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USRPT AND TRAINING THEORY VI:
THE INDIVIDUALITY PRINCIPLE

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The *Individuality Principle* dictates that the decisions concerning the nature of training should be made with each individual athlete in mind (Rushall, 1979). A coach must always consider that each athlete should be treated independently (Bompa, 1986, p. 17). Incorrect forms of training prescription could result in all athletes in a team training with the same schedule and load. Attempts to copy the programs of champions, which is still a common practice among many swimming coaches, will also result in incorrect loadings of the work of training for most individuals.

It should not take an astute coach long to realize that swimmers within a team or squad are quite different. They have different performance and fitness attributes, life-styles and nutritional preferences, and they respond to the physical and social environments of training in their own unique ways. It is essential that training programs cater to those individual needs and preferences to optimize performance improvements. The factors that exist in the training process around which programs are designed are the quality and abilities of the individual swimmer, age, and the principles of training. This *Bulletin* discusses the major factors that need to be considered when individualizing training prescriptions.

Tolerance of Training Loads

The optimum training loads vary between swimmers. Australian swimming coach, the late Forbes Carlile, often recounted the training performances of Shane Gould and Karen Moras, the best two distance swimmers in the world in the early 1970s. Shane Gould thrived on seemingly hard training, with her training performances being of quite a high level. On the other hand, Karen Moras exhibited training performances that were much slower than those of Shane. However, in competitions, the two recorded markedly similar times. It was the training loads, as exhibited by training performances, which were different. It is conceivable that if either of the two athletes were made or encouraged to train closer to the other's performance level, her subsequent competitive performance would have suffered. The late Dr. James Counsilman of Indiana University also described Mark Spitz as being a light trainer when compared with other swimmers in the same pool. His training load was less than that for other swimmers such as John Kinsella, although both were the best in the world at that time in freestyle swimming events.

These are examples of different training loads being required for different athletes to produce the optimum training stress to record world-best performances.

There is no guarantee that an athlete who tolerates heavy training loads is going to be the best performer in competitions. They often set the *"training standards"* imposed by the coach but are not capable of succeeding in contests against the peers whom they have beaten consistently in training. Their performances also suggest that fitness is not the only factor responsible for achieving sporting success. The tolerance of training loads also seems to be related to a swimmer's history of involvement. It is simply impossible to withstand the rigors of a heavy training and competitive schedule if the foundation or basic training is weak and unsubstantial. Gradual adaptation to training over a number of years provides an essential basis for absorbing later heavy loads. The coach must carefully monitor the capacities of swimmers to cope with training loads and adjust training programs when necessary. The *DALDA* provides an indication of the response of swimmers to training loads and shows when swimmers are excessively stressed.

Responsiveness to Training

The capacity to respond to training is related to the initial level of fitness and the physiological characteristics of the individual. The potential for improvement is greatest when the initial level of fitness is lowest. This is clearly illustrated in the change-maintenance-training graph included in the previous *Bulletin 60c*. When a swimmer is unfit, performance improvements will be obvious and substantial with the onset of training. When a swimmer is fit, performance improvements will be small and relatively infrequent. Once maximum fitness has been achieved, it requires much less training to maintain performance than was required to get to peak fitness. The response of a swimmer will vary depending upon the level of fitness and the training program content (the combination of technique development, psychological skills training, and race-pace conditioning).

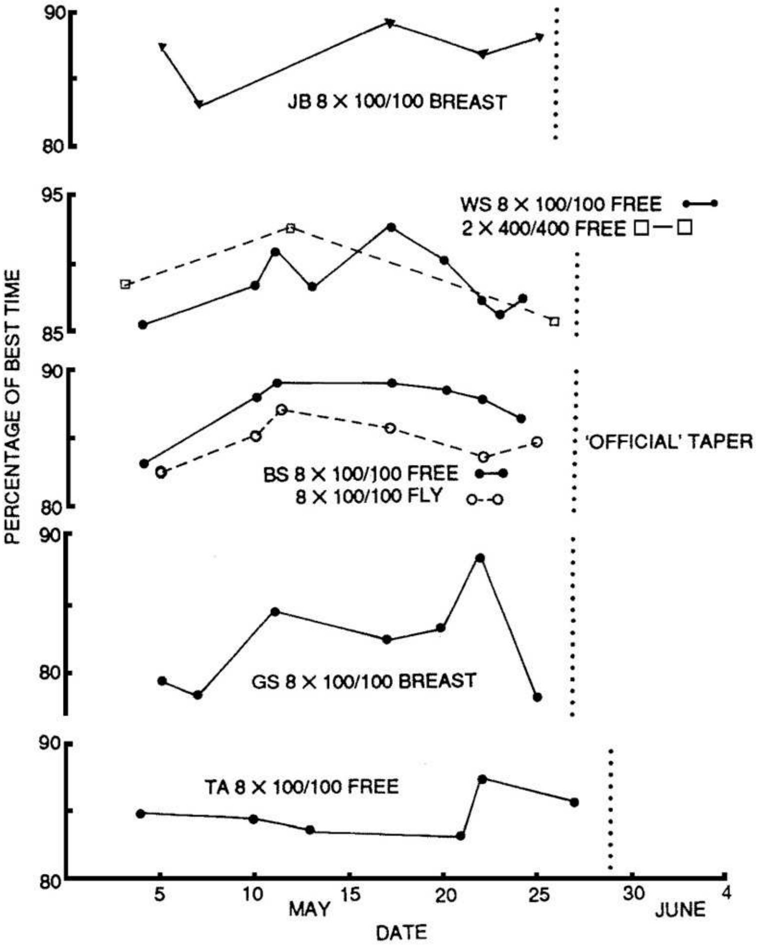
There are some swimmers with higher sensitivities to fitness training. With regard to strength, this becomes very noticeable in males around the time of puberty when some have increased their secretion of testosterone while others have not. Early maturers develop muscle size and definition quickly and often dominate strength and power-oriented sports in a particular age group (Astrab, Small, & Kerner, 2001; Simmons, Pettibone, & Stager, 2002). No matter how much weight training is completed, a late maturer has to await the arrival of puberty before significant power/strength gains are made. But even with the advent of puberty, individuals will differ in their response characteristics and performance levels. Some swimmers just cannot become as powerful/strong as others.

A further strength-training factor that produces individual responses is the proportion of fast-twitch muscle fibers in the main working muscles. Whether using dry-land training (irrelevant training) or very high-intensity swimming (the USRPT relevant form of power development), the proportions of Type II fibers contribute to individual differences. Swimmers with a high proportion profit more from power training than do endurance-oriented athletes (those with a high proportion of slow-twitch muscle fibers). This is because the high degree of tension created in the muscles during power-training exercises requires the fast-twitch fibers to become involved. After some time those fibers hypertrophy and, due to their abundance in the muscle, contribute significantly to increases in its size (Dons *et al*., 1979). Age-group muscle hypertrophy also occurs in USRPT high-intensity training (Losey *et al.*, 2013) which likely will make auxiliary training redundant.

Throughout this *Bulletin*, further features that cause differential responses to training between and within swimmers will be indicated. A person of one age will respond differently from one of another age, such as in the example of power/strength training and the growth stage of puberty. With regard to training loads, young athletes will break down and recover faster in training than they will when they become older. The practice of individualizing training programs requires consideration of the *"responsiveness to training"* factors.

Figure 6.1 illustrates the training responses of five Canadian Olympic swimmers during the final stages of the *"hard"* training phase prior to commencing a taper (peaking) period for the 1976 Canadian Olympic Team trials. The training content was traditional swimming training. Throughout the time of the observations, each swimmer completed the same training segment on a number of occasions. What is depicted in the figure is the average time for each set expressed as a percentage of the time recorded in the subsequent competitive performance. The data can be interpreted as the percentage of effort when time is used as the basis of calculation. What is noticeable is the variation of performances within and between each individual.

Figure 6.1. Training performances of five Canadian Olympic swimmers for a three-week period before the "tapering" (peaking) phase of training leading to an Olympic Trials. Swimmers were trained in a traditional swimming program.



The repetition-training segment is expressed as the number of repetitions by distance. The value following the forward-slash character is the racing distance against which the intensity of the training efforts was determined. A datum point constitutes the average percentage for the number of repetitions in the segment when compared with the subsequent competitive performance.

A summary of the data follows.

1. Subject JB completed four of five sets within an 86-89 percent intensity range. The remaining set was slightly over 83 percent. Except for the lone lower figure, the training responses were remarkably consistent.
2. Subject WS performed two events, one a 100-meter sprint, the other a more endurance-oriented 400-meter event. The

intensities of training for both events fell within the same range, 86-93 percent. The commonality of the training intensities is surprising.

3. Subject BS performed two 100-meter sprint events. The freestyle performances were consistently three to four percent higher in intensity (range 87-89 percent) than were the butterfly performances (range 83-87 percent).
4. Subject GS's performances ranged 78-88 percent for the 100-meter breaststroke event. This included the lowest intensity of any training segment and the widest individual variation of the five swimmers.
5. Subject TA exhibited four consistent levels of performance with two subsequent performances being elevated prior to the commencement of the taper. Performances ranged in intensity from 83-87 percent.

What is evident from these data is that some athletes trained consistently while others varied considerably; most athletes produced little performance change over the period of observation; and the training intensities of two males (WS and GS) differed considerably. The individual variations in training responses of these athletes training in the same pool warranted different programs and performance expectations. Such needs would not be met by having the athletes perform the same training program with the same training stimuli.

Recovery from Training and Competitions

The recovery time from heavy training or intense competitions is longer in some athletes than in others. This is particularly the case with older athletes. Many mature swimmers find they are only able to train lightly for the first few training sessions after a major meet. Light loads are required to facilitate recovery and negate the possibility of further excessive training. Coaches should recognize these differences either by reducing the training load or lengthening the recovery period in swimmers who display the symptoms of chronic fatigue.

Swimmers with different physiological profiles also seem to require different peaking programs. Resistance-trained athletes show a level of maintenance of strength-related variables during periods of inactivity. Hence, reduced or tapered training loads can be extended without fear of deterioration in strength or explosive power performance. On the other hand, endurance qualities are lost relatively quickly, and extended periods of reduced training in distance-oriented athletes are not recommended. An athlete's type of training will require different programming considerations with regard to what occurs in recovery periods. Within a squad or team, individuals will recover at varying rates.

Training Needs

A coach should aim to develop a balanced profile of attributes in all swimmers that have been determined through an analysis of swimmers' histories and where they are valid, reliable, and accurate, objective measures. The consideration of fitness training must be weighed against the need for skill and mental training. Any training should be based on known strengths and weaknesses in swimmers' profiles. For example, a distance swimmer with well-developed endurance capabilities but weak in sprint events would be advised to spend training time on improving anaerobic power and capacity which would contribute to improving sprint performances and finishing capacities (sometimes described as anaerobic power and capacity) in distance events. Another alternative for improving sprinting would be to develop a race strategy aimed at maintaining a faster even-pace throughout an event rather than relying on going out too fast or a sprint finish. Such a swimmer would need to train with a program that was different from others with dissimilar needs.

USRPT performances in normal training indicate when swimmers should expect to improve in competition performances at big meets. When an event-specific set is attempted repeatedly at training and while the number of successfully completed repetitions improves, competition performances should be expected to improve. As the number of repetitions increases, that indicates swimmers can hold the race-pace longer before fatigue starts to affect performance. *Bulletin 60b* (Rushall, 2016) described how swimmers eventually achieve a maximum number of successful repetition completions for a particular set and then progress no further (a *"maxed-out set"*). By increasing the race-pace time for repetitions after a *maxed-out set* has been determined, the maximum number of repetitions completed decreases. Eventually, the completion numbers for the faster-set increase and stabilize again but at a lower number than was demonstrated with the previous slower-repetition target-time. That again indicates maximum physical capabilities for the faster-repetition set. When maximum training performances are recorded, indicating that no further conditioning is possible, the only way a swimmer can progress is to improve propelling efficiency by changing to better technique elements and/or race-skills.

Attempts have been made to predict performances and/or analyze swimmer potential mainly through the use of physiological tests.

- Nagle *et al.* (1998) found that physiological and stroke-dynamic testing yielded very little insight into either 50- or 500-yard performances in a combined sample of male and female swimmers. Zoeller *et al.* (1998) found that La_{peak} and accumulated oxygen deficit were weakly related to 50- or 500-yard performances in serious female swimmers. However, the correlation coefficients were so low that the amount of variance that could be accounted for by La_{peak} was in the region of 25% while accumulated oxygen deficit was not related at all. There was no practical value for swimming decisions for either variable.
- Heart rates were not sensitive to short-term detraining (Neufer, 1989) despite heart rates still being a popular parameter for prescribing and analyzing training responses. If heart rate testing was used to monitor training states, it would not be sensitive to initial declines in performance potential. Thus, it could be said that because heart rate is normal, physical potential should be normal. However, because heart rate is not sensitive to declining trained states, the swimmer's system could be well into decline. Heart rate monitoring could be the cause of erroneous diagnoses of trained states and could contribute to faulty coaching decisions. Howat and Robson (1992) instructed swimmers to train keeping their heart rates within a normal range for aerobic work prescription. Only one in three age-group and senior swimmers responded with aerobic improvements, the remainder demonstrating no change, anaerobic responses, or aerobic regression. Rowbottom *et al.* (2001) found that one or more biological variables in individual swimmers were related to negative progress in training, but there was no consistency across the elite swimmers who served as study subjects. Thus, only individual profiles have the potential to be useful. Since much work is needed to record predictor and unrelated variables for all swimmers, one has to ask is the cost worth it? A reasonable answer would be *"No"*

because even at their best the variable profiles would contain significant error or unrelated variance in their prediction/analytical accuracies. Johnson *et al.* (2009) found that heart rate was not a predictor of lactate, ventilatory, or respiratory compensation thresholds.

- Physiological measures may not be sensitive enough to account for performance variations when athletes are in a trained state (Montpeitit *et al.*, 1981). VO_{2max} was used as an indicator variable for training responses. Fluctuations in performance were independent of measures of VO_{2max}. At best, VO_{2max} might be used to indicate whether or not it has changed in concert with performance variations. Once it has achieved its ceiling level, it cannot account for any further contribution to performance improvements. It might be useful for indicating early changes in the training status of a swimmer who is returning from a detrained state or an extended period of inactivity due to injury. However, would not training performances indicate changes more accurately than a dubious partial-measure of the training status of an individual? Pedersen *et al.* (2010) studied the relationship of VO_{2max} and 200-m freestyle performances in elite swimmers. Higher velocities of swimming and reduced training, despite more than a doubling of supra-maximal interval bouts, had a detrimental effect on VO_{2max} but not on swimming economy or performance over 200-m. Since VO_{2max} was altered but 200-m performance was not, it is very likely that VO_{2max} is a poor predictor of 200-m freestyle performance. To the contrary, Fernandes *et al.* (2010) reported that VO_{2peak} was a good predictor of 200-m crawl swimming performance.
- The role of lactic acid/lactate in swimming confuses many coaches. Thanopooulos, Rozi, and Platanou (2010) found that lactate accumulation is not related to 100-m freestyle swimming performance in national level swimmers. However, mean strength in extended tethered swims (over a time equivalent to that of a 100-m freestyle performance) was related. The relationship accounted for <40% of the common variance between the dependent variables making it a very dangerous practice to base training prescriptions or performance expectations on that single variable.
- A frequent logical error in interpretation of study results occurs. It involves measuring some variables and relating them to one or more other variables while using swimmers as subjects. Matsunami *et al.* (1999) found that a 10-minute swimming test for distance was the best test of relationship with the onset of blood lactate accumulation (OBLA) velocity. OBLA has not been shown to be an important variable for analyzing or predicting trained states (racing-capacity). Matsunami *et al.* (2000) compared 10- and 30-minute swimming tests and found that significantly different physiological responses were obtained for each test. An interval set (10 x 200 m) conducted at the T_{10} velocity also yielded heart rates and blood lactates that were significantly higher than those for the same set performed at T_{30} velocity. What value either test has for race-specific conditioning remains to be demonstrated.
- Popular interest has involved the measurement of anaerobic threshold. Exactly what is important for such a measure has not been adequately explained or related to swimming performances in any meaningful way. The methodological difficulty with considering the anaerobic threshold is that various protocols and criteria all yield different results (Almeidal *et al.*, 1999). Further, Pinna *et al.* (2013) demonstrated that the testing for anaerobic threshold in swimmers should only be undertaken with in-water test protocols.

Other thresholds, such as the lactate, ventilatory, and respiratory compensation thresholds were found to represent different training intensities and are not broadly interchangeable or physiologically related (Johnson *et al.*, 2009). How maximum lactate steady-state is determined governs the associated velocity of swimming (Oliveira *et al.*, 2010). Swimming technique changes over time when swimming at and above maximum lactate steady-state in both continuous and intermittent tasks despite a steady state in blood lactate concentrations. However, those changes seem to be more pronounced in continuous swimming. Changes in stroke technique can be dissociated from changes in blood lactate concentrations in intermittent swimming. Consequently, the measurement of lactate steady-state in swimmers is dependent upon the testing protocol followed. Pyne, Lee, and Swanwick (2001) showed that lactate profiles are not related to competitive swimming performances after a taper.

- Another set of variables considered for predicting performances are those measured with blood tests. Hormone and metabolic indicators do not discriminate between those who could, or could not, tolerate increased training loads (Kirwan *et al.,* 1988). After assessing two consecutive years of training responses and performance in male members of the Italian National Team, Bonifazi, Sardella, and Lupo (2000) found the relationships of swimming training to eventual important-competition measures of post-competition blood lactate and pre-competition plasma cortisol concentrations were significant in one year of serious training and competitions but were not replicated in the other year of observations on different subjects. Blood factors therefore, are inconsistent and are likely to involve factors other than training.
- Gender is only occasionally considered to be an important variable when testing and in particular, researching swimmers. Simmons, Tanner, and Stager (2000) showed that the determinants of sprint-swimming performances were gender specific. In a study of historical importance, in 1976 the Canadian Olympic Swimming Team was tested extensively, particularly on sport-specific psychological tools. At that time, the team was gender-unified. However, the profiles and discriminating factors of the psychological tests indicated extensive differences to the point where it was recommended that in the future Canadian Swimming Teams should be separated based on gender (Jamieson, Rushall, & Talbot, 1977). That recommendation was adopted by Swimming Canada.

What is interesting about swimmer testing is that measures (particularly physiological tests) taken during training are moderately sensitive to changes in training status but are not related to final post-taper performances (Anderson *et al.*, 2003; Pyne, Lee, & Swanwick, 2001). The validity and efficacy of testing during a taper for a big meet is a serious challenge for researchers. Testing opportunities would be limited, restricted, and not necessarily useful. What could one do if a test result showed a deficiency of some sort? It would be too late to attempt to fix the problem with training stimuli because recovery from general fatigue is the real purpose of a taper. It is just impractical to consider doing something during a taper to alter a test result, particularly if the test is only partially related to competitive performances. USRPT should not require a taper, that is, recovery from excessive fatigue. Rather, USRPT requires swimmers to peak their training performances as they hone their pace, technique, and race-skills in preparation for an upcoming meet. Unfortunately, at this time there has been little interest in assessing the physiological states of USRPT swimmers during training and peaking. Since USRPT work is related to competitive performances, one could hypothesize that measures taken during the work-stage of USRPT would be related to final big-meet performances.

Some factors have been shown to be related to competition/maximum performances.

- The most important feature of swimming performance is the application of forces that directly produce propulsion, that is, a swimmer's propelling efficiency (D'Acquisto & Berry, 2003). USRPT is particularly involved with propelling efficiency since improvement in swimming techniques is the cornerstone of a USRPT program.
- The strongest associated factors in 100-m swimming performance were performance in other swimming events, and surprisingly, 400-m freestyle was the second strongest factor (Aspenes & Kjendlie, 2010). Other studies have shown that performance to a high degree relies on favorable anthropometric features, but in the small sample used in this investigation (N = 11) this was only valid for males. In contrast to established beliefs, there was no association between stroke length or stroke rate and performance in either gender. [Land strength was not associated with 100-m performance supporting further the scientific principle of the *Specificity of Training*. The common and often scheduled practice of participating in gym work motivated by the belief that it is beneficial for swimming is ill-informed and a futile activity.] Guglielmo and Denadai (1999) investigated the relationships between arm and pool tests in male swimmers. The estimate of anaerobic threshold derived from performing a set of three increasing intensity submaximal 400-m swims was the best predictor of 400-m swimming time. However, the time taken to conduct that series of swims is much greater than that required by the criterion swim. Thus, the best test for evaluating 400-m performance is simply to swim the distance as fast as possible as a time-trial.
- Hawley and Williams (1991) opined that the *Wingate Anaerobic Arm Test* could be used as part of a battery of tests for evaluating effective capacities in swimmers. It may not be as good a measure of specific-training effects.
- Hooper, McKinnon, and Howard (1999) found several variables to be related to tapering responses. Changes in plasma norepinephrine concentration, heart rate after maximal effort swimming, and confusion as measured by the *Profile of Mood States* predicted the change in swimming time with tapering ($R_2 = 0.98$); the change in plasma norepinephrine concentration by itself predicted the change in swimming time with tapering ($R_2 = 0.82$). The results of this study are unusual in that several other investigations have shown no relationships between tapered performances and several measures taken during training.

Perhaps the most common testing activity is tethered swimming. Few studies have shown tethered swimming information to be valuable.

- Rodacki *et al.* (2013) determined how propulsive forces and stroke rates changed during a simulated tethered-swim and 200-m free-swimming at the beginning, middle, and end of the tests. Peak force on the tethered-swimming task was the best predictor of free-swimming performance. The fatigue experienced in tethered-swimming did not mirror that which occurs in a 200-m time-trial. Consequently, tethered-swimming peak-force is an incomplete predictor of 200-m swimming performance. In young age-group swimmers of both genders, tethered-swimming performance was associated with 50-m performance (Douda *et al.*, 2010). Of all the anthropometric, body composition, and strength factors, tethered-swimming force explained the greatest amount of variance in 50-m swimming performances. The amount diminished from pre-pubertal to pubertal swimmers. The lack of association between the structural factors of swimmers with their 50-m performances, and the diminishing relationship with age attributable to tethered-swimming strength indicates that other factors influence sprint performance in young swimmers with increasing age.

- Tethered swimming tests are relevant for male swimmers but not females (Hohmann, Fehr, & Fankel, 2010). Crawl sprint competition times and a low variation of the propulsive forces exerted in a fully-tethered 6-second all-out sprint test confirmed the validity of the test procedure in elite male swimmers. On the other hand, tethered swimming did not predict sprint performances in females. Female 50-m sprinting and longer swimming performances were almost exclusively related to technique, not strength and thus, females relate to factors not measured by a maximum effort short-duration tethered-swimming test.

The above sample of studies illustrates the paucity of swimming-appropriate tests for measuring swimmer responses to training and for measuring swimming aptitudes that would direct a coach to recommend particular types of events for which a swimmer would be best suited. Similarly, to make decisions about the content of training based on test results would be a hazardous procedure. There just are no tests that can guide a coach to prescribe the training needs of any swimmer. Swimming performances, preferably in competitions appear to be the best guides for training prescriptions. However, USRPT training responses give some indications of events for which a swimmer is best suited. When a swimmer is able to perform more work at race-pace before failing in one or a few training sets when compared to others, is an indication that perhaps the swimmer is better suited for the events represented by those sets. That would appear to be a reasonable research project for some enterprising faculty member or student interested in swimming. Once the fitness potential of a swimmer is attained, the major avenue for further performance progress is through the development/refinement of swimming techniques that improve propelling efficiency/proficiency.

Training Preferences

In order to maximize the productivity of training, a coach should try to cater to each swimmer's likes and dislikes. Traditional training forces swimmers to participate in a variety of boring, irrelevant, and *"garbage yards"* experiences. Repeating long distances (200+ m) when a swimmer's capabilities are better suited to 50- and 100-m events, is one way of exhausting individuals with limited aerobic capacities, with little interest in distance work, and suppressing sprint capabilities (Costill, 1998). It is a good way to provide reasons for a swimmer to quit the sport. USRPT provides a training format that delivers information about performance improvement and it accommodates individual swimmers' work capacities because they cease working when their performance deteriorates to a stated level. USRPT is preferred to traditional swimming training formats by age-group swimmers (McWhirter, 2011). The major factors associated with constructive programs and the atmosphere of training that encourages the best training responses require some understanding of swimmers' training preferences.

Nutritional Preferences

The important role that nutrition plays in optimizing training was stressed in the earlier *Bulletin 60d* that covered the *Recovery Principle*. While it is relatively easy to maintain a balanced diet in the Western world, it is important for coaches to understand that small deficiencies can become major obstacles to improvement in a hard-training swimmer. For example, vegetarians need to take special care to ensure that they get enough protein, minerals, and vitamins in their diet. This can become a particular problem for the Vitamin B complex and iron and may require multi-vitamin and mineral supplementation (Abdallah, Lima, & Pinto, 2004; Holmes *et al.*, 2009). Coaches should be particularly aware of the potential for poor nutrition in young swimmers who are living away from home for the first time. Some form of regular dietary counseling is advisable to keep track of and correct any dietary inadequacies. Poor dietary habits can cause differential energy responses and fluctuations in body composition. Those variations will affect individual needs for specific training programs.

Environmental Tolerance

There are wide individual variations in response to physical features of the environment. Tolerance to heat and cold is partly related to body physique and composition. Body heat is more easily retained if there is an ample amount of insulative body fat and the ratio between body surface area (for heat removal) and body mass (for heat production) is low. Hence, fatter individuals with heavier builds are more tolerant of cold water than those with slighter builds[1]. The reverse is true for hot conditions. Training responses and needs will vary depending on climatic fluctuations. A coach should be aware of these differences when exposing athletes to training in 12-month outdoor pools.

It is also known that altitude and polluted environments affect some swimmers to a greater extent than others. Symptoms of mountain sickness, such as headache and insomnia, can be debilitating for some individuals at quite moderate altitudes whereas others can tolerate more severe hypoxic stress without encountering problems.

Some swimmers are allergic to chlorine. Their reactions are such that unknowing physicians diagnose the respiratory responses as exercised-induced asthma but in reality, the common cause of severe bronchoconstriction is the toxicity of airborne chloramines, the nasty product of pool chlorination (Rushall & Weisenthal, 2003)[2]. Although still the most common method for sanitizing competitive swimming pool water, chlorination is far from the best (Bradford & Dempsey, 2005).

In a similar manner, some athletes experience respiratory distress in only mildly polluted air while others are unaffected. The negative psychological effects associated with the mere smell of ozone, one of the major constituents of pollution in smog-drenched cities, and the irritation it causes the eyes, nose, and throat, can make training difficult for some. A coach must be able to adapt training loads according to the perceived tolerances of individuals for varying environmental conditions.

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[1] This is particularly important for marathon swimming (e.g., crossing the English Channel) and open-water swimming in cold water.

[2] Also see http://coachsci.sdsu.edu/swim/chlorine/chlorine.htm.

Physical Characteristics

Every swimmer has a capacity to use oxygen while exercising and for short-durations perform a portion of exercise in the absence of a totally adequate supply of oxygen. There is extensive variation in those endowed characteristics. Their individually unique combinations warrant different training programs if the natural physical endowment of every swimmer is to be realized. As well, the physical features of some individuals (e.g., long arms, exceptional height, body shape, hand size, etc.) provide them with better tools for developing advantageous leverage, streamline, and the duration of propelling-force application than for lesser-endowed swimmers (Grimston & Hay, 1986).

The greatest physical characteristic that contributes to different physical performances is the gender of the swimmer. Boys and girls respond to the same swimming training program in different ways (Rocha *et al.*, 1997). Even at the highest levels of swimming performance, females are sufficiently different to warrant different training programs to those offered to males (Stevens *et al.*, 2013). Females are different to such an extent that a body of knowledge about the female response to exercise has developed. Before relating research or writings about coaching swimmers, it is first necessary to consider the gender of subjects in the research or discussion. Unfortunately, there is a much greater extent of male research than female research. There are features that do not differentiate the genders and so some mixed-gender research and discussions are valid. However, there are also features that are gender-specific or discriminatory and they need to be applied wisely to swimmers when coaching a mixed-gender group.[3]

Senior swimmers are mostly mature, that is their bodily growth has reached a level where no further structural changes will occur due to growth hormones and genes. A growing swimmer is not a miniature adult. Consequently, programs designed for adults are not necessarily appropriate for swimmers still in the maturation process. During the maturation process, the changing athlete passes through developmental stages that affect the potential to perform and learn exercises better than adults and in other cases worse than adults. Male children and adolescents pass through accelerated skill-learning phases which enable them to learn skills more easily and readily than at other times. However, female children only pass through the childhood skill-learning phase. When a swimmer is in a skill-learning growth phase, that is the time to emphasize swimming skills and technique instruction more than any other aspect of the sport.

Life-style Variations

Within a training squad there are often athletes from all walks of life. Some might be school students, home-schooled students, manual laborers, or office workers, while others may work different shifts. Since the demands of outside-of-swimming life for swimmer resources often compete with those of swimming, the coach should be aware of such commitments when planning training loads. Commitments to the sport may change from time to time. For students, examination-time is one time when swimming should be de-emphasized in order to avoid excessive stress. Most non-students incur times when work or occupation stresses are heightened. Life stresses are cumulative and so training loads should be adjusted to compensate for any variations in life-style that will affect the degree of stress imposed upon the serious swimmer.

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[3] The *Coaching Science Abstracts* (http://coachsci.sdsu.edu/index.htm), authored and produced by this writer, includes specific issues devoted to research using female subjects in exercise pursuits. It also contains specific issues devoted to research on children and adolescents.

The *Daily Analyses of Life Demands for Athletes (DALDA)*[4] is a tool that allows swimmers to self-monitor reactions to life stresses and for coaches to alter training loads accordingly.

Social Interactions within the Group

Training squads usually contain an assortment of individuals with different interests, tastes, and personalities. Because of the stress of demanding training and serious competitions, those differences could produce interpersonal frictions that have a negative effect on performance. It is the responsibility of a coach to monitor the development of such problems and to affect a program alteration that will alleviate their occurrence.

Nine factors that have strong face validity for existing in competitive swimmers within a training squad/group have been discussed above. Those factors are worthy of consideration when formulating training programs for a group of competitive swimmers (i.e., a training squad or group). What is the importance of one factor if taken alone and used for making program decisions? There likely would be a spread of factor scores across the factor-dimension within a squad. However, there might be a few who are very similar to the extent that they could be deemed to have the same factor presence in their make-up. What is the importance of two factors taken together for influencing program decisions? On both factors, there would be a spread of presence across the training group members. The likelihood of a few or even two squad members being similar is much less than for one factor. It would be hard to justify a training program that would accommodate the very few who might be similar. If one considered three factors, the likelihood of two swimmers being similar is very remote. Contemplating the nine factors, it is most likely that every squad member would be unique in the matrix of the nine variables all of which influence training responses and competitive performances. The consideration of one variable does not produce an effective program. Howat and Robson (1992) instructed swimmers to train keeping their heart rates within a normal range for aerobic work prescription. The swimmers' responses within the squad were anything but what was intended. The aerobic stimulus produced the desired effect in one third of the swimmers, an under-training effect in another third, and an over-training effect in the other third. Using a popular *"scientific"* concept only accommodated one in three swimmers within the age-group and senior squads used as subjects. A coach following the heart rate prescriptions for various types of training that were popular, and still are in some domains, will not change two out of three swimmers in the desired direction that has been formulated. Some of the weaknesses with using heart rates for making training decisions have been recounted above. If considering only one factor in program prescription successfully stimulates a training response in one third of swimmers, considering any more factors would likely accommodate no swimmers satisfactorily. The responses of swimmers to a multivariate program would likely be lacking in benefit to any swimmer. Having all swimmers train on one program is a sure-fire way of having little effect on competitive performances.

If a single program is likely unsuitable for any swimmer in a squad, how can continued improvements be reconciled with that hypothesis? In age-group swimmers, each year as they mature performances improve. The reason for the improvements is growth (Toussaint *et al.*, 1990). As swimmers mature and improve in various important physical capacities the benefit of growth as an influence on performance exceeds the non- or detrimental effects of a singular

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[4] See http://brentrushall.com/#psytests.

training program. Hence, despite the coaching received, maturing swimmers continue to perform personal-best swims on an annual basis. The sad fact behind that phenomenon is that had the swimming training been even slightly helpful the magnitudes of performance improvements would have been much greater. In the early 1990s when the International Center for Aquatic Research functioned out of the Olympic Training Center in Colorado Springs, the scientist with expertise in growth and development postulated that growth alone should produce performance improvements of ~4% per year when growth was fully engaged. Most swimmers' annual PB's are less than that supporting that contention that traditional single-training prescription programs actually hold-back swimmers' performance developments. To further justify such an assertion about single-program training prescriptions, if one looks at the performances of some major USA performers at the London Olympic Games in 2012 and compared them to what was performed at the 2016 Olympic Trials and Rio Olympic Games, it should be noted that at least three of the London Gold Medalists (Ryan Lochte, Michael Phelps, Allison Schmitt) all failed to improve on or meet their 2012 performances. Their regressions occurred despite an additional four years of coaching, training, and financial support. The proposed solution to the questionable practice of providing one training program to *"fit all swimmers"* is to at least increase the individuality of training experiences.

This *Bulletin* has listed a number of factors that produce individual variations in training requirements. There are other factors that further develop the individuality of swimmers: heredity, age, gender, the physical environment – heat/cold and humidity (climate), swimming attire, fluid retention and replacement, altitude, jet-lag, travel fatigue, life-style shifts, nutrition, psychological factors and personal make-up, preparedness to compete, self-efficacy for racing. etc. Even more factors could be added (e.g., blood characteristics). The above factors are cursorily discussed in Rushall and Pyke (1991).

The individual needs of each swimmer have to be met to maximize training responses. Each denial of an individual factor will lessen the training experience for the majority of swimmers. Recognition and the accommodation of the *Individuality Principle* will require radical departures from the common handling procedure of having all swimmers in a squad follow the same program. It has been traditional to treat the training of all athletes as if they were clones. Such a singular approach to control is easy and the least time-consuming for a coach. However, because it is easy does not mean that it is the best approach. USRPT provides an ideal way of accommodating individual needs.

USRPT facilitates the programming of lanes to accommodate different strokes and different race distances. Although not every competitive swimming event can be accommodated at the same time of a properly constructed UPSRT training stimulus, across a microcycle (normally one week) of training sessions most competitive interests of individual swimmers can be met on numerous occasions. The real strength of USRPT for programming to accommodate individual swimmer needs is the way a set in completed. The number of repetitions to be completed is not prescribed. Rather, swimmers perform as many repetitions as possible to the point of incurring *neural fatigue*. Within the set, swimmers cease to continue when they reach a coach-defined set of performance failures. [A failure occurs when a swimmer is unable to achieve the target repetition-time based on competitive performances, that is, *race-pace*.] Swimmers do not always perform their best set-maximum. Day-to-day stresses and influences cause swimmers' abilities to maintain maximum efforts within a repeated training stimulus to vary. Thus, USRPT accommodates a swimmer's event interests, inherited physical capacity limits, and day-to-day fluctuations in accumulated life-stresses. The *Individuality Principle* is largely satisfied. That is a distinct improvement over traditional training which usually provides *one program fits all* experiences and individual interests, needs, and capacities are not respected. It is highly unlikely that traditional programs provide any stimulus for performance improvement. On the other hand, USRPT does stimulate improvements by allowing individual work capacities to be accommodated and swimmer interests satisfied.

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