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USRPT AND TRAINING THEORY I:
THE TRAINING EFFECT RESPONSE TO PRACTICE ITEMS

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The structure of a training session for a swimmer can vary greatly depending upon a number of factors. Table 1.1 lists the terminologies used to describe what is included in a USRPT session. The basic unit is a *training unit*, one execution of a defined task, for example, one 50-m swim, a 25-m maximum sprint without breathing (Sprint-USRPT)[1], or an attempt to execute a very fast turn. Repetitions allow a swimmer's ability to perform to the state of being *"overloaded"*. That overloading, if done correctly, stimulates a training response. A series of repetitions of an event-specific training unit is called an *event-specific training segment*. Examples of USRPT training segments are repetitions to failure of 50 m of freestyle swimming at 200-m race-pace with 20+ seconds of rest while concentrating on quick breathing, repetitions to failure of 100 m of freestyle swimming at 1,500-m race-pace with 20- seconds of rest while concentrating on even pacing, and repetitions to failure of 25-m maximum freestyle sprints, one every four minutes, while focusing on maintaining a full stroke length (Sprint-USRPT). A USRPT training session usually entails some variety in the type of tasks that are performed: that is, a number of event-specific training segments are programmed. Those tasks constitute the *training program* for a particular practice session.

The amount of overload for an event-specific training segment is called a *training stimulus*. The common level of overload for USRPT programs is working to a state of neural fatigue (Rushall, 2016a). The total training stimuli producing the overloads in the training segments constitute a general load demand of the training session, termed the *session load* and, in some cases, the *training load*. Since each swimmer has a different capacity to tolerate a session load, the impact of the same program of training on individuals will vary. This reaction capacity is called the *strain* of the load on the swimmer. The result of the modification of the session load by an individual's strain is the *training stress*. Individuals will respond differently to the same training stimuli (Howat & Robson, 1992) which produce particularly individual reactions to the training load.

Although swimmers respond differently when they are subjected to the same training stimulus, the form of the response is similar. This is basic to understanding the nature of training adaptation. The response comprises several stages, each being modified by a number of factors. Much of the remainder of the *Bulletins* concerning USRPT and training theory considers those

[1] Rushall, B. S. (2016). Sprint-USRPT: Training for 50-m Races. *Swimming Science Bulletin, 56*, pp. 103. [http://coachsci.sdsu.edu/swim/bullets/56USRPT50m.pdf]

modifiers, so that coaches and swimmers can develop better training programs. If the form of the response and its modifiers are understood, then training prescriptions can be devised that will more closely approximate the best possible actions to produce performance improvements in all swimmers. USRPT is an attempt to produce the best training format and content to enhance individuals' swimming times.

TABLE 1.1. LABELS, EXAMPLES, AND OUTCOMES OF TRAINING RESPONSE FEATURES

Label	Examples	Features
1. Training unit	50 m	Single performance trials, the most basic unit of training
2. Training segment (event-specific)	Total of like training units: 50 m at 200-m race-pace with 20+ Seconds rest. Accel-ated long stroke.	A segment produces an overload, the training stimulus. Fatigue and recovery needs are developed for the particular activity.
3. Training session	Total of training segments.	All training activities for the practice session.
4. Training load or session load	Three USRPT sets	Fatigue effects of each segment accrue but are diminished by what recovery can occur in the session. The general load demand of a training session.
5. Training strain	How hard the swimmer is prepared to work	Strain is how the athlete copes with and perceives the training load. It is an individual capacity to handle loads often modified by factors such as age, state of training, etc.
6. Training stress	Load x Strain	A general state of fatigue and need for recovery in the individual.

The Form of the Basic USRPT Response

Figure 1.1 illustrates the form of the basic reaction of a swimmer to a heavy training stimulus. It produces an overload with regard to the athlete's capacity to perform a particular training segment. Each stage of the response is described below.[2]

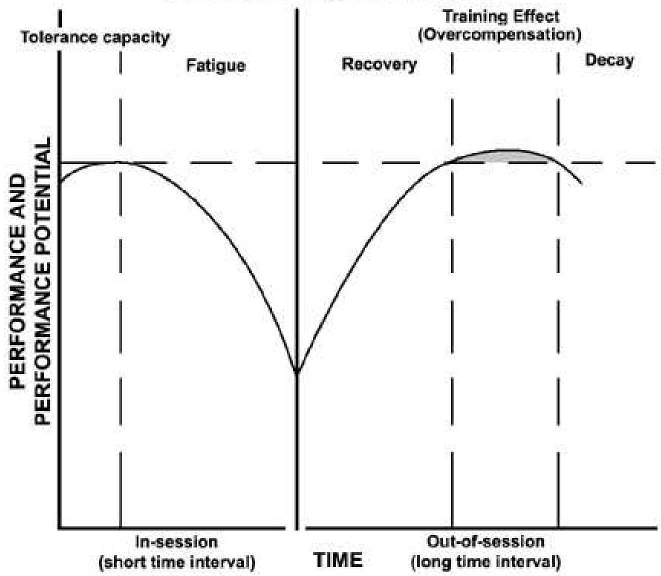
Tolerance Capacity

When an event-specific training segment is attempted, generally the initial response is one of adequate performance. An athlete can normally tolerate the demand of a training stimulus that is placed on the body's resources for some time. The duration of that time is governed by each swimmer's physiological capacities. At the start of the segment, there is usually some warm-up and/or adaptation effect and performance quality improves over the standard of the initial attempt. After that occurs, the athlete tolerates the training stimulus with criterion or better performances. The major factors that govern the duration of a swimmer's response adequacy are

[2] The time axis in the figure is not of consistent duration, the out-of-session section being contracted purely to be accommodated more effectively in the figure.

physiological capacities, the state of training, and the degree of general/non-specific fatigue. In time, an athlete's resources are taxed beyond their capacities, and after several repetitions of enhanced effort, performance deteriorates. The onset of that deterioration marks the transition into the next stage of the overall reaction, *fatigue*.

Figure 1.1. A stylized depiction of the response to a training stimulus showing five stages of the reaction.



Fatigue

When swimmer no longer can adequately perform the tasks of a training segment, the performance deteriorates due to the onset of fatigue. The amount of fatigue that accrues is dependent upon the severity of the training stimulus. Continued attempts at completing the tasks of a training segment while fatigue is being experienced produce further performance deterioration. How fatigued an athlete is or how long this stimulus needs to be tolerated depends upon the aims of training, and is discussed in the ensuing *Bulletin* covering *Overload.* How much fatigue is experienced is a feature that differentiates USRPT from traditional training. USRPT requires swimmers to experience the first stage of fatigue, that is, the neural fatigue state where a particular performance standard cannot be sustained due mainly to technique deterioration. Traditional training often pushes swimmers beyond a specific-performance level or general-performance stimulus to the point where energy resources and performance standard are diminished. The response to coping with heavy stressful fatigue is general, and often to the point of lactic acidosis. Once the event-specific training segment is finished, the next stage of the training response, *recovery*, occurs.

Neural fatigue is the state where the stimulation of correct neuromuscular movement patterns is difficult. In swimming, technique features such as shorter strokes, more floppy arm work, body movements occur in a normally stable body position, etc. indicate that the neural drive for correct swimming work is failing. With intense conscious effort, good technique might be restored for a few strokes but then fail again. Intense cognitive control of technique is required but often results in a slowing of progression. Even after some very concerted efforts to restore desirable movement patterns, the ability to hold swimming form gets less and less. In USRPT sets, before extreme neural fatigue begins to crossover into the next fatigue stage the criteria to terminate participation in the set would have been reached. Therefore, the criteria for failure are USRPT's safeguard against destructive fatigue.

Recovery

After a training stimulus ceases, the body attempts to recover by replenishing any energy resources that have been depleted, repairing any physical damage that has occurred during the segment, and coding in the brain the performance quality factors and energy provisions. The length of time that is spent in the recovery stage is peculiar to every swimmer but is generally related to the amount of fatigue (training stress) that has occurred. As a rule-of-thumb, the greater the intensity of the training stimulus, the longer will be the recovery. Recovery involves the re-establishment of the ability of all systems to function fully. It is one of two parts of the response to a training stimulus and returns to the original level of performance capability.

Training Effect

The second part of the reaction to a training stimulus is through the reorganization of the structural and functional systems of the body. This is responsible for learning or adapting to the stimulus. If the body was subjected to the same training stimulus again, after sufficient recovery and adaptation has occurred, its performance would be different: it would be improved. A common term used to describe this adaptation effect is *"overcompensation"*. The improvement that results from recovery and overcompensation is called the *training effect*. It is the purpose of training to produce as many training effects as possible. Effective training allows time for recovery and overcompensation to occur. If sufficient time for the training effect to occur is not allowed, the subsequent repeated training segments will not produce training effects and performance potential will not improve but actually will get worse. Thus, it is during the recovery and training effect stages of a training stimulus that performance improves, not during the work itself. That means recovery is more important than work for determining a swimmer's performance potential. Once a training effect has been achieved, its longevity is limited. If no further training stimuli are experienced, the training response enters its final stage, *decay*.

Decay

Due to the temporary nature of a training effect, its lack of use or repetition will result in a diminution of performance potential. There will be a reversion back to the pre-stimulus state, that is, the performance level that is normally possible for the individual before experiencing the training stimulus. The length of the decay phase of a training effect is governed by the complexity of the movements practiced, the severity of fatigue experienced from the training stimulus, and the peculiar exercise capacities of the swimmer.

The specific features of each of these stages of the training response are detailed in later *Bulletins*. The curve of the response depicted in Figure 1.1 is hypothetical. Real performances do not produce smooth curves of tolerance and fatigue, while the stages of recovery, training effect, and decay indicate only the potential for performance, not real performance. The body's attempt to tolerate the demands of a training stimulus is quite complex, since various resources are mobilized to produce adequate responses and those resources vary considerably between swimmers. The nature of those, and when and how they are used, governs the response variability during and after an event-specific training segment.

To this point, the discussion has indicated that repetitions of training stimuli within a component microcycle are of the same activity. In traditional training, some coaches believe there is a strong chance that training programs would become very boring for participants. Variety in training stimuli is often considered a necessary feature to maintain high levels of motivation in swimmers. It is erroneously advocated that if successive presentations of training stimuli within a component microcycle are of different training items, the amount and nature of overload should be constant. For example, a swimmer may view the following training items as being equally stressful: eight 200-m freestyle repeats on 2 minutes 45 seconds, aiming at holding 85 percent of best 200-m time for each repeat; four 400-m freestyle repeats on 6 minutes at 85 percent of best

400-m time for each repeat; and sixteen 100-m freestyle repeats on 1 minute 15 seconds, aiming at holding the split time of 85 percent of best 200-m time for each repeat. A traditional coach could schedule these different training items as being steps for the same fitness component since they are roughly equivalent in performance level and training load (work intensity, duration, and between repeat recovery opportunity). However, the assumption of similarity in training segment overload is false. Research has shown that working at the same intensity across different durations of interval training (e.g., 30 seconds of work and 30 seconds of recovery; one minute of work and one minute of recovery; and four minutes of work and four minutes of recovery – all at a constant work intensity) produce markedly different training responses (Astrand et al., 1960; Astrand & Rodahl, 1977; Christensen, 1962; Christensen, Hedman, & Saltin, 1960). Continuous swims at training (e.g., 20-minute swim for distance, 1,500-m swim for time) usually stimulate responses that bear no relationship to competition demands. Very few traditional training sets stimulate responses that are equivalent/relevant to those which occur in races. Much irrelevant training is commonly termed *"garbage yardage"*.

USRPT requires the repetition of sets within a microcycle. Coaches unaware of the intricacies of USRPT claim repetitions of the same sets across a number of training sessions would lead to boredom and de-motivational effects. However, USRPT sets very much involve psychological factors. Each set requires concentration on mental skills, racing-skills, and surface-swimming technique features. As well, the standard of performance for each set is recorded (e.g., the number of successful repetitions before three or two successive failures). With each repeated set, which might occur two or three days apart, the aim of the next set is to improve the number of successful repetitions before the first failure as well as the total number of successful repetitions before termination failure. A goal exists for every USRPT set. Having that goal improves performance as well as makes training more enjoyable (House, 1973, Locke & Bryan, 1966). An astute USRPT coach will endeavor to arrange a program that will result in the majority of swimmers in the squad recording a *personal best performance* at every practice. The goal-setting, the swimmer's responsibility of conducting the event-specific training segment correctly, and the unified purpose of the whole squad of trying to improve in performance at training produces a training-atmosphere and swimmers' attitudes to training that is rarely, if ever, exhibited in traditional swimming practices. As well, the nature of USRPT sets (short-work periods–short-rests) is deemed to be more enjoyable and less demanding than longer intervals and continuous swims (Kilpatrick *et al.*, 2012; Kilpatrick & Greeley, 2013; Martinez *et al.*, 2013; Martinez *et al.*, 2014). Age-group swimmers prefer USRPT to longer-interval and continuous training (McWhirter, 2011).

Outstanding masters swimmer, Glenn Gruber, commented as follows when contemplating USRPT versus traditional training:

> *My impression is that improvement comes from the idea of getting one more in each time before failure with each repetition of a set. In traditional training, the coach says 10 x 100 on the 1:30, and that is what you do. There seldom are any consequences for completing a traditional training set. But with USRPT I always have the opportunity to do better every day and for that improvement to be visible. Visible in the sense that I accomplished more today than yesterday, or more today at a faster pace than yesterday. And then next week I will try to improve again!* (Personal communication; Glenn Gruber, 9 September, 2016).

Because of the imprecisions that are inherent in the practical realities of training, the *event-specific segment microcycle* becomes the building block of all training programs. A microcycle is constituted of at least three exposures to a training stimulus aimed at developing a specific-racing capacity (e.g., 200-m freestyle, 100-m backstroke), each experience being followed by an opportunity for full recovery so that a training effect can be achieved. The segment microcycle should not be confused with the *session microcycle* which considers the *general accumulated fatigue* of a number of training segments.

It is perhaps best to consider the response to a training segment in light of a few examples that occur in typical training situations.

Exact Programming of Events

Figure 1.2. A stylized presentation of responses to exact training stimuli when sufficient recovery between exposures is provided.

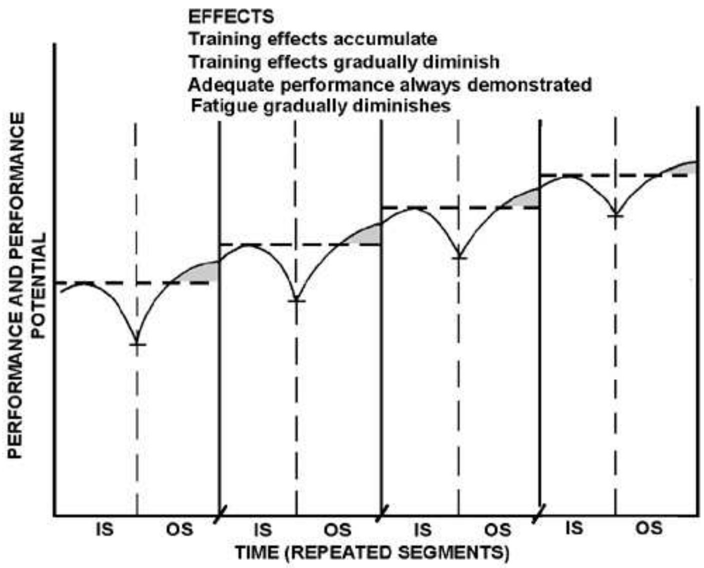


Figure 1.2 illustrates a response schema for repetitions of an exact training stimulus with sufficient recovery and optimal training effect between each exposure. It can be seen that the onset of the second exposure to the training stimulus occurs when the maximum training effect is achieved during the reaction to the first training stimulus. On successive occasions the next exposure to the training stimulus also occurs at the time when the training effect is maximized. Thus, repeated exposures accumulate training effects and the athlete improves in the most efficient manner. Unfortunately, such a perfect program is rarely attainable. However, there are some interesting generalities that can be derived from this exact model. USRPT comes closest to achieving the beneficial accumulation of training effects. The common attempt to provide variety in training stimuli in traditional swimming programs prevents maximized training effects.

Over a period of repeated exposures to the same training stimulus, as training effects accumulate, the reorganizations that result from repeated stimulation by a segment of training are successively refined to produce more efficient forms of a particular performance. Each exposure is perceived to be easier than the previous stimulus because the training effects derived from the previous experience better equip the swimmer to cope with the next training stimulus's demands. Another feature that occurs is that, as repetitions of training stimuli occur, the size of successive training effects diminishes. After a while (the length of time depends upon a swimmer's stress-tolerance capacity), it becomes more difficult to produce noticeable training effects with repeated exposures to the same training stimulus. A swimmer has limited physical resources with which to respond to training stimuli and once those resources are fully used, no further improvement is likely. As a consequence of this finite limitation on adaptation resources for a particular training stimulus, the performance potential of physiological attributes levels off. Fitness levels may be maintained but not improved. Further improvements in performance will only occur if the intensity of the training stimulus is increased. Under this model of exact programming, optimum performance gains are always possible up to a ceiling limit (determined by a swimmer's finite physical capacities).

This ideal model allows one to interpret circumstances that frequently arise during attempts to increase swimming fitness and provides a practice format for race-specific surface-swimming techniques to be developed. Some interpretations are considered below.

Heavy/hard Training Sessions

Figure 1.3 illustrates the responses to traditional repeated exposures of *"heavy"*, *"hard"*, or *"intense"* training sessions and insufficient recovery. This is a typical approach to training where there is an exaggerated emphasis on the belief: *"the more work that is done, the better will be an athlete's performance"*. It is wrapped in the belief that improvements occur during work which is false because it is in recovery that neural and physiological adaptations occur.

When training sessions are programmed with insufficient time to allow full recovery and training effects, the second set of training stimuli occurs before performance potential has even recovered to the pre-stimulus level of the first exposure. When this happens, the performance decrements due to fatigue accumulate. Swimmers become more tired with each successive training sessions if insufficient recovery is not allowed. No training effects, and thus no performance improvements occur. Several features of the excessive training regime that are illustrated in Figure 1.3 should be noted.

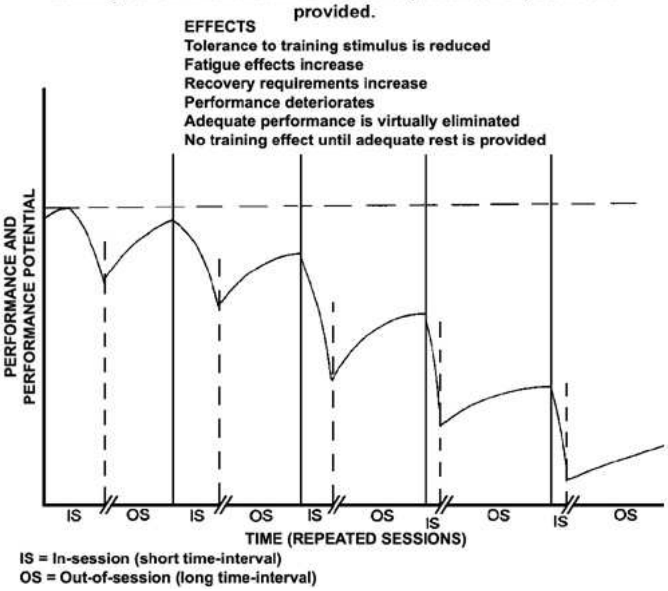


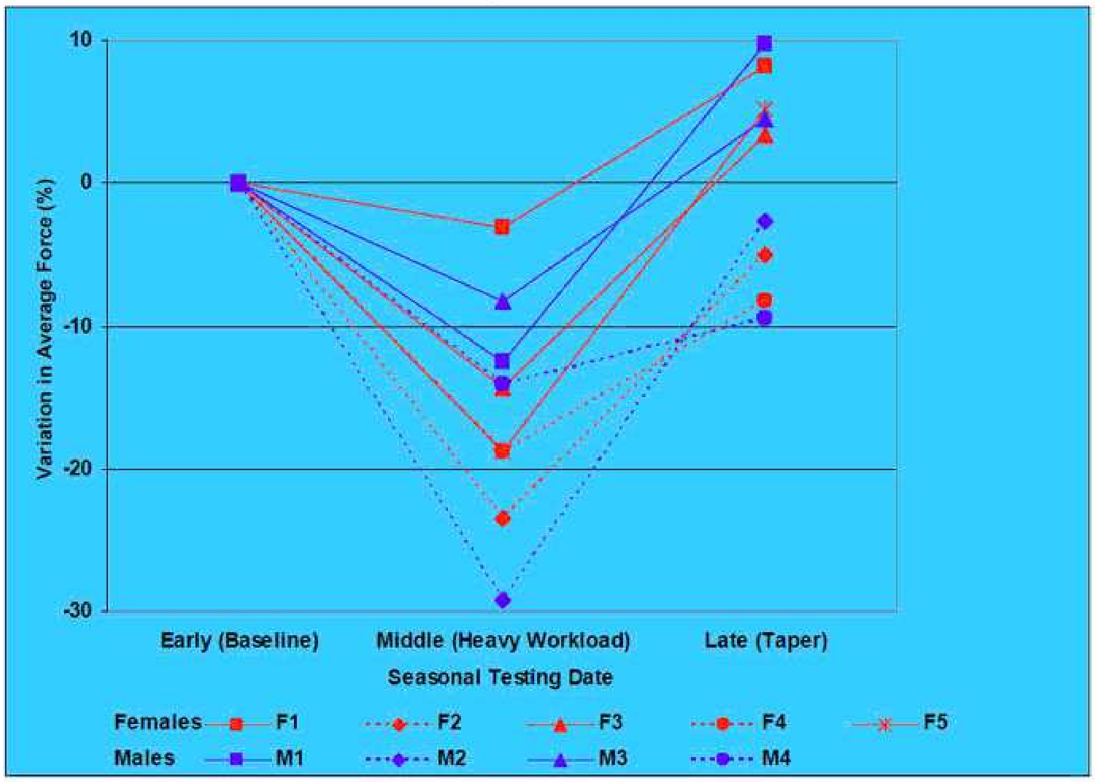
Figure 1.3. A stylized presentation of responses to heavy or excessive training stimuli when insufficient recovery between exposures is provided.

The first session induces normal, untrained, and non-fatigued responses to the training stimuli. With each successive exposure to the practice session, the tolerance capacity for the session is reduced. It is usually not long, even as early as the second exposure, as illustrated here, before no tolerance is exhibited, that is, adequate performances do not occur at the start of the training session. Since the onset of the second training stimuli happens before sufficient recovery has occurred, adequate performance is rare. The fatigue effects become more rapid and larger in magnitude with each successive exposure. The swimmer's performances decline faster and faster, with each practice session and inadequate recovery cycle. As the athlete descends deeper into the accumulated fatigue state, recovery occurs more slowly and takes longer.

Dr. Rod Havriluk (2013) showed that nine months of reputedly *"hard training"* depressed swimming force-production (strength) on the hands to the point that it could only be marginally recovered and improved after a taper at the end of the period. Despite training for three-quarters of a year, almost half the subjects never regained their swimming strength to pre-training levels even with a taper. What a travesty. Figure 1.4 depicts Dr. Havriluk's observations/measurements.

The value of this approach to *"hard"* training should be questioned. It does not allow the body to develop the event-specific reorganization feature of recovery upon which overcompensated training effects are superimposed. It is usually accompanied by other side effects, particularly worsening psychological features and skill, technique, and performance deterioration. This author strongly advises against this training philosophy. The ingredient that is missing from this continual heavy/hard-training model is sufficient opportunity for event-specific recovery and training effects to occur. Without adequate recovery and overcompensation, the development of swimming fitness and technique cannot be realized in an efficient manner.

Figure 1.4.



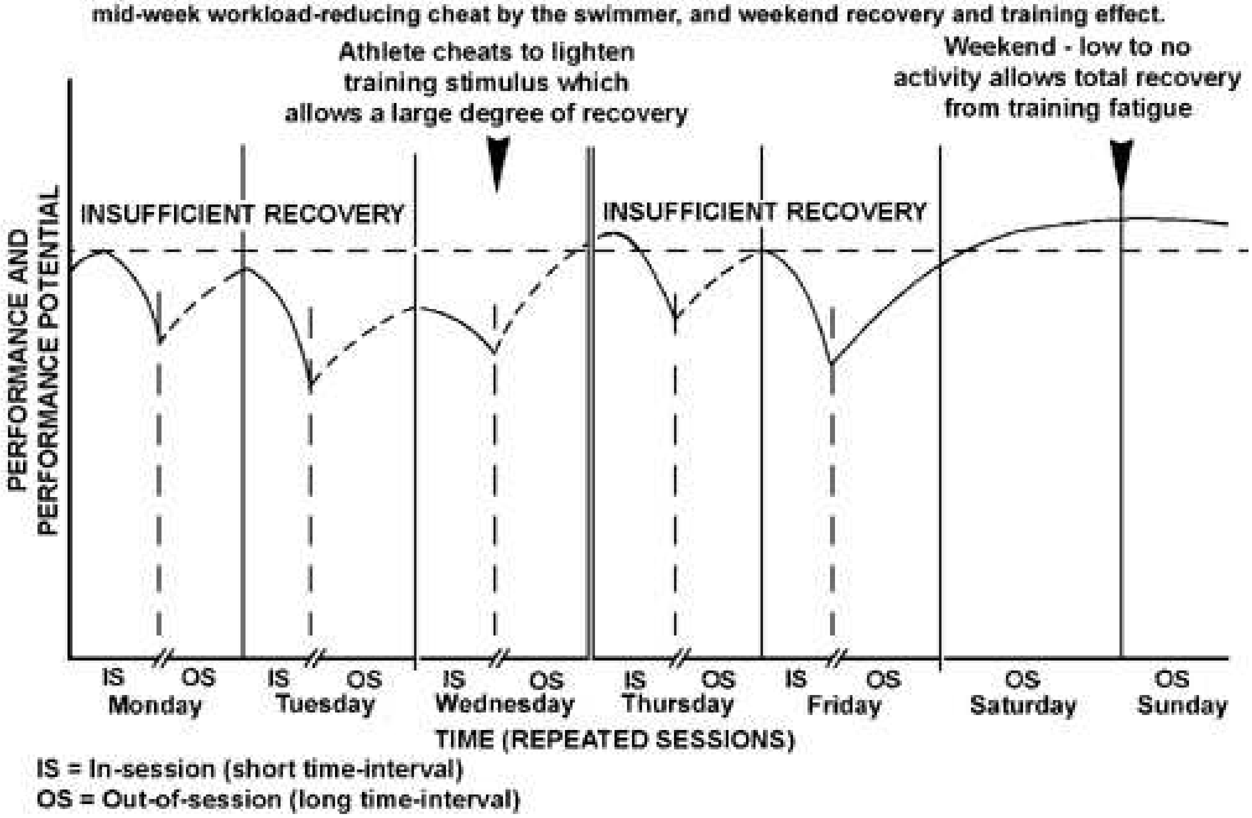
Variation in average hand-force values by seasonal testing date for all swimmers. The solid lines connect data points for swimmers that had taper values greater than baseline. The dotted lines connect data points for swimmers with taper values lower than baseline. [From Havriluk, R. (2013). *Journal of Swimming Research, 21,* 8 pp.]

The above description only applies to traditional heavy training where successive practice sessions contain segment *"variety"*. Without repeated exposure to the same training segment, practice performances are likely to improve only on very rare occasions. The phenomenon described does not occur with USRPT. Each USRPT segment is terminated after neural fatigue is evidenced. Recovery from neural fatigue is very much faster and simpler than general fatigue states of greater severity and so, the probability of high levels of fatigue existing at the start of the next USRPT session is quite low although in some cases a minor amount of general fatigue could carry into the next practice. Despite that, event-specific training effects will have occurred. If USRPT repeated sets are well-spaced specific performances are likely to be affected by low levels of carry-over general fatigue to a very minor degree. In cases where the same USRPT set performances are repeated, a possible factor for the non-improvement could be the minor general fatigue carried-over from the previous training session(s). The USRPT directive to avoid high-levels of fatigue in a training session is supposed to sensitize coaches against persisting with bad swimming (from which nothing good would be gained.

Unprogrammed Training Session Recovery

This discussion pertains to traditional hard-training programs. Many coaches claim that they train their swimmers *"hard"* and that the athletes still improve in performance: that is, training effects occur but are not demonstrated until a taper is incurred. This may well be the case, but because a coach describes what was set as the training stimuli does not mean that swimmers exactly experience them (Stewart & Hopkins, 1997; Young & Starkes, 2006). The assumption that swimmers will follow a coach's program as it is intended in a traditional program is naïve. Apparently, leaving the effort levels of each program item to be determined by swimmers in a meaningful and beneficial way is an erroneous practice. While swimmers complete the correct number of repetitions in sets, the intensity of the swimming rarely reflects a coach's plan. Figure 1.5 illustrates one possible explanation as to why minor performance improvements might occur in a typical heavy-training, weekend-off segment microcycle.

Figure 1.5. Sylized responses to heavy or excessive training stimuli with insufficient recovery, mid-week workload-reducing cheat by the swimmer, and weekend recovery and training effect.



The first two days of training expose the athlete to training stimuli that are of sufficient intensity to cause considerable fatigue. After Tuesday, fatigue accrues because of insufficient opportunity to recover from Monday's work. On the third day (Wednesday), the athlete *"cheats"* on the program, probably as a survival ploy, by not following the programmed training intensity or by inventing excuses that limit training participation. This can be done by not performing with the prescribed intensity, taking more/longer rests than usual, and/or altering the program in some way so that the overload factors in the training stimuli are diminished. Coping behaviors of these types are frequent responses of serious athletes as they attempt to follow the wisdom of their own appraisals of their response to training rather than the excessive demands of a coach-determined program (Rushall & Roaf, 1986). The reduction in the severity of the mid-week training stimulus allows the athlete to recover and, in some cases, even achieve a small general training effect. On the Thursday and Friday of the illustration, it can be seen that the two consecutive exposures of heavy-training stimuli again produce accumulated fatigue. With no training on Saturday and Sunday, usually sufficient time is afforded the athlete to fully recover and incur some training effect for the whole week. The training effect is not event-specific but general whereby bouts of heavy fatigue are handled to some degree of apparent tolerance. Had the mid-week, athlete-determined reduction in stimulus intensity not occurred, then the level of fatigue that would have accumulated after Friday would have been excessive. It is possible that the two days off at the weekend may not have been sufficient for full recovery to occur if that had happened. Thus, the mid-week athlete-determined reduction in stimulus intensity *"saved"* the outcome of the week's work.

Similar cases or variations of the features described in the above example explain why swimmers exhibit training effects and performance improvements despite what coaches attempt to do to them with excessively hard training stimuli. It is contended that the more *"experienced"* (wise) that a swimmer becomes, the more subtle are the athlete's manipulations of the training stimuli which, in turn, avoid the state of excessive accumulation of fatigue.

The freedom of swimmers to moderate the levels of their applications is one reason, among others, why the phenomenon of *"garbage yardage"* has arisen. Often, the intention of a swimmer when completing a program item is to survive the set rather than gain some benefit from it. Stone *et al.* (2012) experimented with cyclists and found that supposed *"all-out"* efforts very frequently were not maximum efforts. If a training set is described as being a maximum-effort set, unless there is an objective measure to indicate the level of effort (as there is in USRPT), response and intensity variability are likely to yield effort levels that sustain an effort-capacity reserve. When swimmers suffer long-term training fatigue, traditional swimming practices provide few, if any, opportunities to improve race-relevant performance elements (Rushall & Pyke, 1991).

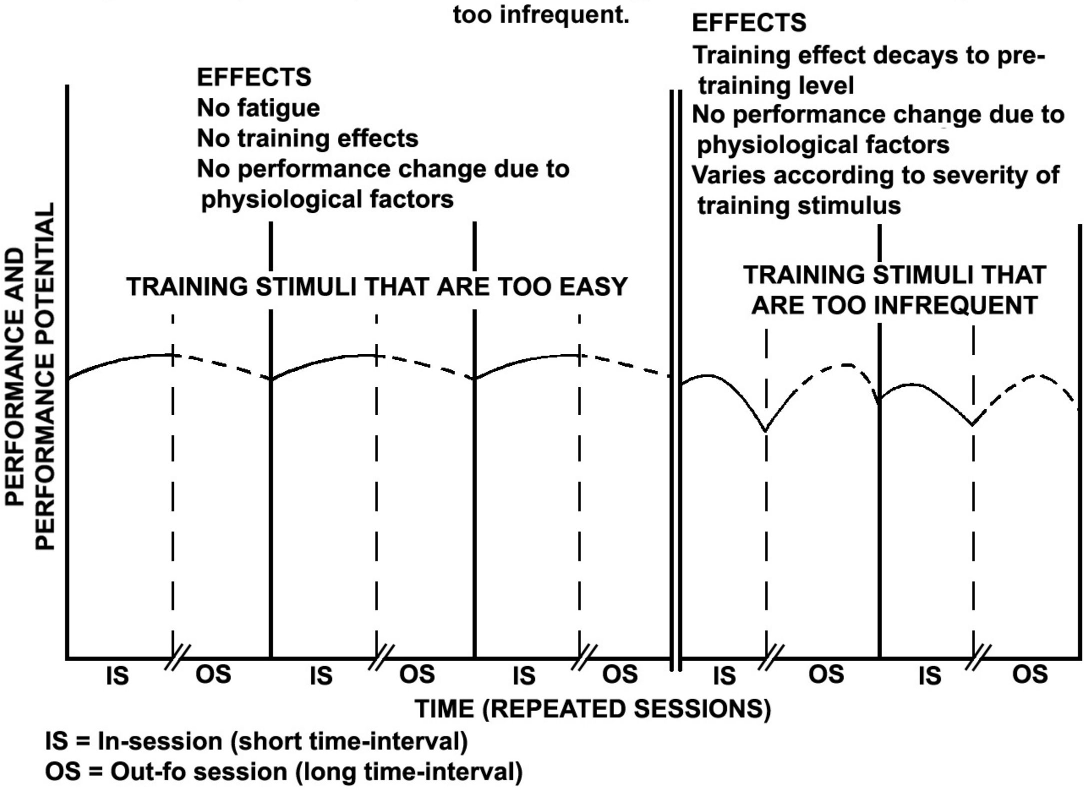
Before a traditional swimming practice starts, swimmers review the session's program and determine how they will distribute their effort intensities across the practice's items. The over-riding strategy is to survive the practice with as little discomfort as possible. The avoidance of working at a beneficial level of quality is an undesirable outcome of traditional programs that focus on work rather than recovery plus training effects.

Training Sessions That Are Too Easy

Figure 1.6 illustrates the responses to training stimuli that are too easy. When no fatigue occurs the body does not have to recover and overcompensate. Consequently, there is no accumulation of general training effects, only a minor amount of decay during the inactivity stages between exposures to the training stimulus. Thus, for each successive day, performances improve in the tolerance stage of the response, and then decline during the inactivity stage. Without sufficient repetitive stimulation, general training effects do not occur.

Somewhat surprisingly, much traditional training and incorrectly administered USRPT programs provide very low to no training stimulation at practice sessions. In traditional terms, when a set is designed all swimmers are expected to complete the set. For a few swimmers, that requirement will be very hard and to survive they downgrade their effort level to *"complete/survive"* the set. That task might be a training stimulus of moderate intensity. For the majority of swimmers in a seriously training squad, the set is completed adequately and so is the next training set, and the next, until the very last or last few repetitions in the session which might be performed with considerable effort. In that commonly observed scenario, the training stimuli are sub-maximal, particularly those that occur early in the practice session. Since three months is about all that is needed to establish aerobic adaptation (Bonifazi *et al.*, 1998; Costill *et al.*, 1991), continual training after that time yields no further physiological benefits but only potential harm (i.e., overtraining, exhaustion, staleness, burn-out). To avoid moving into a detrimental athletic state, swimmers modify training demands so that they complete every session's program without being unduly stressed. In that situation, the severity of the training stimulus is weak and yields no further practical benefit despite continued participation. In year-round programs, very little improvement in performances from physiological factors should be expected.

Figure 1.6. Stylized response curves to training stimuli which are too easy or too infrequent.



In USRPT, every set should be completed to neural fatigue. As has been pointed out elsewhere (Rushall, 2016b), few coaches implement this feature which is required to achieve a significant training effect that will translate into performance improvements. Commonly, pseudo-USRPT coaches use traditional training methods of requiring swimmers to complete a set number of repetitions rather than working to the neural-fatigue level, which could vary from day-to-day depending upon outside-of-the-pool life-stresses. When a prescribed finite number of repetitions is completed, swimmers often are nowhere near beneficial training stimulation (i.e., neural fatigue). Consequently, swimmers training supposedly in USRPT programs but with this programming error are really performing sub-maximal work which has doubtful performance benefits. When USRPT programs are first attempted and finite repetitions are performed, because of the volume of race-pace work being unusual, adaptation does occur and performances improve. But, in time performances plateau because when USRPT work becomes sub-maximal there is no stimulation to improve performances.

The phenomenon of training sessions that are too easy constitutes a major portion of swimming practice sessions. Only when an observable and measurable phenomenon that indicates neural fatigue is used can a coach and swimmer be sure that beneficial training has been experienced. When USRPT is conducted correctly, it constitutes harder training than pseudo-USRPT or traditional training.

Training Sessions That Are Too Infrequent

Figure 1.6 also illustrates what happens when training stimuli are sufficient to cause a general training effect, but the frequency of occurrence is insufficient to maintain the temporary training-effect state. Between exposures to the training sessions, the effect decays back to the pre-exposure level and no performance change occurs.

The two features highlighted above, indicate the need for the session to be of sufficient overload (intensity/severity) to cause some fatigue to occur in the swimmer. Repeated exposures to similar stimuli need to be experienced frequently enough to avoid having a swimmer enter the decay stage of the training response, while at the same time allowing sufficient time for recovery and training effects to occur. Thus, the timing of exposures to training stimuli and allowing sufficient opportunity to recover and overcompensate is one of the critical decisions that have to be made when developing and administering training programs.

USRPT attempts to produce efficient training that uses swimmers' training performances as the indexes of improvements in race capabilities. Traditional training does not do that.

In the above descriptions of training phenomena, only the *Exact Programming of Events* topic pertains to USRPT. USRPT is event-oriented and in no way does it erroneously embrace coaching myths such as *lactate-tolerance training*, *endurance training*, *back-half training*, etc. USRPT programs are simply the sequencing of exposures to event-training stimuli. Planning aims to yield performance improvements in all events (if conditions are favorable) with a set of week-long event-specific microcycles. Debilitating fatigue is avoided although it does occur more often in large USRPT squads because the coach's monitoring of swimmers' fatigue levels is an overwhelming task.

The topics of *Heavy Training Sessions*, *Unprogrammed Training Session Recovery*, *Training Sessions That Are Too Easy*, and *Training Sessions That Are Too Infrequent*, pertain to traditional swimming programs that mix varied training tasks within and between sessions, (and therefore prevent event-specific training effects), and mainly focus on varying degrees of *hard work*. Such training only develops improved general tolerance to fatigue. Since specific swimming events do involve a minor proportion of general fatigue there is the possibility that small improvements in some events could occur. As Dr. Rod Havriluk showed, those benefits do not occur in a substantial proportion of swimmers who have been led to believe that *hard training* will produce performance improvements.

The reason for presenting USRPT and traditional swimming training phenomena is to show that USRPT aims to produce performance improvements all year. On the other hand, traditional hard training is sustained by the hope that small performance improvements will occur after a taper.[3] That outcome does not occur in the majority of performers in traditional programs.

In the tentative trialing of USRPT, many coaches produce hybrid traditional-USRPT programs. The results from such programs are not much different to what would occur if no USRPT was involved. The irrelevancy and fatigue of traditional work to a large extent cancels-out the positive effects of USRPT. Hybrid programs that have been tried have largely been unsuccessful if one considers both the successful (improved) and unsuccessful (unimproved) performers at the main meet of the season.

USRPT needs to be done correctly. Coaches who claim to have tried it but have not had success usually do not conduct the format with the necessary design features and aims. As an example of the total ignorance of what constitutes USRPT, the reader should go to the Internet entry *USRPT –Southwest Stars Style* (http://proswimworkouts.com/workouts/usrpt-southwest-stars-style). The boldly displayed title is then followed by training items none of which illustrate USRPT format. Readers should be wary of such false *prophets*.

Event-specific Microcycles

In realistic circumstances, it is not possible to control a swimmer's training response with sufficient precision to guarantee that an ideal training effect will occur through one experience of an event-specific training stimulus. For practical purposes, it is advisable to repeat the training stimulus in three or more training sessions, assuming that adequate rest between sessions is provided. Those repetitions constitute an *event-specific microcycle* when conducted over a week. As well, there is always the possibility of not gauging the recovery processes correctly. If that occurs, then a swimmer might not have sufficient time to achieve a training effect and fatigue will accumulate across training sessions. Thus, it is a wise procedure to be conservative in developing event-specific training plans by concluding a series of exposures to a training stimulus with a much lighter training stimulus or even a prolonged rest period. The final reduction in the intensity of the training stimulus is called the *"unloading"* phase of the event-specific microcycle. Active unloading phases in a microcycle are preferred because recovery is accelerated through activity rather than passive rest.

The programming of event-specific microcycles is predicated on there being definite objectives for training. A microcycle entailing a training stimulus should aim to produce some training effect in a swimmer. The need for exposing the swimmer to the stimulus should be balanced with the need for the athlete to recover. Since recovery occurs much more slowly than does the onset of fatigue, it is wise to conclude each event-specific microcycle with a phase of stimulus reduction, just in case adequate recovery has not occurred between each of the previous exposures. Figure 1.7 illustrates the event-specific microcycle model.

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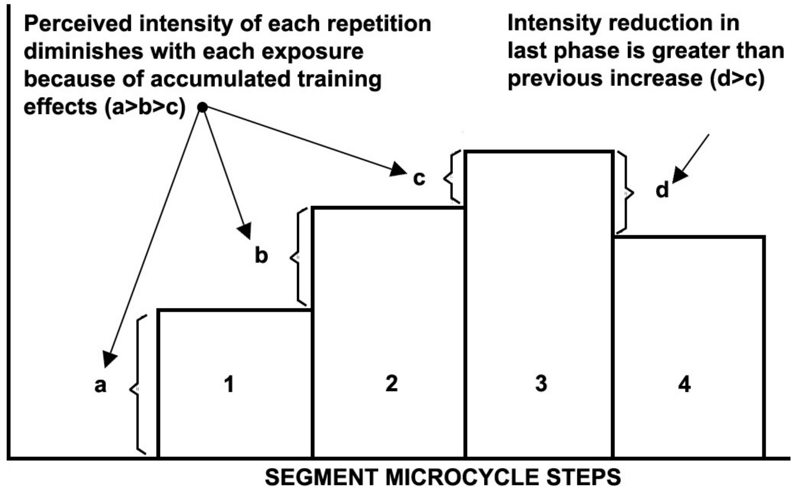
[3] In some swimmers in traditional programs, performances improve because of growth which occurs in such a magnitude that it masks the negative effects of the swimming program. Since growth occurs in spurts, there will be some times when no performance improvements occur and other times when they will. Typically at serious age-group meets, half the entrants improve on entry times and the other half fail to reach their level (Rushall & Ryan, 1995).

Figure 1.7. The basic form of an event-specific microcycle.



Swimming fitness is specific to each event. No two events are alike in terms of their practice and competitive demands. They differ in form (the four strokes), the pattern of muscular movements that produce that form through the phases of a race, the event-specific energy supply and the way that supply changes as a race progresses, and the mental content that ideally accompanies the stages of a race. The specific nature of every swimming event requires a microcycle to be developed for each race that is important to a swimmer. This discussion should be interpreted as considering one specific event and how it is trained in its microcycles. The ultimate feature of a fully implemented USRPT program is that several races can be practiced in a single training session. Three events per session is recommended if part of every practice entails work on racing-skills and/or surface-swimming techniques (particularly the introductory phase of a stroke element). Four events could be accommodated but that would eliminate opportunities for skill, technique, and psychological development in a two-hour practice session. The task for a coach is to schedule USRPT sets for all the races of interest to a swimmer across the traditional calendar week and the sessions attended by the swimmer. That needs to be done for all swimmers, many of whom will be training for the same events.

An example of an event-specific microcycle follows.

1. *Monday afternoon*: Concentrating on swimming over the forearm in the pull; 200-m freestyle race-pace over 50 m with 20+ seconds of rest; work to failure.
2. *Wednesday afternoon*: Repeat the previous set; Concentrating on swimming over the forearm in the pull; 200-m freestyle race-pace over 50 m with 20+ seconds of rest; work to failure.
3. *Friday morning*: Repeat the previous set; Concentrating on swimming over the forearm in the pull; 200-m freestyle race-pace over 50 m with 20+ seconds of rest; work to failure.
4. *Saturday morning*: **Half-set of the best performance of the week**, concentrating on swimming over the forearm in the pull; 200-m freestyle race-pace over 50 m with 20+ seconds of rest.

This microcycle has three repetitions of the same set. Hopefully, each successive use will yield a better performance than the previous one. Considering the three sets, the best result of the most number of successful repetitions achieved is halved and becomes the number to be swum on Saturday morning. Half-sets should be attempted with the goal being to be successful on every repetition (i.e., no failures).

The feature that is important for coaches to understand in implementing this USRPT model is that recovery from a training stimulus is as important as the magnitude/type of the stimulus. Modern training approaches now require coaches to be as concerned with recovery as they are with workloads. It is inappropriate to expose an athlete to a training stimulus unless full recovery from the previous training stimulus has occurred.

USRPT will develop event-specific swimming fitness to a maximum that is limited by inherited capacities. *Once peak event-fitness is achieved, no amount of further USRPT or traditional training will alter the limit that has been reached.* With each year of growth, age-group swimmers develop incrementally (growth is not a constant factor). USRPT trains age-group swimmers to their current limitation. Finally, when maturation is reached and no further development of limited inherited capacity occurs swimming performances based solely on fitness will not change. The failure of swimmers to improve in performance after maturation is an indication of the limited coaching to which they are exposed. When fitness for racing no longer can be increased, that is it has reached a ceiling-level, the only avenues for improving swimming proficiency is through the refinement of swimming techniques, racing skills, and psychological control factors that ensure all of a swimmer's physical and technical resources are used correctly in competitions. No matter how much training is done, no matter how hard a swimmer tries at practices, racing-fitness is limited by the capacities that distinguish every swimmer. USRPT accelerates the adaptation of physical resources to training-stimuli compared to the length of time it takes to develop full fitness with traditional training. The endurance/ aerobic component of a swimming race is fully achieved within 12 or fewer weeks when starting from an untrained state (Costill *et al*., 1990). Anaerobic (sprint) fitness is maximized in as few as four weeks. A conditioning emphasis is not a path to success in the vast majority of swimmers (Kame, Pendergast, & Termin, 1990). Working hard all year in the belief that improvements will result from some unknown mythical changes within a swimmer is part of the erroneous dogma of much of competitive swimming coaching.

Implications

A traditional belief of coaches has been: *even though swimmers are always tired, training hard, and their performances not changing or even getting worse, good things are still happening to them.* That is wrong. Constant fatigue states do not make a better swimmer. Better swimmers come from continual improvement derived from experiencing training effects. If swimmers' performances are not improving, they are not experiencing beneficial training.

Nothing good happens to an athlete when continual catabolic overload-exercise training is experienced (the characteristic of traditional *"hard"* training). Exercise fatigue only serves to remove an individual from an established homeostatic state. Performance improvements only occur during anabolic recovery/rest when the body reestablishes its homeostasis and more. One has to get tired to improve but it is not the tiredness/fatigue that leads to change. Physical overload only sets the form and stage for beneficial recovery and training effects. The following are what is known about work and recovery in physical conditioning.

- Exercise fatigue is necessary for performance improvement. It establishes the type of adaptation that can occur and determines how much rest/recovery is needed. In USRPT, excessive fatigue is neural fatigue.
- Exercise fatigue followed by recovery only re-establishes the body's homeostasis. Performance potential is only recovered.
- It is only when training effects (overcompensation) occur that performance potential changes in the direction of the type of fatiguing exercise experienced.

- Performance improvements through physical conditioning should only be expected when training effects are allowed to occur. In serious swimmers, without training effects and their exquisite timing, there can be no improvement in physiological factors or energy resources for a particular swimming event due to physical conditioning.
- USRPT is the best form of training for developing event-specific fitness. However, the level of fitness that can be achieved is limited by inherited capacities and is achieved in no more than 12 weeks when starting from an untrained state. The USRPT format is ideal for teaching race-pace techniques (Rouard *et al*., 1977). Because there is no upper limit to skill acquisition, technique instruction should remain the major focus of any competitive swimming program.

Continued overloading without recovery that facilitates overcompensation does not lead to positive performance adaptations. The case has been made in this *Bulletin* for recovery and training effects being more important than overload when seeking performance improvements in swimming races through conditioning. The more frequently recovery and overcompensation are allowed to occur after overload/fatigue, the more a performance can change due to physical adaptation up to the ceiling level of inherited physical capacities.

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