more general preparation of swimmers for a full range of events.

Cons

- Long-term goals may be at the expense of short-term gains.

Specialised and detailed program is more suited to smaller sized squads.

Features of Total Condition Training for Speed

To improve start time, which is the time from a dive start to the 5m mark, and can be sub-divided into reaction time and movement time.

Reaction time is the time from the firing of the starting gun to the first sign of movement.

Movement time is the actual duration of the start from the first sign of movement to the swimmer reading the 5m marker.

The start is an explosive movement and will be assisted by a conditioning program that develops strength and power in the lower body. Of course, starting is also a skill that needs to be learned and perfected through appropriate instruction and practice. It may be useful to set aside 10 minutes for group starting practice (and relay change overs) every week or two.

To improve acceleration, training sets incorporating a systematic increase in speed, up to maximal speed, should be undertaken.

In swimming parlance, the most common acceleration drill is the "build" set and its many variations. This work is undertaken normally over 50m or 100m and involves an increase in pace through each lap or 25m segment. The increments of the increase in speed will vary according to the individual swimmers event and specific requirements.

Some coaches also use "variable pace" drills where swimmers can accelerate and decelerate according to a set pattern; e.g., 8 x 50m on a 60 second cycle alternating 25m fast, 25m easy with 25m easy, 25m fast.

Another type of acceleration drill is a short descending set such as 8 x 50m D1-4 on 60 seconds, where the times are descended from moderate to fast in efforts 1-4 and again in 5-8.

Strength and **power** **training** is essential to fully develop the various components of speed.

This work may take the form of traditional strength training in the gym (free weights, machine weights or circuits) or more specialised forms such as plyometrics, jump training, swim bench, jump squats, power cleans or other strength and power related activities.

It is worthwhile to consult a strength and conditioning coach or gym instructor to discuss the strength and power training requirements for both age group and senior swimmers.

Similar to speed, there are different components of strength such as general strength, maximal strength, power and strength endurance. **Power** is the combination of speed (time) and strength (force) and therefore higher velocity drills must be considered; power will not be developed unless high speed intervals are used.

The most commonly used drills for power training are sets of 15-25m efforts at maximal effort from either a dive or push start, e.g. 10 x 50m as 20m fast – 30m recovery on a 1:15 cycle.

In the model of total conditioning, **maximal speed** is developed by a combination of endurance, speed and supplementary training activities.

Maximal speed can only be sustained for a short distance (duration) before deceleration is evident. Deceleration or slowing of swimming speed is most likely the result of biochemical and physiological processes such as depletion of the high energy compounds ATP (adenosine triphosphate) and creatine phosphate within contracting skeletal muscle.

The most effective means of developing speed is through a periodised program of **high to maximal velocity short interval training**. This type of work takes the form of sets like:

(i) 10 x 25m F/S maximal effort, or
(ii) 8 x 50m at 200m race pace with 100m recovery swimming,
where the most important factor is the speed or pace of the repeats.

Maximal race speed will only be improved when swimmers are swimming at speeds very close to, equal to, or in excess of existing maximal speed. This can be achieved by use of speed assisted drills.

An important principle of the physiology of sprint training is that very high energy compounds in the muscle such as ATP and creatine phosphate (CP) are depleted rapidly during maximal effort work and take **approximately 3 minutes to be fully restored**.

Recent research at the University of Western Australia has shown that it may even take 4-6 minutes before normal levels of ATP and CP are restored. This means that longer interval sprint work which significantly depletes CP levels (e.g. maximal effort 50m and 100m intervals) for outright speed is most effective on cycle or turn around times of approximately 5 minutes.

In practice, this is achieved by having swimmers undertake some low to moderate-intensity aerobic recovery swimming during long and intensive sprint sessions:

e.g. 8 x 50m maximal effort with 200m recovery on a 5 minute cycle.

Active recovery is preferable between efforts as the body will recover more quickly than with passive rest (e.g. sitting on the deck or supporting one self on a lane rope!).

Another important type of sprint training is the short rest spring set such as 4-8 x 50m F/S maximal effort on a 35 seconds cycle. Gennardi Touretski refers to this type of set as an "activation" set. The aim is to activate or mobilise the physiological processes of the lactic acid energy system (anaerobic glycolysis).

This set is only done infrequently at key points in the training program - such as during the transition from aerobic to quality work, prior to a mid-season competition, and during a full length competitive taper.

The work is very arduous and should only be attempted when swimmers are in good shape. Not only does it play a role in stimulating some of the necessary physiological adaptations, it is of course, very specific training for 100-400m events.

A comment on **lactate tolerance training**. This term has been used in several of the classification of training systems developed for swimming and refers to high intensity interval work that is known to elicit high levels of blood lactate.

In one sense the term is misleading, because it may imply that the main aim of the exercise is to develop high levels of lactate in order to stimulate the development of physiological processes. Of course, the debilitating effects associated with an elevated level of muscle and blood lactate can impair training and competitive performance.

The critical aspect is to improve the swimming speed during this type of work. A common mistake is to focus too heavily on the effort. Swimming these type of sets with high heart rate and blood lactate levels at slow speeds is not a very effective method of training.

Experienced coaches will know the considerable limitations of doing repeat maximal effort 100's e.g. 6–8 x 100m maximal efforts on 8:00. There is, arguably, a place for such sets, but a more effective approach is to incorporate recovery swimming between each of the quality efforts. This way, you get better speed without the interference of high blood lactates.

Coaches should use **speed-assisted drills** throughout the training program. Examples of speed-assisted drills include the use of paddles and pull buoy, stretch cords and various pulley systems.

The Australian Institute of Sport has recently installed a **motorised pulley** in its 50m pool and this has proved to be very useful in introducing swimmers to higher level speeds.

For example, with senior male freestyle swimmers, the speed is set to 20-22 seconds, which is slightly in excess of race speed. The pulley system is also an effective means of checking the quality of streamlining of individual swimmers. Any deficiency in streamlining (excessive drag) becomes very noticeable when the speed of the pulley is set above normal race speed.

Unless you try something beyond what you have already mastered,
You will never grow

Summary

The development of speed-endurance is, as the name suggests, a combination of speed and endurance training. We have suggested that a highly developed background of endurance is essential to support the speed training necessary for an elite level sprint swimmer. This approach, of course, has to meet the requirements of individual swimmers, and what suits one swimmer may not suit another.

In brief terms, speed-endurance is developed through a periodised program of basic aerobic work (longer intervals at the level of sub-maximal aerobic and anaerobic threshold), general dry-land strength-endurance training in the gym, and specific high-intensity interval training (sets of high intensity 50-200m intervals).

The **frequency of speed training** is another common topic of conversation. Through experience, some coaches devote a number of specific sessions to speed each week, while others will incorporate a few sprints at the end of every workout.

However, there is no hard and fast rule. For a full and exhausting sprint workout it is suggested that at least 24-48 hours of recovery (i.e. low to moderate-intensity aerobic swimming) be undertaken before the next full sprint workout. This time is required for muscle glycogen stores, particularly in fast twitch muscle fibres, to be restored to normal levels.

This length of recovery should also permit regeneration of neuromuscular pathways that regular muscular contraction. Central nervous system or neuromuscular fatigue may limit the ability to swim fast even though muscles may be fully hydrated and refueled.

The importance of the technical aspects of sprint swimming is appreciated by every coach.

In addition to the subjective evaluation of the coach (the so-called coaching "eye"), it is good practice to utilise video camera technology to occasionally assess and correct the technical aspects of each swimmer's stroke.

Some elite coaches may have access to more sophisticated biomechanical analysis of the different strokes at different speeds.

One approach to the development of speed is to improve the efficiency and economy of swimming throughout the full range of training and competitive speeds. While all coaches acknowledge the importance of improving efficiency and economy during submaximal swimming, it is also equally important in higher velocity sprint swimming. The best sprinters have efficient and economical techniques at the higher speeds in terms of both metabolic and mechanical factors.

Speed should be assessed regularly by timing 25 and 50m efforts in the swimmer's main stroke. Coaches do this routinely and it is a good way of checking how an individual swimmer's speed is responding to training.

To check reaction time, acceleration and maximal speed it is appropriate to use a dive start. To simply check acceleration and speed, a push start can be used. Coaches (and swimmers) should use the 25m and 50m split times from their best competitive effort as a reference point.