Recovery-Adaptation: Strength and Power Sports

By: Michael H. Stone, Ph.D. and Margaret E. Stone, USOC Coaching and Sport Sciences Division

For the coach and athlete, the primary goal of the training process is to enhance performance. However, it may be argued that enhancing performance is actually a process of intentionally repeating stimuli (exercise), which result in recovery-adaptation while attempting to avoid overstress-overtraining. There are basically two methods a coach and an athlete can use to enhance the stimulus-recovery adaptation process:

1. Reasonable planning and execution of the training program, which should include not only the training stimulus, but also, built in rest.
2. Adopting reasonable methods of enhancing recovery adaptation other than training (e.g., nutrition, nutritional supplements, possible massage or vibration).

RECOVERY can be defined as- "regaining what was lost"- for the coach and athlete that is not very satisfying, as it returns the athlete only to where they started.

ADAPTATION- can be defined as- "the process of adjustment to a specific stimulus". This process of adaptation can include adjustment in physiology, psychology and mechanics, which ultimately lead to improved performance- a much more satisfying, prospect. So, in a sports context, recovery-adaptation becomes paramount.
TRAINING-THEORETICAL MECHANISMS FOR SUCCESS- OR FAILURE

As previously mentioned, the training process is concerned with preventing overstress-overtraining while enhancing performance. There are several hypothetical/theoretical mechanisms, which can help us understand the training process:

<u>Stimulus-Fatigue-Recovery-Adaptation (SFRA):</u>

Conceptually an appropriate stimulus will result in fatigue, recovery and adaptation such that performance is eventually improved (i.e., supercompensation). This concept is not limited to a single exercise response, but may be viewed on a longer basis in producing training adaptations (Rowbottom, 2000). There are a number of observations that lend support to this concept. For example: Verhoshansky (1977, 1985) noted that a unidirectional concentrated load of strength or strength-endurance training for several weeks could result in a diminished speed-strength (power) capability among track and field athletes. Upon returning to normal training increased performance can often be observed, sometimes beyond the original baseline values. Verkoshansky (1977, 1985) suggested that these results may be explained by the SFRA concept. Similar results have been observed among young weightlifters after a planned high volume over-reaching phase (Fry et al., 2000, Stone and Fry, 1997) and maybe linked to alterations in anabolic/catabolic hormones. This concept has similarities to Selye's General Adaptation Syndrome (GAS), which can be used to model sports performance (Stone et al., 1991). Conceptually, adaptation or mal-adaptation is the summation of all stressors that an athlete may encounter. So,

recovery-adaptation may be viewed as long-term interplay among various stressors and not just training.

Fitness vs. Fatigue

A second model is Sport Preparedness. The characteristic of sports preparedness deals with the degree to which an athlete is ready to perform. Although a high level of "preparedness" does not guarantee a superior performance- it does raise the performance potential. According to this theory (Zatsiorsky, 1995), an athlete's preparedness can be determined by the summation of two after-effects of training: fatigue and fitness. Basically, this theory indicates that fatigue dissipates at a faster rate than fitness, thus enhancing preparedness. In contrast to the SFRA theory, which is based on a cause-and-effect relationship between these factors, the fitness-fatigue model proposes that they have opposing effects. This has a simple but profound implication for program design and implementations: Preparedness, which is strongly related to performance, can be optimized with strategies while minimizing fatigue. So, if preparedness is enhanced, performance should also be enhanced- evidence for these relationships can be found in the positive performance effects of a "taper" (Mujika and Padilla, 2003).

Training Strategy

Fatigue is a natural consequence of training stress (especially with high volume-loads)- and adaptations are primarily manifested during subsequent unloading periods- fatigue management is key in producing a sound program. These unloading periods can be implemented at different levels in a periodized program, (Stone et al., 1999a, 1999b, Plisk and Stone, 2003) for example:

MACROCYCLE- active rest/transition periods after competitive periods

MESOCYCLE- restitution microcycles after overreaching microcycles, concentrated blocks or stressful competitions

MICROCYCLE- the use of unloading weeks following successive weeks of increased volume or intensity

INTRA-MICROCYLE (DAY-TO-DAY)- maintenance/restitution workloads or recovery days; daily training routines can be distributed into modules separated by recovery breaks (i.e., multi-sessions per day) and additional intra-session relief breaks (e.g. rather than use a "repetition maximum" approach where each set is completed in continuous fashion, it can be advantageous to subdivide assigned workloads into clusters separated by rest pauses)(Haff et al., 2003).

There are several levels of potential variation in the training program. Variation has clearly been shown to be a key factor in recovery-adaptation (Foster et al., 1998, Stone et al., 2000). As part of this variation, introduction of unloading periods (i.e. rest-recovery periods) into the training program structure can reduce the

overstress/overtraining potential and enhance the recovery-adaptation process ultimately enhancing performance.

Unloading Periods: Estimating the Work-Load

Work (force x displacement) is directly related to the energy used during exercise and is also related to the energy consumed during recovery. So, the more work performed in a training session the greater the potential for extended recovery periods.

The inability to recover not only effects adaptation, but also affects the athlete's ability to respond to the next training session. In order to implement appropriate unloading periods it is necessary for the coach to develop an understanding of the measurement or a reasonable estimate of work for their specific sport. This is relatively easy in weight-training as the volume load (repetitions x mass lifted) is associated with recovery energy (Scala et al., 1987). Thus, calculating the volume load per session can give a qualitative indication of how long it will take to recover.

However, in other sports activities estimates can also be derived from specific exercise characteristics- for example in sprinting, work may be estimated using a combination of distance run and times achieved (Kirksey and Stone, 1998). Developing estimates of work for various exercise and unloading periods (i.e., if you don't know what a heavy work load is – then you cannot implement a light one).

Monitoring the Training Process

One of the most important aspects in considering training-recovery-adaptation is monitoring the process. Failure to properly monitor results in the coach never really knowing if his or her training plan produced the desired results. A positive or negative performance result may have been due to outside factors (including chance) rather than good planning. Monitoring the training process should include the development of tests, which reflect sports specific fitness and preparedness. These tests should be:

1. Relatively easy to administer and relatively non-interfering with training- tests should include a variety of physiological, biomechanical and psychological aspects as well as performance tests.
2. Characterized by rapid data return.
3. Easy for the coach/athlete to interpret.
4. Administered in an integrated fashion with the training plan.

Integration of the monitoring process into the training program should entail testing at key phases- for example: just before and after general preparation, special preparation and competition and immediately after competition- this type of testing program will allow the coach to assess the adaptation of athletes to various types of stimuli across time. In this manner, the coach will know whether or not the desired results are being obtained for each training stimuli (i.e., each phase).

Training logs should be kept by each athlete so that relationships between training variables (volume, intensity factors and exercise selection) and tests can be

noted. Administration of tests and interpretation tests results can be enhanced by forming a coach directed team of sports scientists and medical personnel. This process (and team) may also aid the coach and athlete in adapting training or formulating new and innovative methods of training.

In summary, recovery-adaptation is a multi-dimensional process that is driven by the training stimulus. Creative planning of the training process, which not only includes the training stimulus but also built in rest and recovery periods, can enhance recovery-adaptation. A necessity is proper monitoring of training-recovery-adaptation. Ultimately, appropriate planning and monitoring of this process ca result in superior sports performance.