The Physiology of Performance

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An Interview with Iñigo Mujika

Dr Iñigo Mujika is a physiologist and coach, who among his peers is widely seen to be leading the amalgamation of science and sport with the aim of improving performance.

Mujika earned PhDs in the biology of muscular exercise (University of Saint-Etienne, France) and physical activity and sport sciences (University of the Basque Country). In addition to his native Spain, he has held research and training positions in Australia, France and South Africa, through which he has gained experience working in several sports including professional cycling, swimming, running, rowing, tennis, football and water polo.

His research in the physiological aspects associated with sports performance includes areas such as training methods and recovery from exercise, tapering, detraining and overtraining. In the last decade he has published nearly 80 articles in peer reviewed journals as well as books entitled *Tapering and Peaking for Optimal Performance, Recovery for Performance in Sport* and *Endurance Training: Science and Practice.* He is also an associate editor of the International Journal of Sport Physiology and Performance and has his own website (www.inigomujika.com).

Among Mujika's regular messages about training for maximal performance in any sport are the importance of the coach having precise, in-depth information about volume, intensity and frequency as the basis for monitoring and manipulating the training programme and the importance of the training-regeneration balance.

Earlier this year NSA contributor Jimson Lee of Speed Endurance.com asked Mujika to share his views and ideas on the training of athletes, technology and recovery. Excerpts from the conversation are published here and the full interview can be found on Lee's website www.speedendurance.com.

NSA *The fine line between tapering and detraining is getting smaller as competitive seasons are getting longer. With some metrics of fitness and power varying, how does one know if they are reaching a point of lost fitness?*

Mujika: In my view, the key metric to assess where an athlete is at any point in time is performance in training and in competition. If an athlete is not performing at his or her expected level, we need to make some kind of performance-fatigue assessment. If performance is indeed declining, we should assess why this is the case, starting with exclusion criteria such as confounding illnesses. We should also as-

sess whether there are clear errors in the athlete's training programme: insufficient training volume, intensity or frequency; excess or insufficient competition, nutritional errors, and other confounding factors such as psychological problems, social issues, travel fatigue, etc. We can, of course, make use of biological markers such as resting cortisol levels or maximal lactate production, but I have always believed that communication with the athlete is the most important way to assess what is going on.

NSA *Some coaches are monitoring fatigue but not managing training outside of formal sessions. What are ways to make non-specific training outside of sessions a combination of both adaptation and monitoring physical abilities?*

Mujika: Not assessing training or physical activities outside of formal practice is equivalent to trying to make a nutritional assessment including only the foods ingested by an athlete at meals, but ignoring what they eat once they are on their own. We need to know what the athlete does outside of formal practice, as this may have a huge impact on the way they adapt to training. All physical training should be included in the quantification of an athlete's activity profile, and this can be done with the use of physical activity questionnaires, or by means of technological tools such as heart rate monitors or accelerometers.

NSA *Can you share any good workouts that could help athletes monitor power or conditioning?*

Mujika: In terms of tests or workouts that may help monitor power or conditioning, I am sure that every fitness coach has his or her own method, which could be a reference training set, a countermovement jump, a repeated effort test, a maximal or submaximal Yo-Yo Intermittent Recovery Test, etc. The most important thing is that these reference workouts or tests should be carried out in standardised conditions, be relevant to the sport, as well as being valid, reliable and sensitive to changes in an athlete's fitness level.

NSA *You mentioned years ago that longer sprints may be important to prepare for injury reduction in team sports?*

Mujika: My philosophy is that we need to identify the factors determining physical performance in sport, then try to find the right training mix that includes proven methods to improve each and every one of those factors. For example, in most sports an elite athlete requires high levels of endurance, speed, power, strength, and agility. We as coaches need to make use of the best training methods to improve each one of these qualities. We also need to be aware that the technical and tactical areas are also key to performance, and after assessing an athlete's strengths and weaknesses, we need to determine the training time that will be specifically allocated to each of these areas, and the time needed to optimally integrate them to maximise each athlete's contribution to overall performance.

NSA *What can sport science do to help the medical team and coach with during the season by integrating a balance between skill and general training?*

Mujika: Within this framework, injury prevention is a key aspect of daily training. In athletics, the physical qualities required from athletes should be trained in conjunction with injury prevention (e.g. core training, proprioception, use of eccentric overload training of thigh muscles, dynamic stabilisation through vibrations, uneven and unstable surfaces, etc.). In this respect, I believe that it is better to have your athletes at 90% of their physical capacities, than having them not compete due to injury.

NSA *Many athletes are in tune with their bodies while technology seems to be focused on objective sensors. Is this a good direction?*

Mujika: As I said in my recent editorial "***The alphabet of sport science research starts with Q",*** I consider the quantification of training a cornerstone of athletic preparation for competition and a key aspect of good sport science. In this respect, any type of quantification is certainly

better than no quantification at all. Of course, quantifying the external load imposed on an athlete is necessary, but we all know that individual athletes will adapt differently to the same training load, so assessing the internal load is also important. In my early studies with elite swimmers we quantified up to 28 training variables for each athlete, daily, throughout an entire season, year after year. We then applied a mathematical model to relate the training input with the performance output, and later assessed the impact of these training indices on various biological markers. This type of quantification requires a very methodical and systematic approach to training, and generates a huge volume of data, so we need to make sure that we can manage and interpret the data to make it useful. At the time, we did not include any psychological monitoring of the athletes, which was clearly an error.

NSA *Where do you think things are going with monitoring the athlete as a person versus just a physiological body?*

Mujika: Athletes' performances improve or decline not just due to physiological changes; psychological status and mood states also play a key role in an athlete's ability to perform in both training and competition, so being able to continuously monitor their physiological and psychological status is extremely important. Whether this is done through technological gadgets, questionnaires or by means of open communication is less important, as long as the quantification process is methodical, systematic, and provides valid and reliable information to optimize an athlete's adaptation and performance.

NSA *Endurance training is a specialty of yours but recovery and regeneration from speed and power training is a growing need in sports. What are the mechanisms we can exploit without attenuating adaptations?*

Mujika: This is certainly a very interesting issue. I have often stated that I see the training process as a cycle that includes both the time spent training and the time needed to recover from a given training bout. Over the years, the first part of this cycle has been emphasised to enhance performance, with coaches and athletes looking for ways to train longer and harder. In the past fifteen years or so, however, there has been a growing interest in the second part of the cycle, i.e. recovery, in an attempt to improve performance by recovering better in between workouts, training cycles, or even in between seasons. In this regard, various recovery modalities and strategies are gaining wide acceptance among athletes, and sport governing bodies. Training centres and professional teams are investing financial and human resources to provide these recovery modalities to athletes. Individual athletes are also making use of popular proactive recovery methods. The big question here is whether by facilitating recovery processes athletes are blunting their adaptation to training. In other words, by making use of such recovery modalities, do athletes get more benefit from their training, or do they need to train more to get the same benefit? Research in this area is still inconclusive, so making general recommendations would not be wise.

NSA *Is legal regeneration outside of sleep, eating right, and not doing too much training possible? Are we just doing stuff to "feel" better and get a placebo effect or are there things to make changes to our bodies for the better?*

Mujika: My view is that similar to physical training, nutrition or psychological skills training, athletes should use a periodised approach to proactive recovery. As my colleague Steve Ingham from the English Institute of Sport puts it, the focus should be on maximizing adaptation, not maximising training. So when adaptation is more important (such as during the early and mid-season), athletes should focus more on training and less on proactive recovery; but when recovery is more important than adaptation (such as in the late season or in the lead-up to and during major championships), athletes should make use of all proactive recovery strategies proven to be physiologically and/or psychologically effective for them. All of this said, proper training, adequate sleep and sound nutrition are still the most important strategies to optimise training adaptations! In my colleague Bill Sand's words, no recovery modality is powerful enough to overcome stupid coaching, bad planning and lack of talent.