MIND GAMES

60-SECOND SUMMARY

HOT OFF THE PRESS

DIRECTORY

OLYMPIC COACH

FALL 2005 • VOLUME 17 • NUMBER 3

Message from
CHIEF OF SPORT PERFORMANCE

•

MONITORING THE ELITE ATHLETE

•

TESTING-HOW, WHY, WHO, WHAT AND WHEN
(and how to make sense of it)

•

PERFORMANCE TESTING FOR ATHLETES

CONTENTS

FALL 2005 • VOLUME 17 • NUMBER 3

FEATURES

DEPARTMENTS

OLYMPIC COACH is a publication of the United States Olympic Committee Coaching Division. Readers are encouraged to submit items of interest for possible inclusion. Submitted materials will be acknowledged but cannot be returned, and inclusion cannot be guaranteed. Materials should be sent to Catherine Sellers at the address listed under Publisher.

PUBLISHER
United States Olympic Committee
Coaching Division
1 Olympic Plaza
Colorado Springs, CO. 80909-5760
Telephone: 719.866.4984 or 866.4852

ON THE COVER
Kimberly Severson of the United States leads her horse Winsome Adante over an obstacle en route to winning the bronze medal in the individual three day eventing jumping final competition on August 18, 2004 during the Athens 2004 Summer Olympic Games at the Markopoulo Olympic Equestrian Centre Jumping Arena in Athens, Greece. (Photo by Nick Laham/Getty Images)

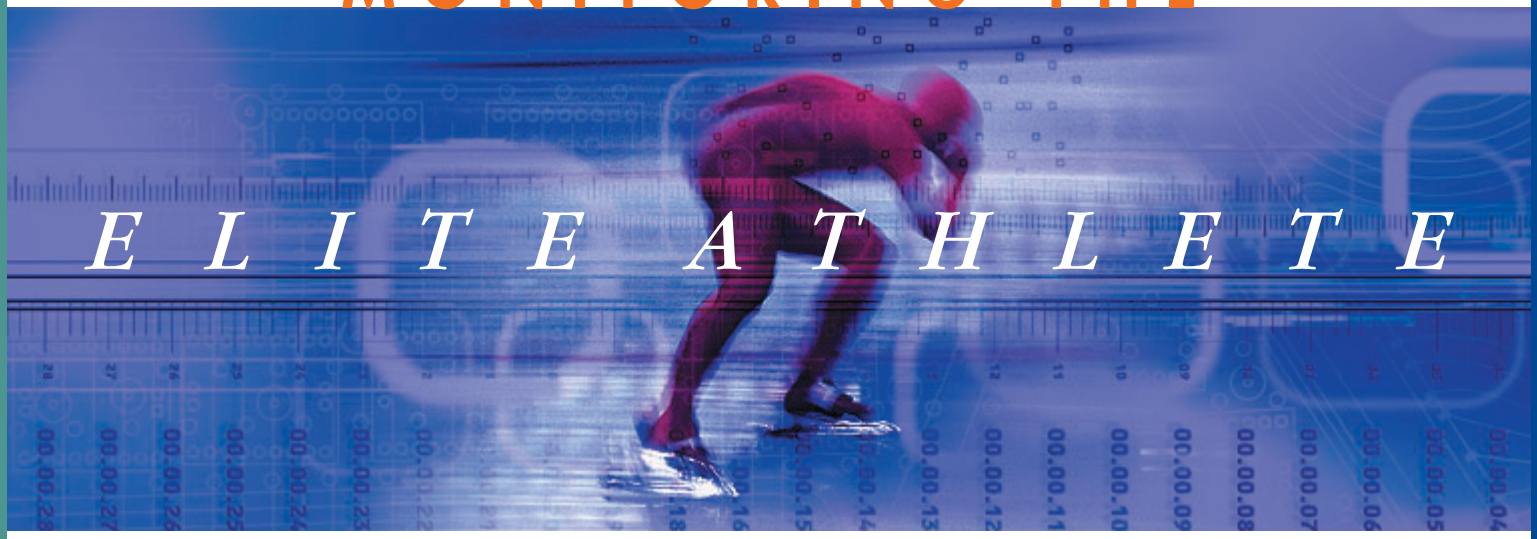
Message from the
USOC's
CHIEF OF SPORTS PERFORMANCE
by
STEVE ROUSH

Sustaining competitive excellence, commitment, lifelong learning, leadership, motivation are all aspects of being a highly successful coach, regardless of the level of athlete you coach. The same can be said for the support staff and the administration of a great sports organization. We know that Team USA will be faced with challenges both in Torino and in Beijing. The newspaper reports of the Russians and the Chinese joining together to topple the U.S. from the top spot does raise the bar, however, we believe our coaches and athletes will meet those challenges.

Those of you who are avid readers of Olympic Coach magazine show that you are up to that challenge and that you exhibit those traits listed in the first sentence. This issue of Olympic Coach is focused on monitoring and evaluating athletes during training. This is one of the keys to sustaining competitive excellence. It is hard to compete at the highest levels for long periods of time, but proper monitoring lets the coach know that the athlete is prepared. Dr. Bill Sands and Dr. Mike Stone prefer to use — preparedness — to describe the outcomes of training. Dr. Jimmy Disch, who has worked with USA Volleyball, writes of using monitoring to diagnosis and prediction. Wayne Goldsmith provides ten rules to think about when testing. Pulling it all together with the coach leading the way in "big" events is another great article by Dr. Sean McCann in the Mind Games column.

We hope that you find this edition thought provoking and we encourage you to view monitoring as another "tool in the toolbox" for the great coach.

MONITORING THE ELITE ATHLETE



By Wm. A. Sands, Ph.D. and Michael H. Stone, Ph.D.

(This is the first of a two part series concerning Monitoring and Evaluation. The second of the series will be in the next Olympic Coach magazine.)

It is hard to imagine a general not constantly monitoring the condition, position, and readiness of his/her troops. It is equally hard to imagine a stock market investor not monitoring his/her portfolio on a constant and regular basis. However, in elite athlete training we often don't monitor athlete preparedness beyond simple gut feelings and we too often wait only for competitions to show us whether we did a good job. Sadly, if you wait for competition, you're probably too late. Monitoring provides a means of controlling the athlete development process and thus a window on preparedness. Monitoring provides the link between planning and preparedness, between planning and performance. Monitoring can provide you with insights into athlete preparation that you've never had before.

WHAT IS "MONITORING?"

Monitoring can be thought of as the periodic or continuous surveillance or testing of some characteristic(s) of interest. Working backward in the previous sentence:

1. the characteristics of interest are athletic preparedness and performance,
2. testing refers to the examination and/or manipulation of some characteristic(s) to determine its status or change,
3. surveillance refers to the observation of some characteristic(s) to determine its status or change,
4. continuous refers to something that is more or less constant or without interruption
5. periodic refers to something that recurs at regular intervals.

Although we surely monitor performance via win/loss records and competition scores, the hard part about monitoring is surveillance and testing of preparedness. Preparedness can be defined as the difference between fatigue and fitness, and refers to the day-to-day status and condition of the athlete — in essence — the results of training and all other stressors that impact the athlete. While the coach and athlete may have only modest control over the competition because judges, officials, referees, weather, and other aspects of the environment may intrude, the coach and athlete have considerable control over training and therefore preparedness. One of the major goals of monitoring is prediction. By monitoring preparedness, we hope to be able to predict whether the athlete will fare well or poorly in the competition.

Monitoring involves the use of information, obtained from a process, to then alter the very process from which the information came. For example, if we have information from an athlete that tells us that the athlete is suffering from fatigue, we might use that information to then reduce the amount of the athlete's training demands in order to facilitate recovery. We are using information from the athlete and the effects of the athlete's training and other stressors to then alter the training demands and thus the athlete. This is a cyclic and recursive (i.e., each cycle calls a copy of itself) process that continues throughout the career of the athlete. Of course, we hope that the alterations are positive in nature and that the athlete improves more due to our intervention than he/she would have without the intervention.

Alterations to training result in changes in the athlete that are delayed. The duration of the delay is often unknown. These changes are then also monitored to ensure that the changes match expectations. If the changes do not match expectations then new alterations are selected and implemented. The point is to drive the athlete/system in the direction you want it to go by a cyclic and recursive feedback system that provides useful information in a timely fashion.

WHY MONITOR?

TRAINING IS A PROCESS. A process is one or more actions that bring about a result. Preparedness is the goal of training and performance is the outcome of preparedness. Thus, preparedness and later performance, are also processes. Training demands monitoring because the actions or tasks of training do not provide the same results at all times, with all athletes, in all circumstances. Moreover, training may provide results that are not only unexpected, they may be unwanted and perhaps dangerous. The effects or results of training are always preceded by the causes or tasks of training such that in the interim between the tasks and the results we may be able to "listen in" on the process and determine whether the tasks are causing the athlete's changes to head in the right direction. By "listening in" on the training process we may be able to identify training errors and triumphs in order to avoid the first and emphasize the latter.

TRAINING IS A LONG-TERM PROCESS. The effects of training are delayed and cumulative (58). In a sense, training is an *investment* not a purchase. Athletes and coaches invest time and effort in training to achieve a delayed result. The delayed result is usually measured as increased preparedness such as: greater fitness, efficiency, skill, elegance, and so forth. Due to the delay, we cannot be certain about causes and effects. There may be multiple things impinging on the athlete that later accumulate to result in changes in preparedness and performance. For example, we may have an athlete who in different competitive seasons uses two very different training programs. Both result in progress, but during one program the athlete is ill more often. Could this be the result of the training program? How would we know? We are concerned with the influence of training on individual athletes and teams, we can't really devise a kind of experiment that would allow us to impose the two training programs on identical athletes or teams because by definition - there are no identical athletes or teams when we consider "elite" athletes (44). And, we are concerned with our athlete *right now*, we have to work with *the athlete we have* not some "average" athlete that is the result of a statistical procedure (44;50). In order to understand how long-term processes influence our athlete, we need to monitor and then judge whether there is a good argument for assigning a cause (i.e., training, some other stressor, or the accumulation of stressors) to something that precedes the effect (i.e., illness, progress or whatever).

THE EFFECTS OF TRAINING ARE NOT ENTIRELY PREDICTABLE, AND WILL NEVER BE ENTIRELY PREDICTABLE. We commonly suffer from an argument as old as LaPlace (47) that if we had sufficient information, an all-knowing person or perhaps a computer, could predict everything about the future (43). The problem is that we will never have all the information we need to predict the future, and in principle, we *can't* have all the information we need. This means that there will never be any kind of "recipe" for training, something like "do this and then your athlete will win." In principle, such a recipe *cannot* exist and this places further emphasis on monitoring in order to exert some control over the process via intelligent feedback and rational training changes.

MISTAKES ARE EXPENSIVE. The investment of time, money, and other resources into the development of elite athletes is extraordinary (5;16). Training mistakes usually involve defeat, poor performance in decisive moments, and/or injury (2). These types of problems have an origin in poor preparedness. Monitoring is one of the few tools available to help coaches and athletes discern how training and other stressors might be linked to all aspects of preparedness and performance. Chronic fatigue and overtraining, although beyond the scope of this document, are the prime suspects in poor performance and may be avoided by early detection via monitoring (2;15;18;30;33;38). Elite athletes must push the edge of their adaptation envelope, always coming close to their limits of their training capacity without going beyond.

Monitoring provides a means of better training management. Management means to control the course of an activity. In order to control the course of an activity, you will need to know how an activity changes and what influences an activity to change. In other words, you'll need to know what to monitor in order to detect that something in the athlete has changed.

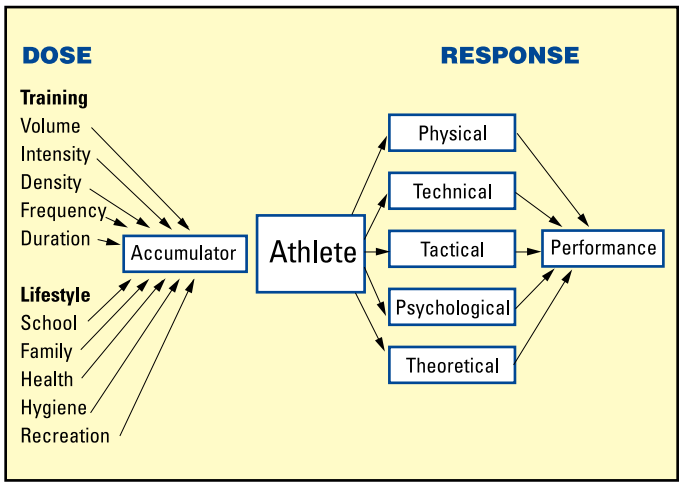
WHAT IS WORTH MONITORING?

Once you agree that monitoring is important and worth doing, then the question arises, what is *worth* monitoring (20;21)? To use the metaphor of altitude, monitoring can occur at ground level (sets, reps, weight, skills, kicks, punches, etc.), from 100 feet (lactate, immunity, glycogen, oxygen uptake, etc.), from the 1000-foot level (group dynamics, team tactics, top eight performances, medal counts, etc.), or from the 10,000-foot level (surveys of coaches, assessment of training plans, etc.). As such, monitoring is an elastic process that can assist individual athletes (the goal of this article) and monitoring can also be used to keep track of how training and performances are going for team leaders, managers, and others who are not involved in the day-to-day decision making of individual athletes and teams. In this article, we will stay at or below the "100-foot level."

Our concern here is monitoring the "dose/response relationship." Borrowed from medicine, the basic idea is that what we do to the athlete in terms of training demands is the "dose." How the athlete "answers" or how the athlete's body "replies" to the dosage is the "response." In a medical setting the typical use of this idea is determining how much of a drug a doctor gives to a patient to get a certain response. Dosages for common drugs are included on packaging. These dosages are designed to elicit a certain response in the person taking the drug. For example, children often receive lower dosages of certain drugs than adults. Athletes who are in the early stages of training generally receive different training prescriptions than veteran athletes. Athletes preparing for competition should receive different training prescriptions than the same athletes reporting for their first day of training. Monitoring training dose is relatively easy; however response monitoring could easily fill a book.

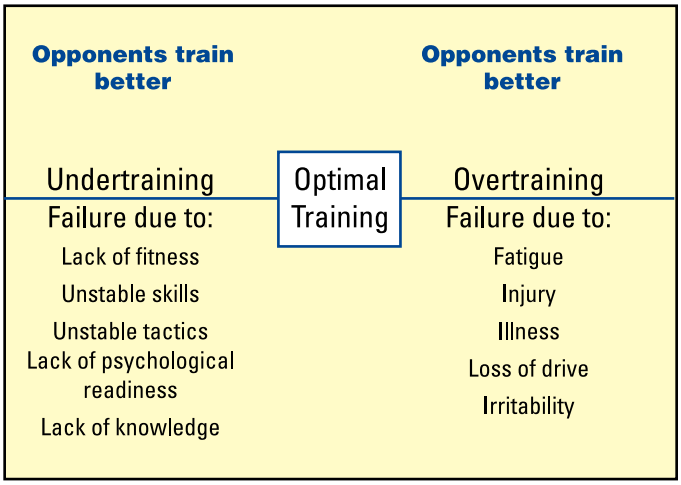
IT HELPS TO HAVE A MODEL. There are two models that are basic assumptions of monitoring. The first model (Figure 1) deals with categorization of the various stresses that impinge on the athlete and provides a general overview of the monitoring process via dosage and response. The second model (Figure 2) deals with an assumption that training is an optimization problem. In other words, athletes can train too little and fail simply because their opponents train harder and smarter, or athletes can train too much and fail because of fatigue, injury, and illness that arise from too much stress.

Figure 1



Monitoring model of the dose/response relationship. Note that lend themselves to monitoring variables are shown below "dose" and "response." Each area, in turn, can be broken down to individual monitoring variables.

Figure 2



Optimization of training. Note that the "window" of training is shown in the center box where optimal training occurs. If the athlete under-trains he/she shifts to the left, and if he/she over-trains he/she shifts to the right.

DOSAGE. The athlete's training demands are perhaps the easiest to characterize. Training demands are expressed as volume, intensity, etc. (Figure 1). All coaches and athletes should regularly track their training dosage. This information can be invaluable in determining how much work the athlete has accomplished and can signal when the athlete

is approaching too much or too little training. It is important to realize that it is by accumulation that training dosage matters (58). It is unlikely that a single training day or lesson will be overly demanding enough to harm an athlete in the long-term. Moreover, it is also unlikely that if an athlete misses one training day or lesson that this will upset the progress of training enough to ensure long-term consequences. However, as the training days and lessons accumulate to about a week's worth of training then accumulated over-demands or lack of demands will likely have an impact on the long-term progress of the athlete. As such we tend to monitor training in week-long periods or "chunks." Training theory literature has named these shorter periods of training "microcycles" (12;34;36;57).

The "what" you monitor in dosage is highly sport dependent. For example, track and field throwers would likely monitor the number of throws and distances along with the typical sets, reps, weight, speed, and so forth from the weight room. A distance runner might monitor distance, speed, time, terrain, intervals, steps, and weight room factors. A gymnast might monitor the number of skills performed and total time required. A wrestler might monitor actual wrestling time along with the number of skills practiced.

Each of these dosage variables should be recorded each training lesson and placed in a training diary. Coaches *should* be able to prescribe training and simply record what they prescribed as the training demands. However, experience has shown that what coaches prescribe and what athletes actually do can be remarkably different. Because of this potential discrepancy, a diary of what the athlete actually does is crucial for the coach to have so that future training demands can be planned accordingly. As a personal anecdote, while at the Lake Placid Olympic Training Center, in a lecture one of us asked all the coaches to close their eyes and then asked the athletes a simple question: "When the coach tells you to take a rest day (i.e., no training), do you?" "In other words, when the coach has planned a rest period, do you actually rest?" Only a handful of the dozens of athletes raised their hands. Most of the athletes continue to train even when the coach has prescribed rest. On the other hand, we have all seen athletes who don't perform all of the work that was prescribed for them. It is quite difficult to conduct a rational training program when athletes don't do what the coach prescribed. Moreover, all of the wonderful periodization plans are worthless if the athlete doesn't actually do the prescribed work or does more than the prescribed work. Unexpected results are likely to occur and the ability to control the training and performance of the athlete becomes impossible. At the very least the coach doesn't know how to plan for the future without knowing what actually happened in the past. In a very practical sense, if athletes don't rest during the rest days then they are unlikely to be able to push themselves hard during the high stimulus days and thus don't get the necessary overload they need to make the progress they're likely seeking.

Dosage must be monitored. If you do nothing else — monitor dosage. Dosage is the easiest to monitor, will make the most sense to the coach and athlete, and goes a long way in painting a picture that both the coach and athlete can use to modify, and thus enhance, training and performance.

RESPONSE. Athletes' responses to training can fill several large books. Athletes produce measurable responses in physical (physiology) (1;3;6;7;9-11; 13; 14; 19; 21; 23; 27; 28; 35; 48; 54; 55; 59; 60), technical (skill/biomechanics) (51), tactical (strategy) (24;26;32;56), psychological (mental/emotional) (4;17;25;29-31;37;38;49;52), and theoretical (knowledge) (53)domains. However, the vast majority of studies of athlete responses to training have been from physiology and psychology.

Responses to training stress can be found in all of the domains above, but psychology and physiology emphasize that, although quite different in orientation — either can usually detect responses to training. Responses to training are neither physiological nor psychological, they're biological (8). Division of responses into the domains above is somewhat artificial and based on human conventions rather than anything inherent to the processes. This artificial division also points to the fact that there has been little consensus on a single marker or group of markers that are utterly infallible in detecting the status of any given athlete's response to training. The attempts to detect markers for overtraining have been such a case. Schiffer describes the problem eloquently, "Although researchers have suggested an impressive array of sophisticated tests to detect overtraining, the best measures continue to be the simplest changes in performance and self-rated perception of fatigue and well-being" (46), p 81. Schiffer's quotation above emphasizes the usefulness of self-report data. However, it is our opinion that both self-report data and laboratory based tests should be used in monitoring. Both methods have strengths and weaknesses that complement each other.

Response monitoring has involved a host of biochemical tests, psychological surveys and batteries, and other measures. Variables have included heart rate, immune responses, mood states, lactate profiles, oxygen uptake measures, hormone profiles, cardiac variables, and many others. Unfortunately, the lack of consensus on which variable(s) to monitor for each athlete has resulted in interesting problems of interpretation.

There may be a lesson in this lack of consensus. What we may actually be looking for is simply an anomaly. The anomaly may come from any monitored system, physiological, psychological, and so forth. But what you're really looking for is anything out of place.

WHAT ARE YOU REALLY LOOKING FOR?

Let's say you have monitoring data, what do you do with it? How do you interpret data and translate it to a training prescription? Although scientists can argue the finer points of whatever biological mechanism they are surveying, what you really want to know is whether the athlete is adapting to your training demands. Is the athlete improving, staying the same, or getting worse? Does the athlete's current state of preparedness meet your expectations and fit within your plan? Certainly, there are times when fatigue is the goal of training, sought rather than avoided. Occasionally, the athlete may reach a peak of preparedness that is good, but to do so too early is bad. Moreover, there are times when you are not worried if an athlete is fatigued, frustrated, unhappy with his/her performance, and so forth.

There are only a limited number of things that dosage and response data can tell you: some variable is increasing, decreasing, staying the same, cycling (i.e., repeating some pattern), following another variable, and/or pulsing abruptly (i.e, suddenly changing). Figure 3 shows real data in training intensity, measured as elements (i.e., skills) per minute, over three months leading to the 1988 Olympic Trials. Figure 4 shows increasing and decreasing trends of real data from a former elite female gymnast. Also, Figure 4 shows a rather sudden change in resting heart rate data. Figure 5 shows cyclic behavior, especially during the competitive period, and sudden pulses of change in new injury per exposure records.

Figure 3

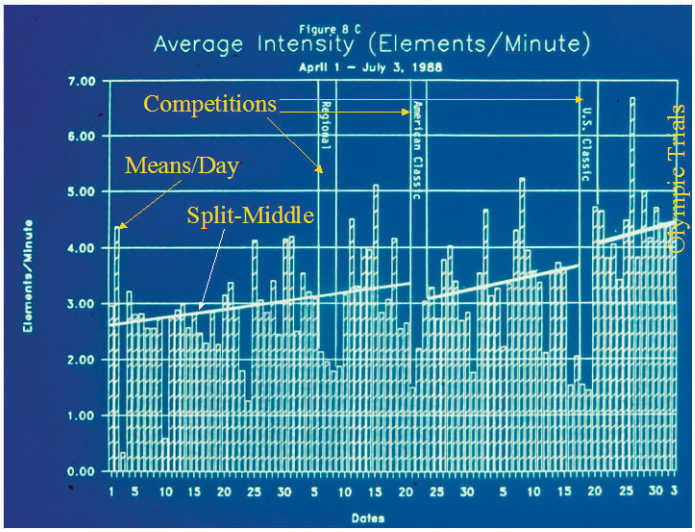
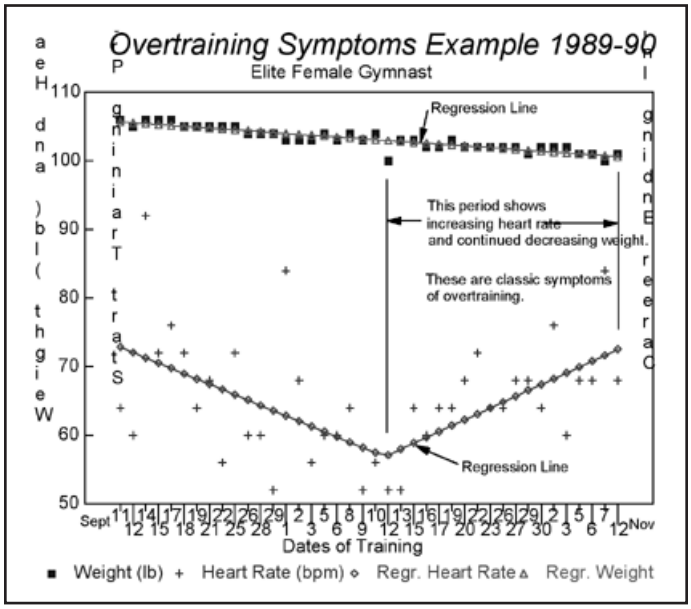
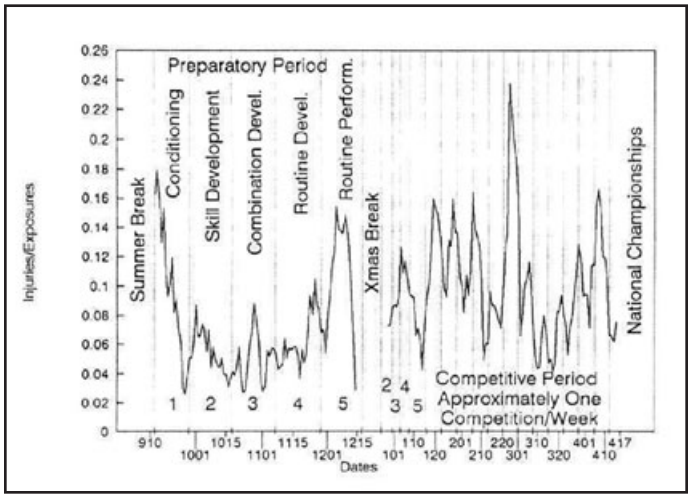


Figure 4



Increasing and decreasing trends. Note that weight is decreasing while resting heart rate began with a decreasing trend followed by an increase. Increasing resting heart rate coupled with decreasing weight are classic symptoms of overtraining.

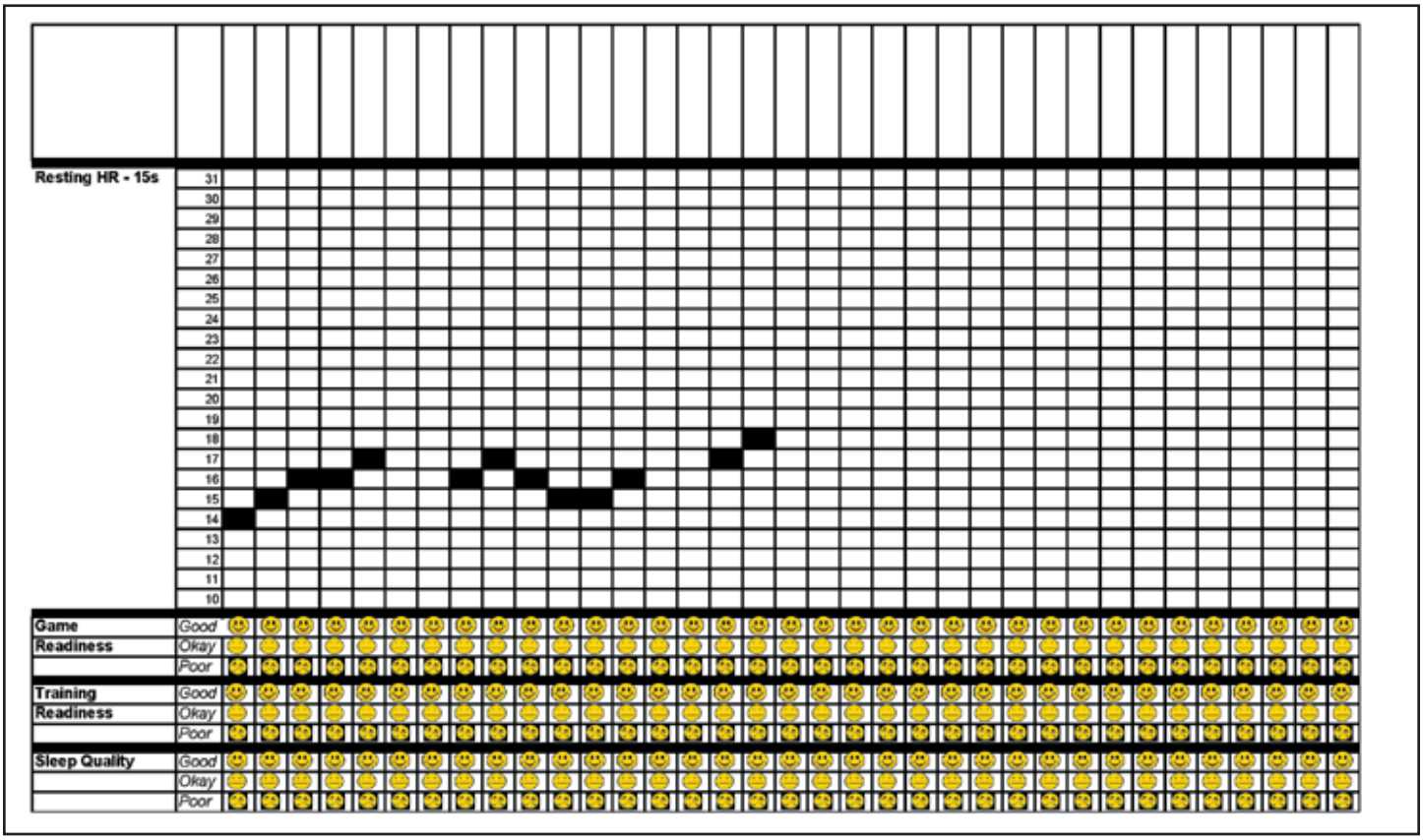
Figure 5



New Injuries per Training Exposure. This figure shows cyclic behavior of new injuries during the competitive period (right side) that coincides with each competition.

What you're looking for are patterns. Patterns of long-term monitoring data, both dosage and response, can be used to identify whether training demands are going as planned and whether the athlete is adapting to these loads. Perhaps very important for our discussion here, all of the data shown in Figures 3-5 are self-report data. The athletes recorded their elements, scale weight, resting heart rate, and injuries. A second area of interest, as demonstrated from these data (Figures 3-5) is that there is a fair amount of "noise" in the data. Data is not often nice smooth lines,

Figure 6



Excerpt from a training log. Note that the athlete's resting heart rate taken over 15 seconds is shown in the upper area. The "smiley" faces are shown below and allow the athlete a simple way of noting opinion or psychological self-report ideas. The athlete can simply place a dot in the appropriate square and then connect these dots to reveal trends.

athlete records of dosage, response, and performance will vary over time. In the second article of this series, we will discuss how to deal with these types of longitudinal or long-term data in terms of processing and interpretation.

One of the most important problems that coaches face with long-term monitoring data is how to make sense of the data. However, there is one aspect of the data that is collected that can be mentioned here — variation. Long-term data tends to vary due to the natural variation present in an athlete's status from day-to-day. Data will also vary because of the error present in the measurement. For example, even determining resting heart rate may have error due to miscounting, inability to find a strong pulse, problems with determining "half-beats" during the starting and stopping of counting, and mis-timing. We would like to minimize error variation due to testing so that the variation due to the process under observation can be seen more clearly.

It is important to determine the natural variation present in any variable used for monitoring. Figure 4 shows scale weight and resting heart rate from one athlete over more than three months. The heart rate data (pluses) is much more variable than the scale weight data (triangles). Hopkins (22) has shown that a change of about 1/2 the natural variation of an athlete is a large enough change to be worthwhile or worthy of our attention. How do you determine variation? Perhaps the simplest is to note the range of data values in a graph such as shown in Figure 3 and then visually estimate about half of this variation. A better means is to determine the standard deviation of the collective long-term data.

HOW TO MONITOR?

Monitoring should include both training diaries, and if possible, field- and/or laboratory-type tests. The most important aspects of monitoring are to maintain consistency in assessing and recording each variable and to treat the data as longitudinal data. The best way to handle longitudinal data is to graph it. Graphs can be made directly from training diaries (Figure 6), from spreadsheet-type programs (Figures 3-5), and from specialized software and procedures (Figures 7-8). Therefore, you should keep in mind that monitoring data will ultimately need to be graphed so that interpretation is visual and easy.

Figure 7

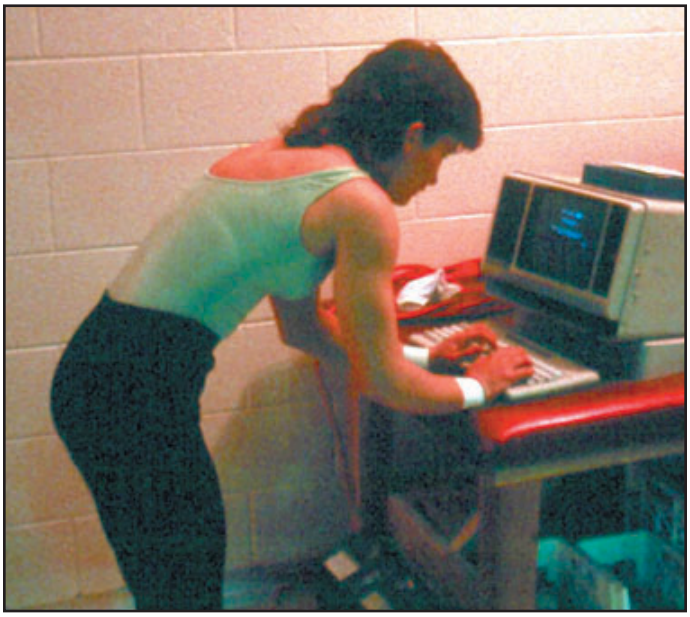


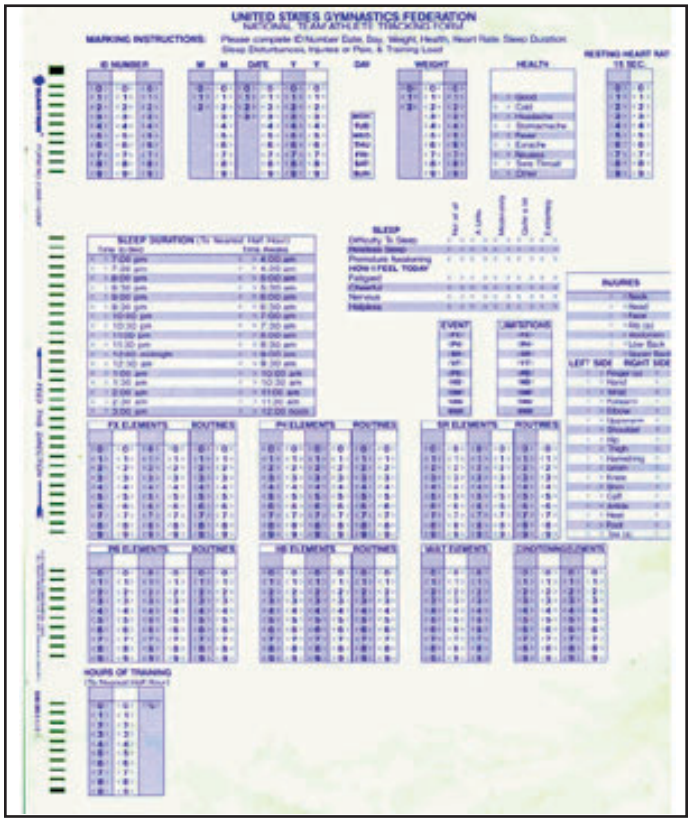
Figure 7. Athlete entering training data directly to a computer.

Training diaries are a simple, common, and easy means of recording monitoring data. Training diaries are usually maintained by athletes with periodic reviews by the coach and sport scientist. A simple means of using a paper diary for training monitoring is shown in Figure 6. A table or matrix of possible values for each monitored variable is included so that the athlete need only put a "dot" or "X" in the column. The appropriate column is dictated by the date of the data recording. The athlete or the coach can later "connect the dots" to provide a line graph that will indicate trends in the data over time.

Figure 7 shows an elite gymnast completing data entry via specialized software using a computer that was kept in the training facility. Specialized software can increase the ability of capturing self-report data and then turning the data around for easy analysis and characterization by the coach and/or sport scientist. However, the computer system has to be more than a simple database. The computer software must also invoke artificial intelligence methods so that the computer sifts through the data for the coach, identifies discrepant data and trends, and then prepares a simple report for the coach so that the coach doesn't have to "hunt" for relationships.

Figure 8 shows the monitoring form used for data entry by USA Gymnastics. This form was designed specifically for gymnastics and includes both dosage and response information. Although the data are all self-report, the analysis was extensive involving scanning of the forms, reduction of data, analysis of data, storage of data, and reporting of data (22;39-42;45). Analysis of the obtained data involved an "expert system" developed from a computer language

Figure 8



Computer "dot" sheet for recording training dose and response information for USA Gymnastics. This data form was used for several years to record national team training data. The resulting forms were mailed to a central location for scanning, storage, and analysis and then a report was returned. Today, this type of information would be obtained and turned around much faster via the internet.

called Prolog which is often used in artificial intelligence settings. The program was coded with over 200 rules obtained from the literature on overtraining and training theory regarding trends in training that should be flagged so that the coach could be alerted quickly and easily.

Laboratory tests provide more sophisticated, more valid and more reliable data than the self-reported data in training diaries. However, laboratory tests are usually performed less frequently resulting in a lower resolution of data. Laboratory tests are generally selected based on the sport, the information sought, available equipment and expertise, and access. Because laboratory tests tend to be more sensitive than training diaries, a "test microcycle" should precede each laboratory testing session. By having a "standard" microcycle prior to testing, the coach can be more assured that the athlete is in a similar state of fatigue as he/she approaches the test. Moreover, the athlete should undergo one or more tests prior to the major laboratory assessments to ensure that the athlete is not fatigue, well hydrated, and otherwise ready to produce a maximal effort.

CONCLUSION

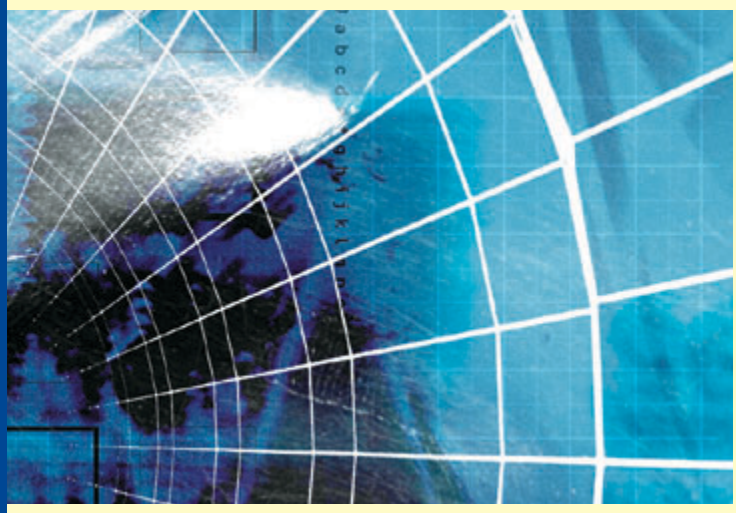
Monitoring training requires that training dosage and response variables be recorded over the long-term. These variables should be recorded with the intent of determining how the athlete is performing in the time domain as opposed to comparing one athlete with another or one team with another. You're looking for patterns in monitoring data that demonstrate that training is or is not proceeding as planned. With regard to the actual method of recording data, some methods are more cumbersome than others, and the choice of a method is likely a practical as opposed to scientific issue. Any form of data recording and storage is acceptable as long as the data are later used to enhance performance.

Dr. Bill Sands is the head of the Biomechanics Department for the United States Olympic Committee at the Colorado Springs Olympic Training Center. Bill was formerly at the University of Utah.

Dr. Mike Stone is the Director of the Exercise Physiology Laboratory at East Tennessee State University in Johnson City, TN. Mike was formerly the head of the USOC Physiology Department.

REFERENCE LIST

1. Adlercreutz H. Effect of diet exercise on hormones: Implications for monitoring training in women. *Clinical Journal of Sport Medicine* 1991;1:149-53.
2. American Academy of Orthopaedic Surgeons. Sports participation, injury and cost data. American Academy of Orthopaedic Surgeons, American Orthpaedic Society for Sports Medicine, www.aaos.org/wordhtml/press/boomer/sports.htm. 2000.
3. Banister EW, Wenger HA. Monitoring training. In: MacDougall JD, Wenger HA, Green HJ, editors. Physiological testing of the elite athlete. Ithaca, NY: Mouvement Publications; 1982. p. 163-70.
4. Berglund B, Säfström H. Psychological monitoring and modulation of training load of world-class canoeists. Medicine and Science in Sports and Exercise 1994;26(8):1036-40.
5. Bernard, A. B. and Busse, M. R. Who wins the Olympic Games: Economic resources and medal totals. 2002. Dartmouth University, Dartmouth, MA, National Bureau of Economic Research.
6. Bishop D. The validity of physiological variables to assess training intensity in kayak athletes. *International Journal of Sports Medicine* 2004;25:68-72.
7. Dare B. A review of heart rate monitoring. Track Technique 1983;85:2716-8.
8. Dishman, R. K. Biological psychology, exercise, and stress. *Quest* 46, 28-59. 94.
9. Flynn, M. G., Pizza, F. X., Boone, J. B., Andres, F. F., Michaud, T. A., and Rodriguez-Zayas, J. R. Indices of training stress during competitive running and swimming seasons. *International Journal of Sports Medicine* 15(1), 21-26. 94.
10. Foster C. Monitoring training in athletes with reference to overtraining syndrome. *Medicine & Science in Sports & Exercise* 1998;30(7):1164-8.
11. Francaux M, Jacqmin P, Sturbois X. Effect of training on lactate clearance. In: Ramstetter E, Zieres-Nauth C, Mack M, editors. Workshop Report Accusport. Mannheim, Germany: Boehringer Mannheim GmbH; 1995. p. 52-6.
12. Harre D. Principles of sports training. Berlin, German Democratic Republic: *Sportverlag*; 1982.
13. Hartmann U, Mader A. Importance of the lactate parameter for performance diagnosis and for the regulation of training in top competition athletics and in recreational sports. In: Ramstetter E, Zieres-Nauth C, Mack M, editors. Workshop Report Accusport. Mannheim, Germany: Boehringer Mannheim GmbH; 1995. p. 14-20.
14. Held T, Grossenbacher A. Improvement of the informative power of simple endurance tests by lactate determinations. In: Ramstetter E, Zieres-Nauth C, Mack M, editors. Workshop Report Accusport. Mannheim, Germany: Boehringer Mannheim GmbH; 1995. p. 57-60.
15. Hoffman JR, Kaminsky M. Use of performance testing for monitoring overtraining in youth basketball players. *Strength and Conditioning Journal* 2000;22(6):54-62.
16. Hogan K, Norton K. The 'Price' of Olympic gold. *Journal of Science and Medicine in Sport* 2000;3(2):203-18.
17. Hollander DB , Meyers MC, LeUnes A. Psychological factors associated with overtraining: Implications for youth sport coaches. *Journal of Sport Behavior* 1995;18(1):3-20.
18. Hooper, S. L. and Traeger Mackinnon, L. Monitoring overtraining in athletes. *Sports Medicine* 20(5), 321-327. 95.
19. Hooper SL, Traeger Mackinnon L, Howard A, Gordon RD, Bachmann AW. Markers for monitoring overtraining and recovery. *Medicine and Science in Sports and Exercise* 1995;27(1):106-12.
20. Hopkins, W. G. Quantification of training in competitive sports. *Sports Medicine* 12(3), 161-183. 91.
21. Hopkins WG. Measurement of training in competitive sports. *Sportscience* 1998;2(4):http://www.sportscie/org/jour/9804/wgh.html.



22. Hopkins WG. How to interpret changes in an athletic performance test. *Sportscience* 2004;8:1-7.
23. Hopkins WG, Hawley JA. Monitoring training and racing of an elite cyclist. *New Zealand Journal of Sports Medicine* 1989;17(1):2-4.
24. Hughes, M. and Franks, I. M. Dynamic patterns of movement of squash players of different standards in winning and losing rallies. *Ergonomics* 37(1), 23-29. 94.
25. Hughson S. Performance monitoring — the psychology of slalom. 1999 International Slalom Coaching Conference; Belconnen, ACT, 2616: Australian Sports Council; 1999.
26. Ishii T, Masuda T, Kurogi H, Yabuno S, Yamamoto H. The distance covered of soccer and rugby referees during the match using a mobile "GPS". In: Gianikellis KE, editor. Scientific Proceedings of the XXth International Symposium on Biomechanics in Sports. Caceres, Spain: Universidad de Extremadura, International Society of Biomechanics in Sports; 2002. p. 322-5.
27. Janssen PGJM . Heart rate monitoring for estimation of training intensity. *Medicine in Sports Training and Coaching. Basel, Switzerland*: Karger; 1992. p. 115-59.
28. Jones J. The value of heart rate monitor training. *Strength and Conditioning* 1994;16(1):36.
29. Kellmann M. Current status and direction of recovery research. In: Kellmann M, editor. Enhancing recovery: preventing underperformance in athletes. Champaign, IL: *Human Kinetics*; 2002. p. 301-11.
30. Kellmann M. Psychological assessment of underrecovery. In: Kellmann M, editor. Enhancing recovery: preventing underperformance in athletes. Champaign, IL: *Human Kinetics*; 2002. p. 37-55.
31. LeUnes A. Monitoring athlete mood using the Profile of Mood States: a case study. *Applied Research in Coaching and Athletics Annual* 1997;12:85-90.
32. Lothian, F. and Farrally, M. Estimating the energy cost of women's hockey using heart rate and video analysis. *Journal of Human Movement Studies* 23, 215-231. 92.
33. Mackinnon L, Hooper S. Training logs: an effective method of monitoring overtraining and tapering. *Sports Coach* 1994;17(3):10-2.
34. Nadori L, Granek I. Theoretical and methodological basis of training planning with special considerations within a microcycle. Lincoln, NE: National Strength and Conditioning Association; 1989.
35. Olbrecht J. The effective monitoring of training with science. Fort Lauderdale, FL: American Swim Coaches 31st Annual World Clinic; 1999. p. 115-21.
36. Plisk SS, Stone MH. Periodization strategies. *Strength and Conditioning Journal* 2003;25(6):19-37.
37. Raglin, J. S. and Morgan, W. P. Development of a scale for use in monitoring training-induced distress in athletes. *International Journal of Sports Medicine* 15(2), 84-88. 94.
38. Rushall, B. S. A tool for measuring stress tolerance in elite athletes. *Journal of Applied Sport Psychology* 2(1), 51-66. 90.
39. Sands, W. A. National women's tracking program pt. 2 - response. Technique 10(1), 23-27. 90.
40. Sands, W. A. Monitoring the elite female gymnast. *National Strength and Conditioning Association Journal* 13(4), 66-71. 91.
41. Sands, W. A. AI and athletics. PC AI 6(1), 52-54. 92.
42. Sands, W. A., Henschen, K. P., and Shultz, B. B. National women's tracking program. Technique 9(4), 14-19. 89.
43. Sands, W. A. and McNeal, J. R. Predicting athlete preparation and performance: A theoretical perspective. *Journal of Sport Behavior* 23(2), 1-22. 2000.
44. Sands WA, McNeal JR, Stone MH. Plaudits and pitfalls in studying elite athletes. Perceptual and Motor Skills 2005;100:22-4.
45. Sands, W. A., Shultz, B. B., and Newman, A. P. Women's gymnastics injuries. *American Journal of Sports Medicine* 21(2), 271-276. 93.
46. Schiffer J. Overtraining. New Studies in Athletics 2001;16(4): 79-122.
47. Shermer, M. Exorcising LaPlace's demon: chaos and antichaos, history and metahistory. History and Theory 34(1), 59-83. 95.
48. Smith DJ, Norris SR. Training load and monitoring an athlete's tolerance for endurance training. In: Kellmann M, editor. Enhancing recovery: preventing underperformance in athletes. Champaign, IL: *Human Kinetics*; 2002. p. 81-101.
49. Steinacker JM, Lehmann M. Clinical findings and mechanisms of stress and recovery in athletes. In: Kellmann M, editor. Enhancing recovery: preventing underperformance in athletes. Champaign, IL: *Human Kinetics*; 2002. p. 103-18.
50. Stone MH, Sands WA, Stone ME. The downfall of sports science in the United States. *Strength and Conditioning Journal* 2004;26(2):72-5.
51. Strand BN, Wilson R. Assessing sport skills. Champaign, IL: *Human Kinetics*; 1993.
52. Taylor SR, Rogers GG, Driver HS. Effects of training volume on sleep, psychological, and selected physiological profiles of elite female swimmers. *Medicine and Science in Sports and Exercise* 1997;29(5):688-93.
53. Thomas, K. T. and Thomas, J. R. Developing expertise in sport: The relation of knowledge and performance. *International Journal of Sport Psychology* 25, 295-312. 94.
54. Tonkins, Jr. W. P. Analysis of the relationship between exercise capacity and heart rate variability in trained and untrained individuals. 99. University of Memphis, Memphis, TN, University of Memphis.
55. Troup J. Monitoring performance with an applied approach. Las Vegas, NV: *American Swim Coaches Association*; 1983. p. 95-110.
56. van der Mars, H. and Darst, P. W. Improve your coaching environment through behavior analysis. *The Journal of Applied Research in Coaching and Athletics* 3(4), 262-273. 88.
57. Verkhoshansky, Y. Main features of a modern scientific sports training theory. *New Studies in Athletics* 13(3), 9-20. 98.
58. Verkhoshansky YV. Programming and organization of training. Moscow, U.S.S.R.: *Fizkultura i Spovt*; 1985.
59. Viru A, Viru M. Biochemical monitoring of sport training. Champaign, IL: *Human Kinetics*; 2001.
60. Viru M, Viru A. Monitoring of training. *Track Coach* 2002;Fall (161):5154-5.

TESTING —

How, Why, Who, What, and When

(and how to make sense of it)

By Wayne Goldsmith

A renowned swimming coach was walking up and down the side of the pool working with a world record holder. A younger, relatively inexperienced coach, eager to learn asked, "How do you know how your swimmer is going?" How do you know when she is ready to do her best?"

The senior coach replied, **"I just know".**

Testing does not replace the skilled eye or instinctual feel of an experienced and talented coach. It aims to provide measurement and objectivity to some of the elements of performance that coaches "see" and "feel" and "know".

This article discusses some of the current issues in the testing of high performance athletes and looks at the crucial aspects of the measurement and evaluation of elite sports performance.

THE TESTING PROCESS: NOT A ONE OFF EVENT!

Testing is not a one off event-it is a process that begins and ends with a test.

The testing process sequence includes:

- Coach determines the need for testing and discusses the test protocols with a sports science/sports medicine professional.
- Testing is scheduled and logistics, equipment, personnel etc. are organized.
- Pre-test athlete education session organized (if appropriate).
- Testing is conducted.
- Results and data collected, collated and managed.
- Results and data evaluated.
- Results and data discussed with coach and athlete.
- Coach considers results and data and makes training program decisions based on the information.
- The next test date is scheduled.
- Athlete is retested to determine progress.
- Process repeats!

Testing is a useful coaching tool, but it is one part of the overall process of athlete preparation and development.

COMPETITION BASED TESTING

Of course, the best form of testing for high performance athletes in elite sporting programs is... competition.

Competition provides the unique combination of factors that are only found on the pitch, on the track, on the court, in the pool or on the water during actual games and events.

However, it is often difficult for the coach to be effective in competition based testing as he/she is focused on observing the athlete in competition conditions and perhaps even making strategic/tactical decisions based on those observations.

Therefore, it is essential that the elite coach identifies a reliable, experienced support team of professionals who can manage the details of competition based testing leaving the coach free to coach.

After the competition or perhaps even during rest periods, the support team can provide the coach and athlete with detailed analysis of the performance and together work towards a strategy to improve competition results.

HOW TO TEST

The perfect test is one where the athlete is accurately evaluated in the precise conditions likely to be experienced in competition and the results of the test directly relate to competition performances.

This is invariably difficult to achieve as there are various factors experienced in competition which are near to impossible to replicate in a training or testing environment.

For example: How do you measure a striker's ability to score a goal under game pressure when the only time they face game pressure is during a game?

How can you test a swimmer's ability to break the world record when they will only be swimming at world record speed over race distance during the world record swim?

Typically, testing protocols and methods are single discipline perspectives of one element of performance, e.g. tests based on physiology, biomechanics, psychology, nutrition or medical. The challenge for the coach is to effectively manage this narrow perspective to gain an overall understanding of the athlete's abilities and capacities at the time of testing.

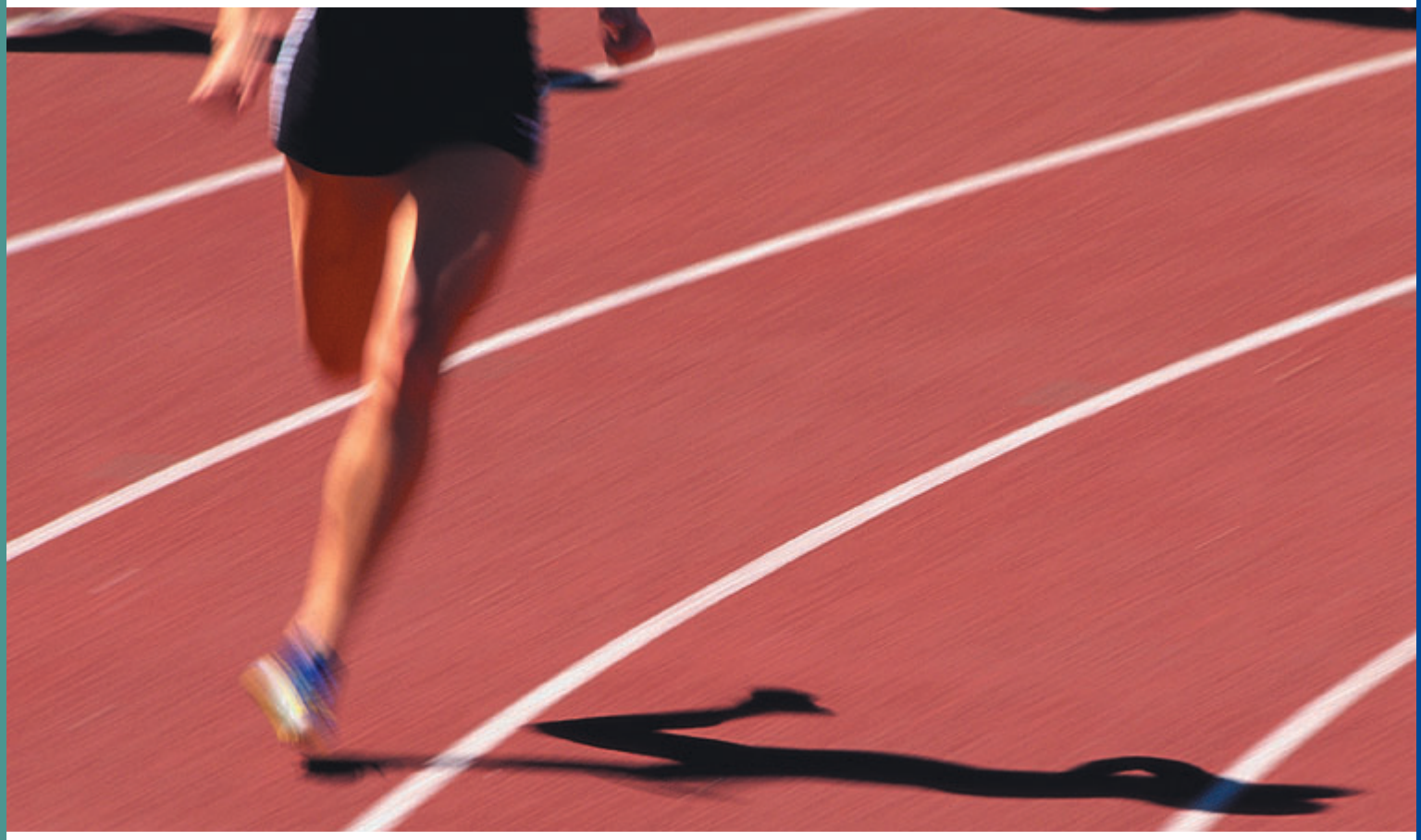
WHY TO TEST?

Generally, there are many reasons why a coach would want to test an athlete. Once training and competition goals have been clearly established, a coach would test athlete:

1. To provide information and feedback on the progress of the training/preparation of the athlete— Are we on track to achieve our goals?
2. To provide information on specific elements of the athlete's capacities and abilities — Is the athlete developing and improving?
3. To determine areas of weakness or limitation — Are there problem areas or issues that need to be overcome?

WHO TO TEST?

Practically any athlete can be tested. Even young athletes can be tested for skill development and technical progress. Young athletes can also be educated on how to develop the skills necessary to perform the testing protocols they are likely to experience as senior athletes. For example, many tests require the ability to accurately maintain a precise speed, power output, pace or time. These skills can be taught to relatively young athletes as part of their development process and to prepare them to complete senior testing protocols as they mature.



WHERE TO TEST?

Field or laboratory-the toughest question in the testing puzzle. Both have advantages and disadvantages. Field testing can be simple, easy, inexpensive and meaningful to the coach and athlete but can be difficult to control, owing to environmental factors and a wide range of other complicating variables experienced in the training and competition setting.

Laboratory testing is often expensive, requires complex equipment and trained personnel to operate it and in many cases, has the considerable challenge of making the test results meaningful and specific to the actual sports environment.

Tests for oxygen exchange dynamics (e.g. VO2 max) have generally been performed in laboratories as the availability of precision equipment allows for more accurate testing. However, the limitation in laboratory testing is in the capacity to reproduce actual sports specific training and competition conditions. For example, the measurement of VO2 max on a cycle ergometer or rowing machine in the lab is based on well established testing protocols. However, the lab cannot exactly reproduce the external environmental factors (bike or road conditions, weather, hills, wind resistance: rowing-the water conditions, current, weather, wind, boat friction/water resistance) that athletes experience in training and racing.

Effective testing can be done at any time during the training or competition program depending on what you are looking for.

In the end, a combination of regular field based testing (because of the practical, easy and immediate nature of the testing) together with occasional laboratory testing (because of accuracy, reliablility and quality) is a good option.

WHAT TO TEST?

Selecting what to test for is a complex issue for every coach. Universities and other professional organizations can provide the coach with a wide variety of tests and toys all with the promise of quick easy solutions to performance challenges. One of the biggest problems for coaches is that many do not clearly identify what it is they want to test. As a result, when a sports science professional suggests what is possible, the coaches respond like the kid in a "toy shop" wanting a little of everything.

Deciding what to test starts with a simple philosophical question for every coach:

"WHAT DO I BELIEVE ARE THE KEY DETERMINANTS OF SUCCESSFUL PERFORMANCE IN MY SPORT"

For example, as a coach of marathon runners you decide that the key determinants for success in your sport are oxygen exchange dynamics and biomechanical efficiency at 80-90% of maximum speed. Once you have made this philosophical decision, finding the right tests to evaluate the athletes is relatively easy.

As a coach of a soccer team, your philosophy is that the best players are skillful at high speed. Again, the choice of tests is a simple matter once you have decided what you want to look for. Another advantage of establishing your own testing philosophy is that "unless you stand for something, you will fall for anything". Sometimes coaches fall for promises of magic pills and quick fixes from sports science professionals looking for subjects for a study or research project.

WHEN TO TEST?

Effective testing can be done at any time during the training or competition program depending on what you are looking for. Tests of maximum capacity or peak abilities are generally best performed when the athlete is rested and unfatigued. Traditionally this has meant testing during or at the end of a rest or recovery microcycle. However, if you as a coach have determined that you would like to assess the impact of physiological fatigue on skill and speed, then testing tired athletes is consistent with your overall program philosophy.

SUMMARY — THE 10 GOLDEN RULES OF TESTING

1. Test for things that make sense. Testing VO2 max in lawn bowlers is not logical
2. Test because you believe it will make a difference. Just testing for testing sake or because the equipment is available is not the most effective use of training time.
3. Test with a performance focused goal. Test elements of performance that you believe will make a direct impact on performance. Try not to get trapped in testing just to try and get a progressively better test result unless it is directly related to actual competition performance of the development of more effective training protocols.
4. Don't ask for a single test-ask for a series. If you make the commitment to be involved in a testing program, ask for more than one test. One off tests rarely tell the whole story.
5. If you are working with sports science/sports medicine

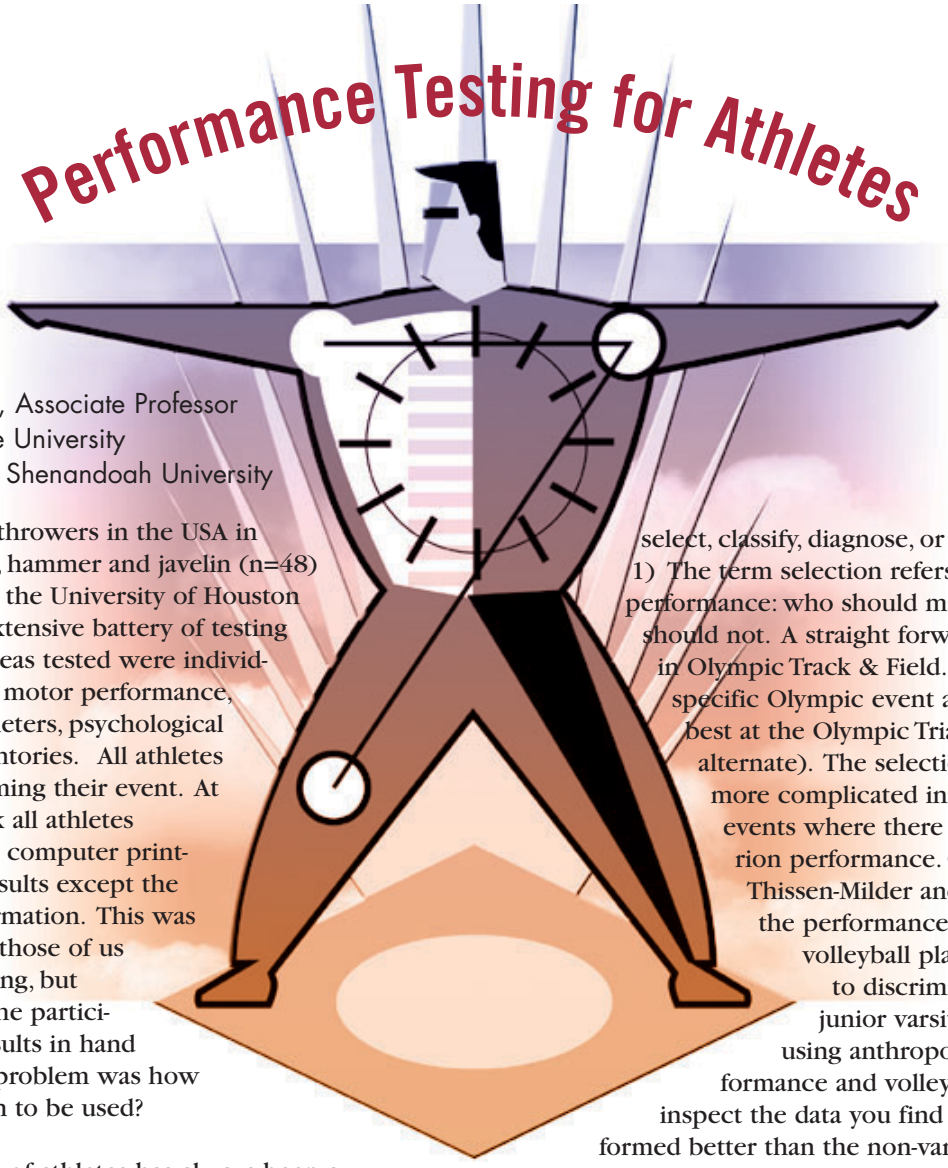
professionals, demand that any test results are provided within 24 hours and that the professional allocates time to explain the results and their relevance to your program. This applies particularly if you have agreed to allow your athletes to be involved in a research project.

6. Think multi-disciplinary. If the athletes are being tested through lactate analysis, also measure and observe technical changes to assess the impact of fatigue on technique and skills. If they are being evaluated using heart rate; note speed, technique and if possible assess psychological skills at the same time.
7. Be visionary. If you as the coach see the need for a test to evaluate an element of performance which you believe is crucial to the success of the athlete, develop your own test! Ask a sport science/sports medicine professional to help you with the measurement side of things, but many great coaches use simple field tests that are meaningful to them but which may lack absolute scientific validity. Many scientific tests were originally ideas inspired by visionary coaches.
8. Keep records. Try to record all test results. Have assistant coaches, parents of athletes, injured players, reserve team players-anyone-trained to record (accurately) test results.
9. Measure what is measurable-Control what is controllable-What can be measured and controlled is likely to be meaningful. (Bill Sweetenham)
10. Take time to educate athletes about testing. In time, senior athletes can learn to do some or most testing protocols themselves. Athletes can learn to monitor their own heart rates, take their own times, count their strides, record their feelings... and the better educated your athletes are to self manage/self monitor their own testing, the more meaningful the results are to them. Also, having educated athletes who can self monitor means the coach has the freedom to coach, observe and learn during the testing process.

As it is with your overall program, testing is Athlete Focused and Coach Driven-manage the testing process so that you can provide your athletes with the best possible opportunity to achieve their performance goals.

Wayne Goldsmith is an Australlian Swimming Coach as well as a consultant to various international swimming programs. Wayne was the winner of the Eunice Gill Award for Outstanding Contribution to Coaching Education in Australia. He is a Level II coach in Swimming, Track and Field and Triathlon.

Performance Testing for Athletes



By Dr. Jimmy Disch, Associate Professor
of Kinesiology, Rice University
And Scott C. Disch Shenandoah University

In 1978 the top throwers in the USA in shot put, discus, hammer and javelin (n=48) spent a week at the University of Houston going through an extensive battery of testing and training. The areas tested were individual strength, power, motor performance, physiological parameters, psychological tests & dietary inventories. All athletes were filmed performing their event. At the end of the week all athletes walked away with a computer printout of all of their results except the biomechanical information. This was a massive effort for those of us involved in the testing, but the goal of having the participants leave with results in hand was achieved. The problem was how was this information to be used?

Performance testing of athletes has always been a popular endeavor since the days of Dudley Sargent. The problems are what tests to use, how to interpret the results and ultimately how to implement them? The obvious areas to test are the motor performance and psychological dimensions. The problem with the motor performance tests are (1) which ones to use, (2) how many trials to administer and (3) what do the results mean. Recent interest has developed in neurocognitive testing. In the psychological and neurocognitive areas, the question of trials is not a concern since affective tests are only administered once. The questions of which tests and how to interpret them are pertinent.

The remainder of this article will attempt to answer these questions related to motor performance testing only.

USES OF PERFORMANCE TESTING

The primary goal of testing is to aid in making intelligent decisions. From an evaluation stand point the information that can be gleaned from performance tests can be used to select, classify, diagnose, or predict. (See Figure 1) The term selection refers to different levels of performance: who should make the team and who should not. A straight forward example would be in Olympic Track & Field. Those selected for a specific Olympic event are those who perform best at the Olympic Trials (top three and one alternate). The selection problem becomes more complicated in team sports and events where there is not a concrete criterion performance. Consider the study by Thissen-Milder and Mayhew (1991). In the performance testing of high school volleyball players they were able to discriminate between varsity, junior varsity and freshmen levels using anthropometric, motor performance and volleyball skills tests. If you inspect the data you find that the varsity performed better than the non-varsity players in most areas, especially the skills tests. This is expected. The interesting information in this table is the motor performance levels of the freshmen players. These levels are the same or exceed the JV players in most areas. This indicates that there may be a lot of future talent in the freshman class.

Figure 1 PURPOSES OF PERFORMANCE TESTING

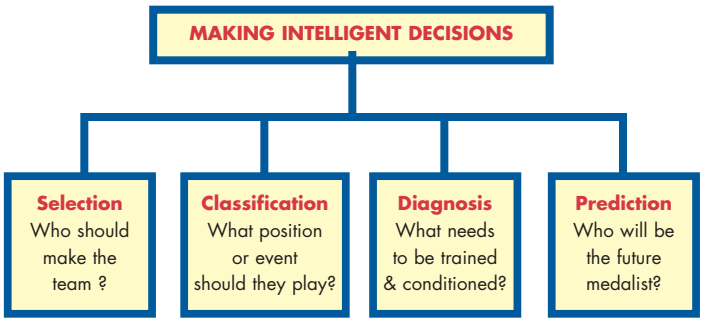


Table 1 HIGH SCHOOL GIRLS VOLLEYBALL DATA

VARIABLE	FRESHMAN MEAN	(N = 12) s.d.	JUNIOR VARSITY MEAN	(n = 14) s.d.	VARSITY MEAN	(n = 24) s.d.
Age (yr)	14.12	0.61	15.65	0.63	16.4	0.64
Height (cm)	167.1	6.7	167.0	7.4	168.7	7.8
Weight (kg)	58.8	6.4	50.7	8.0	58.6	10.5
Percent fat	18.1	2.6	19.6	3.4	17.2	3.8
Sit-and-reach flexibility (in)	6.5	1.8	6.6	2.5	6.6	2.2
Agility (s)	33.8	2.0	31.6	2.3	41.9	1.8
Vertical Jump (cm)	37.8	7.1	35.6	5.9	43.6	5.6
Forearm pass (cts/min)	21.1	8.0	25.5	8.4	40.8	6.9
Overhead volley (cts/min)	22.9	7.2	22.3	7.2	34.8	6.8
Wall Spike (cts/min)	5.2	4.6	7.1	8.8	13.7	7.3
Bump Set (cts/min)	27.6	9.2	31.4	7.8	41.9	3.6

Testing of this type should not be the sole factor in determining team membership, but it does add credibility to the coach's selections (See Table 1).

Classification refers to placing an athlete in an event or position best suited for their specific traits. Again in track and field the classification of sprint or distance runners is obvious. But assigning athletes into multi-event competitions could be aided by valid performance testing. A classification example can be examined in the work of Disch, Ward and Foreman (1978). In this example a group of youth female track athletes (n=41) were tested to determine if they were classified into the proper events. Table 2 presents performance profiles of distance runners, sprinters

Table 2 : PERFORMANCE PROFILES FOR FEMALE TRACK ATHLETES

Z Score Equivalent	Weight	Percent Body Fat	Visual Reaction Time	Vertical Jump	Velocity2 5-10 yard (Interval Time)	Velocity 8 35-40 yard (Interval Time)
2.0	186.88	9.47	.189	24.27	20.80 (.721)	28.25 (.531)
1.8	181.03	10.37	.194	23.63	20.59 (.729)	27.80 (.540)
1.6	175.18	11.28	.199	22.99	20.38 (.736)	27.39 (.548)
1.4	169.32	12.18	.204	22.35	20.17 (.744)	26.99 (.556)
1.2	163.47	13.08	.210	21.71	19.96 (.752)	26.59 (.564)
0.8	151.76	14.89	.220	20.42	19.54 (.768)	25.78 (.582)
0.6	145.90	15.80	.225	19.78	19.33 (.776)	25.37 (.591)
0.4	140.05	16.70	.231	19.14	19.12 (.785)	24.97 (.601)
0.2	134.19	17.61	.236	18.50	18.91 (.793)	24.57 (.611)
0.0	128.34	18.51	.241	17.86	18.71 (.802)	24.16 (.621)
-0.2	122.49	19.41	.246	17.22	18.50 (.811)	23.76 (.631)
-0.4	116.63	20.32	.251	16.58	18.29 (.820)	23.36 (.642)
-0.6	110.78	21.22	.257	15..94	18.08 (.830)	22.95 (.654)
-0.8	104.92	22.13	.262	15.30	17.87 (.839)	22.55 (.665)
-1.0	99.07	23.03	.267	14.65	17.66 (.849)	22.14 (.678)
-1.2	93.21	23.94	.272	14.01	17.45 (.860)	21.74 (.690)
-1.4	87.36	24.84	.278	13.37	17.24 (.870)	21.34 (.703)
-1.6	81.50	25.74	.283	12.73	17.03 (.881)	20.93 (.717)
-1.8	75.65	26.65	.288	12.09	16.83 (.891)	20.53 (.731)
-2.0	69.80	27.55	.293	11.45	16.62 (.902)	20.12 (.746)

Scores represent standard score transformation for all tests.

Distance Jumpers Sprinters/Jumpers Throwers Subject 7

and jumpers, and throwers. The obvious dimensions that differentiate the groups are body type and speed. The really interesting information that can be observed in this table is the profile of subject #7. She exhibited good but not great levels of both speed and power. This information could be utilized to counsel her into multi-event performances.

Diagnosis is an extremely fruitful use of performance testing. Diagnosing athletes strengths and more importantly their weaknesses will allow for efficient individualized training regimes. The final example is a theoretical diagnostic example. Consider the data displayed in Table 3. Two players are profiled who have distinctive performance patterns. Player one has very high levels of motor performance characteristics. However, he does not possess the body weight of players his height. He should be placed on a diet and weight program to increase his lean body mass. Player two on the other hand has good size and body composition characteristics, but lacks high levels of motor performance variables. His program should be focused on specific training to improve speed and quickness.

Prediction is probably the most exciting form of performance testing. In the late 60's and 70's, the Soviets and the Eastern block Communist countries claimed to be able to test youth athletes and not only classify them into the correct sport or event, but also predict who would be able to compete at the Olympic level. When asked about what tests were used and how the tests were analyzed, the answers were vague and incomplete. Prediction is an ultimate use of performance testing, but at this point is not practical in real world situations.

STATISTICAL AND MEASUREMENT ASPECTS

To further examine the realm of performance testing athletes, several statistical and measurement terms need to be considered: reliability and validity. A test is deemed to be reliable if it can be accurately measured. A forty yard dash is a very reliable test under most testing circumstances, whether it is measured electronically or hand held. A valid test is one that is relevant: it measures what it is supposed to measure. The forty is a valid measure of speed, but not of endurance.

Table 3 MEN'S VOLLEYBALL PERFORMANCE PROFILE

PERCENTILE	WEIGHT (lb)	HEIGHT (in.)	PERCENT BODY FAT	VERTICAL JUMP (in.)	TRIPLE HOP (in.)	AGILITY RUN (s)	20 YD DASH (s)
99	200	78	5.70		344	7.7	2.5
95	189	77	5.94	29	341		2.7
90	188		6.15	27	333	7.8	
85	185	76	6.58	26	330		2.8
80	183	75.5	6.86	25	319	7.9	
75	182		6.99		313		
70	181	75	7.30	24	303	8.1	
65	180		7.41		302		2.9
60	179	74	7.55		297		
55	174		7.6	23	296	8.3	
50	172		7.74		295	8.5	
45	169	73	8.09		292		
40	162		8.21		287		
35	161		8.47		285		3.0
30	158	72	9.68		279	8.8	
25	157	71	9.88	22	276		
20	156	70.5	10.15				
15	154		10.88	21	272	8.9	3.1
10	151	70	11.63		266	9.4	3.3
5	136	69	11.63	20	254	9.5	3.4

Player 1 Player 2

The most difficult aspect of performance testing is not finding reliable tests, but finding valid ones: ones that really discriminate between performance levels. Test selection should be theory driven. At least one test should be selected to measure all of the traits that are related to success in a given sport or event. The tests should usually not be skill oriented, i. e. not related to specific learnable elements within a given sport. They should be based on basic motor abilities - innate factors such as speed, power, agility, etc. The most common way in which to develop performance testing batteries is to compare two groups that are inherently different on the test battery. A classic example of this approach was used at a tryout camp for the USA Women's Volleyball team in the early 70's (Jackson, Disch, Liskevych, Field, and Grimmett, 1974). Twenty players were invited to a tryout camp in Houston under the tutelage of then coach Pat Zartman He was not interested in performance testing, but Terry Liskevych, an assistant at the time, was. He talked Pat into allowing the players to be tested. A battery of motor performance tests were selected that included a vertical jump, triple hop, twenty yard dash, agility run, basketball throw, height, weight, percent fat estimated from skin folds and a three minute sub-maximal step test. It should be noted that none of the tests related specifically to volleyball skills. The tests were administered by Kinesiology professionals at the University of Houston and Rice University. None of the coaches involved with the tryout camp were directly involved with the testing. At the end of the camp eight players were selected to play with the national team with the other 12 assigned to train regionally. A multiple discriminant analysis was performed on the tests with the selection decisions used as the dependent variable. The results of the analysis indicated that 90% of the players were properly classified based on the performance tests alone. This is an excellent classification rate made even more impressive by the fact that these were the top 20 players in the country that were not already on the U.S. team, a very homogeneous group from an ability standpoint. An examination of the two misclassifications was very enlightening. The one that was selected for the USA team, but was incorrectly classified by the tests came into camp in relatively poor physical condition. She was also observed to not give maximum effort in the testing. But her volleyball skills warranted her selection. The other misclassification tested well enough to make the team, but was not selected for political reasons.

SELECTED MEASUREMENT OBSERVATIONS

Some other points salient to performance testing of high level athletes are (1) practical versus statistical significance, (2) false positives and false negatives, and (3) safety. When dealing with high level performers the differences between medaling and simply qualifying for the finals may be very slight. Traditional statistical test of significance may be misleading because important results may not be significant at the .05 level. Also, random groups are not appropriate for testing athletes of this type. These are select, performance groups based on very high levels of competitive performance. Descriptive differences must be interpreted based on previous experience and years of prior performances.

False positive and false negative can have a huge impact on testing. A false positive is a player that tests well enough to make the team, but really cannot compete at that level. A false negative is someone that should be on the team, but does not test well enough to make it. Both types of misclassifications can be severe, but this is where intelligent coaching decisions come in. When Dr. Bob Ward was the strength & conditioning coach for Tom Landry and the Dallas Cowboys, he was the first one to really utilize performance testing with NFL football players. He found that the most helpful use of these test was not to tell you who could play, but who could not! At free agent camps the Cowboys could run hundreds of players through a series of motor performance tests in the morning and determine which few had the potential to play. They could then focus their attention on the few that tested well enough to warrant a further look.

A third primary concern of testing is safety. All the normal considerations regarding testing should be followed: safe conditions, warm up, adequate rest, etc. The point that has to be emphasized is "do normally safe tests pose a risk for high level athletes?" The example of this concern relates to the aforementioned throwers camp in Houston. One of the tests to be used was the standing long jump. A group of the shot putters pointed out to the testers that because of their large body structure the standing long jump put inordinate stress on their knees. They had no problem performing the vertical jump test, but were excused from the standing long jump.

CONCLUSION

In conclusion, there are a number of important uses of performance testing. One problem that has not been mentioned is the time needed to test. Many coaches feel they do not have adequate practice time to train their players. Therefore they are hesitant to take time to test. Our suggestion is to select a small battery of tests you feel are most relevant to your specific situation. Test twice or at most three times throughout the year: preseason and post season or preseason, post season, and off season. Finally integrate the test results with your coaching expertise. Use the information in ways you feel best help your program. Communicate the results of testing to the athletes! Help them understand how the results can be used to improve both the player and the team.

REFERENCES

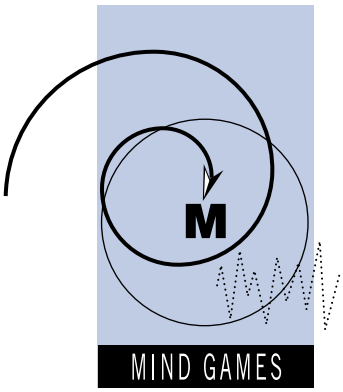
Disch, J.G., Ward, P.E., & Foreman, K. (1978). Classification variables that discriminate among groups of Female track athletes In J. Terauds & G. Dales (Eds.), *Science in Athletics*, (pp. 265-276), Del Mar, CA: Academic Publishers.

Jackson, A.S., Disch, J.G., Liskevych, T., Field, P. & Grimmett, D. (1974). A test battery to discriminate between levels of volleyball playing ability. In Volleyball Workshop; Houston: E Pluribus UNUM, 7 pp.

Morrow, J. R. Jackson, A.W., Disch, J.G., & Mood, D. P. (2005). Meausurement and *Evaluation in Human Performance*, 3rd. Ed. Champaign, IL: Human Kinetics.

Omizo, M.M., Morrow, J.R., Ward, G.R., Disch, J.G. & Michael, W.B. (1979). The validity of a composite of nineteen personality variables in differentiating between American world class Olympic contenders and undergraduate education majors. *Educational and Psychological Measurement*, 39: 977-983.

Thissen-Milder, M, & Mayhem, J.L. (1991). Selection and classifications of high school volleyball players from performance tests. *Journal of Sports Medicine and Physical Fitness*, 31: 380-384.



So You Want To Be A Great "Big-Event Coach?" Three Things That Can Make or Break You

by Sean McCann, USOC Sport Psychologist

With the upcoming Olympic Trials for the Winter Games, we wanted to reprint this article by Dr. McCann. Enjoy!

Like athletes, some coaches thrive in big pressure situations, and others fare poorly. The Summer Games in Athens were my 6th Olympic Games, and with close observation of coaches in these situations, I have noticed certain patterns that exist in the coaches who excel under pressure. For simplicity's sake, I have organized these behaviors into three key skill areas; self-knowledge, having a coaching-stress-thermostat, and relationship-building with athletes.

SELF KNOWLEDGE

I am regularly surprised by generally successful coaches who have very large "blind spots," or issues that everybody except the coach seem to be aware of. Often, coaches are left in the dark about the blind spots until something goes very wrong in a big event. In preparing for big events, I'd suggest gaining self-knowledge in two areas: Defining coaching excellence at big events, and getting feedback on your strengths and weaknesses when stressed.

DEFINE COACHING EXCELLENCE. In an Olympic Coach article a few years ago, I wrote how difficult it was for Olympic coaches to evaluate their own coaching performance separately from the medal performance of their athletes. Forcing yourself to write down a checklist of "behaviors of excellent big-event coaches" before the event, can help to increase self-knowledge. By rating your skills in each of these behaviors (e.g., daily organization, flexibility under pressure, optimism, ability to delegate, etc.), it will give you clues on your potential blind spots at big events. Of course, success at the big events is related to excellence, but it isn't the same thing. As Joe Paterno said *"Success is perishable and often outside our control. In contrast, excellence is something that's lasting, dependable, and largely within a person's control."* If you strive for big event coaching excellence, success is more likely to come.

LEARN YOUR STRESS PERSONALITY THROUGH FEEDBACK. One of the most useful (and difficult) things a coach can do is get honest feedback from the people around them. For big event coaching, it is extremely useful to know how those around you see your strengths and weaknesses when you are feeling criticized, angry, nervous, or depressed. These four conditions are regular visitors to coaches at big events, and knowing how you are perceived by athletes and other staff during those moments can help you develop a strong plan to use your strengths and compensate for your weaknesses. Unfortunately, research has shown that the higher you rank in an organization, the less likely you will be to get honest feedback. You need to have at least one person in your coaching environment that isn't afraid to tell you the truth. Do you?

A THERMOSTAT FOR COACHING STRESS

Like a thermostat that releases coolant to an engine in danger of overheating, it is important for coaches to have mechanisms to handle the increased stress of big events. Coaches who lack these mechanisms tend to get in "survival mode"

during big competitions and a coach who is just "trying to make it through" a major event is not an excellent coach. There are four key strategies to building your own stress-thermostat:

1) **CONTROLLING ANXIETY.** People vary greatly in how nervous they get during competition. Nervousness is not a problem unless it interferes with your ability to coach at your best. Unfortunately, I have witnessed numerous examples of a nervous coach coaching poorly at the most important events. This can happen by making other staff nervous, by worrying endlessly, by spreading nervousness to athletes, by over-coaching (saying too much) and under-coaching (saying too little), by focusing on not making mistakes instead of possible opportunities, by becoming rigid, and by becoming tense and irritable and draining the fun out of everyone around you. If any of these have happened to you at smaller events, they are more likely to occur at bigger events.

Compartmentalizing, or setting aside those thoughts for a while in order to focus on the here and now, is a key skill to master.

To battle coaching anxiety, you must be good at controlling thoughts, feelings, and your physical state. Identify the thoughts and feelings that calm you down, and develop the ability to call-up those thoughts and feelings when nervous. For example, one successful coach thinks of his family for 30 seconds before he gives a speech to his team. This allows him to believe his message of having fun and staying relaxed and aggressive. In addition to thoughts and feelings, developing breathing and relaxation techniques to quickly lower your heart rate and slow down breathing will help prevent your coaching body from undermining your coaching mind.

2) **STRESS-MANAGEMENT STRATEGY.** I don't know any successful coaches who don't have some way to reduce overall stress. For most coaches, the most successful way is exercise, although I have known coaches to read, listen to music, write letters, and play video games. Whatever strategy you use, the key thing is to **continue the strategy during big events!** I have seen too many coaches who give up a stress management strategy during the Olympics because "I just don't have time." If managing stress makes you a better coach, you can't afford to stop managing stress in the biggest events with the most stress.

3) **COMPARTMENTALIZING.** A number of real issues can interfere with your ability to focus on the present and have an effective meeting with an athlete during a big event. These issues can include; unfinished business, questions about schedule changes, unexpected technical challenges, anger over stupid decisions, challenges in your personal life, and a variety of other issues. Compartmentalizing, or setting aside those thoughts for a while in order to focus on the here and now, is a key skill to master. Without this skill, you can lose the ability to solve problems quickly as well as the ability to connect emotionally with the people around you.

Even very simple techniques can help you develop the ability to compartmentalize. One strategy coach's use is to identify a physical place which is the last point where extraneous thoughts can enter your head. For example, a coach who always drives a car to competitions, literally opens a glove compartment, takes a breath, drops in all extra unhelpful thoughts, closes the glove compartment and leaves those issues for after the competition. Another coach uses a two sentence verbal checklist before talking to individual athletes on competition day. Before approaching the athlete, he says "Where am I? I'm right here, right now." With this exercise, he assures all other thoughts are cleared from his head so that he can really listen to the athlete.

4) **IMPULSE CONTROL.** The powerful emotions that hit you at big competitions are one of the things that can make coaching at big events so much fun. On the other hand, strong emotions can sometimes overwhelm coaches. While anger and frustration may be real and appropriate responses to a terrible call that could cost you a medal, effective big event coaches learn to control the impulse to vent anger during the competition. Impulsively shouting, swearing, or physically displaying your feelings can send a powerful message to other coaches and your athletes.

At a recent Olympics, an athlete told me that an outburst by an angry coach told her that the coach didn't believe she could win in her next event. In fact, the coach was angry at something else, but the athlete assumed he was angry about her performance. For a coach at a big event, finding a safe place to express feelings is one thing, losing control is another. At big events, with everyone under stress, losing control is very dangerous.

KNOWLEDGE OF YOUR ATHLETES

The best coaches understand their athletes. Period. One wrinkle for coaching at big events is that your athlete may show you something you haven't seen from them before. As one coach told me after a devastating surprise failure at the Olympics, *"I didn't think I had to talk to him about managing pressure. He is a World Champion! Of course, in hindsight, he had lots more pressure and expectations*

here. I worried about some of the others, but not him. I should have talked to him."

Of course, understanding your athletes and developing effective communication is the heart of all effective coaching. Big event coaching is no different except the consequences of not knowing your athletes' is bigger! Keys to remember on this important subject include:

1. **DON'T OVERLOOK EMOTIONS.** Feelings are often more important than thoughts at big events. People react differently to stress, and athletes may be on a completely different page than you. Know the early warning signals for confidence problems, nervousness, and over-arousal. One coach told me after the fact "*I saw her nodding and smiling, but I could tell she was so fired up that she wasn't listening at all.*" Taking the extra five minutes with this athlete to calm her down and remind her how simple the job was made all the difference for this Olympic medal winner.
2. **DEVELOP GOOD QUESTIONS.** Getting in the habit of asking rather than telling pays giant dividends at big events. Rather than guessing how the athlete is doing, asking the right questions can help the athlete develop self-knowledge, self-control, and self-confidence. Among the best questions you can ask are those that remind an athlete how they got to where they are. For example, asking **what they did** to make training go so well the day before is a great way to talk to an athlete before a big event. It reminds them to focus on the "what to do, not the what if".

One of my favorite exercises with a nervous athlete at a big event is to go through four questions:

1) What is your job? (Answer, for example "wrestle well tomorrow")
2) How do you do that? ("Attack the first minute, then go harder")
3) Can you do that? ("YES! I'm in amazing shape)
4) Will you do that? ("Yes.")

Asking questions can become a routine that allows you to quickly figure out where your athlete's head is at. In addition, it lets athletes find solutions rather than simply agreeing with yours (if the athlete can't say it, he isn't likely to believe it!).

3. **DEVELOP TRUST SO THAT ATHLETES CAN EXPRESS WEAKNESSES.** Guess how many athletes like to tell their coaches that they are afraid? Exactly. None do. Guess how many coaches want a terrified athlete to keep it to themselves at a big event? OK, maybe some would! But you cannot solve a problem if you don't know it exists. Your athletes need to be able to tell you when they need your help, when their own skills are over-matched by the situation.

One of the most dangerous myths athletes hold is that "mental toughness" means ignoring the dangerous and distracting thoughts, the anxiety, and the self-doubt. Many athletes believe that talking about fears makes them real, while trying to push these thoughts and feelings away equals mental toughness. Unless they have a strategy for controlling their thoughts and fears, however, this approach is doomed to fail at big events, where the demons are so much bigger. This problem is greatly increased if athletes are afraid to admit any weaknesses to their coach. Treating nervousness and self-doubt as normal parts of big events allows you to talk about and help solve these challenges with the athletes. On the other hand, if mentioning these things is taboo, you won't know until you see them arrive in the form of defensive and tentative behaviors in the competition.

One of the most dangerous myths athletes hold is that "mental toughness" means ignoring the dangerous and distracting thoughts, the anxiety, and the self-doubt.

4. **KNOW THE DIFFERENCE BETWEEN "GOOD QUIET" AND "BAD QUIET."** You must know how your athletes look when they are ready to go versus when they are trying to look as if they are ready to go. Knowing this difference is the key to big event coaching, because knowing this means you know when to brake, when to steer and when to get out of the way. Of course, it isn't just the quiet athletes you need to read. You also need to know what it means when an athlete laughs with others, does jumping jacks, talks on the cell phone, or prays. You must know the normal competition routines, and the ones you are seeing for the first time. Big events often bring new behavior, and you must determine if this new behavior is good or bad.

The best way, of course, is to go from past behavior (which is always the best predictor of future behavior). Seeing behavior for the first time at an Olympics isn't necessarily a bad thing, but it sure isn't always a good thing either. If you have good communication, it is rarely a problem to ask in athlete how they are doing, especially if that is your normal routine. Just like your athletes, you should always question why you are doing something for the first time at a big event.

The extra adrenaline that comes with big events like the Olympics and World Championships are like a wave coming at you. If you have the three key areas figured out (self-awareness, coaching stress-thermostat, and really know your athletes), you can catch that wave like a surfer and have a great time. If you don't, well, it's like a wave coming at you.

60-SECOND SUMMARY

Review — HOME ADVANTAGE

1. "The Home Advantage in Sport Competitions: Courneya and Carron's (1992) Conceptual Framework a Decade Later", Albert Carron, Todd Loughhead and Steve Bray. Journal of Sports Sciences, April, 2005; 23 (4): 395-407.

2. "Home Advantage in Speed Skating: Evidence from Individual Data", Ruud H. Koning. Journal of Sports Sciences, April, 2005; 23 (4): 417-427.

3. "Audience Support and Choking Under Pressure: A Home Disadvantage?", Harry Wallace, Roy Baumeister and Kathleen Vohs. Journal of Sports Sciences, April, 2005; 23 (4): 429-438.

4. "Home Advantage in the Winter Olympics (1908-1998), Nigel Balmer, Alan Nevill and Mark Williams. Journal of Sports Sciences, 2001;19 (2):129-139.

"Home advantage has been shown to exist for individual sports (alpine skiing), team sports (soccer, hockey, football, baseball, basketball) and for countries organizing sports tournaments like the Olympics and World Cup Soccer" (2). "In their analysis of the number of medals won by competing nations in the Winter Olympic Games (1908-1998), Balmer, Nevill and Williams (2001) found that when all events were combined, a significant home advantage was present." (1) Stephen Clarke states that "historically the home team wins over three times their usual percentage of medals".

As you can see from these two quotes, the home advantage is a very real phenomenon—even in the Olympic Games setting. In fact, Carron and Hausenblas (1998) gave five generalizations regarding the power of the home advantage.

1. Occurs in professional and amateur sports.
2. Present in individual and team sports.
3. The gender of the athletes does not make a difference.
4. Benefits the home country in international competitions.
5. Has been in existence since 1888 (English soccer).

Carron and Courneya looked at four factors concerning home advantage: crowd factors, learning or familiarity, travel and rules.

CROWD FACTORS

The crowd size does not have as much of an impact as the crowd density (number of people watching v. the size of the facility). During cheering and booing, the home teams did better, but during "antisocial crowd behavior ("swearing, chanting obscenities, throwing objects, etc.) the home team committed more violations".

The performances of teams actually improved in the absence of spectators. (1) Although not discussed in Carron

and Courneya, this may be an issue of skilled v. effort performances as described by Wallace et al. "Skilled performance normally involves non-conscious, automatic processes that are subject to over learning... effort is more subject to immediate conscious control than skill." In essence, those individuals who think about performances may be affected more by the crowd.

The literature shows that it does affect judged sports (figure skating) more than non-judged sports (speed skating). Three studies found that officials provide positive officiating for the home team. Balmer et al (2001) showed that this bias occurred even in the Olympics, "The host countries had a proportionately larger home advantage only in the subjectively judged events of freestyle skiing and figure skating."

Other studies dealing with team sports noted that officials in loud crowds called significantly fewer fouls against the home team.

LEARNING/FAMILIARITY

"Familiarity with local conditions is potentially a more important factor in determining home advantage. A Dutch Olympic medalist stated "It takes three days to get used to the ice and skating rink at high altitude. Canadians and Americans have a great advantage in that respect." (2)

In a soccer study, it was indicated that "teams playing on an artificial turf had significantly higher home advantages than teams on natural grass".

TRAVEL

One study on basketball showed that when the opponent traveled less than 200 miles, the home advantage was 58.8%, when an opponent traveled more than 200 miles, the home advantage increased to 84.6%, but this study had a small sample size. Another researcher looked at 3500 games and concluded in that the home advantage was 64.3 % regardless of distance traveled. (1)

RULES

"In their study of softball, Courneya and Carron found that batting last did not provide a home advantage." (1) No studies since 1992 have been done in this area.

WHY HOME ADVANTAGE?

The research has a difficult time pinpointing the why of home advantage, but clearly shows that it exists. Coaches believe that the familiarity with their home venue is the main reason for home advantage above all others.

WHAT CAN A COACH DO?

The question for the coach is how to nullify the home advantage. Simply knowing that there is a home advantage can aid the coach in preparation for the away game. Taking the time to make plans for handling the usual competition issues can give the coach more time to plan for the unexpected.

Since most coaches believe that familiarity is a benefit to the home team, the coach can focus on practicing or competing on the competition surface a number of times before a major competition. If you can not travel to the location, try to mimic the conditions of the facility, same size rink or field, type of turf, climate conditions.

Another consideration is to try to eliminate the travel factor, by arriving in enough time to eliminate jet-lag and allow the athletes to adjust their body clocks.

The reduction of the subjective assessment bias by judges reacting to home crowd is by far the most difficult to plan around. The ability of a team to be "adopted" by the home country and/or crowd could be a possible direction.

It is important to remember, that home advantage is real, but the most prepared team typically wins. Home advantage strategies are good for the coach to work on but for athletes-it's just another competition.

HOT OFF THE PRESS

http://www.brianmac.demon.co.uk/eval.htm
This is a great website for all sorts of information that a coach can use. This particular citation is concerning evaluation and a listing of tests for a variety of needs. You will need to check on the validity and reliability on the test before using.

http://www.aafp.org/afp20000501/2683.html
http://www.contemporarypediatrics.com/contpeds/article/articleDetail.jsp?id=111781
Now is the time of the year when many athletes are going through their Preparticipation Athletic Evaluation. These are two great articles talking about what makes great sports physical.

http://www.exrx.net/Testing/OtherTests.html
For those who work with Paralympic athletes, here is a 12 minute test for wheelchair athletes with norms.

www.usoc.org/19578_19081.htm
REFLECTIONS ON SUCCESS: U.S. OLYMPIANS DESCRIBE THE SUCCESS FACTORS AND OBSTACLES THAT MOST INFLUENCED THEIR OLYMPIC DEVELOPMENT.
This 47 page document has a wealth of knowledge about coaching and athlete issues tucked into it. The only area that crossed over as a success factor and an obstacle in the top five was Coaching.

OLYMPIC COACH E-MAGAZINE

The U.S. Olympic Committee Coaching and Sport Sciences Division reminds you that our quarterly magazine, OLYMPIC COACH, is now available electronically as the OLYMPIC COACH E-MAGAZINE.

This quarterly publication designed for coaches at all levels can now come to you via e-mail. The quarterly e-mail provides a summary of each article in the magazine with a link that takes you directly to the full-length article. The E-magazine contains the same content as the print version of the magazine. The best news is that OLYMPIC COACH E-MAGAZINE is available to all coaches and other interested individuals free of charge.

To receive your complimentary subscription, go to the web site at http://coaching.usolympicteam.com/coaching/ksub.nsf, and sign up. The subscription information that you provide will not be shared or sold to any other organization or corporation. Please share this opportunity with other individuals in the coaching community. The PDF version of past editions of the Olympic Coach magazine are available at:http://coaching.usolympicteam.com/coaching/kpub.nsf

SEARCH CAPABILITY
Olympic Coach E-Magazine can be searched by keyword. To use this feature go to:
http://coaching.usolympicteam.com/coaching/kpub.nsf/webdateview

USOC DIRECTORY FOR

THE COACHING RESOURCES STAFF

SPORT PERFORMANCE

Scherr, Jim—CE0	719/866-4701
FAX	719/866-4141
Roush, Steve—Chief of Sport Performance	719/866-4627
FAX	719/632-9282

COACHING & SPORT SCIENCES

Williams, Lance—Interim Director, Coaching and Sport Science	719/866-4775
Sellers, Cathy - Manager, Coaching	719/866-3236
FAX	719/866-4850

INTERNATIONAL GAMES

Ingram, Doug—Managing Director	719/866-4821
FAX	719/632-4164

INFORMATION RESOURCE CENTER (Library)

Slater, Cindy—Manager	719/866-4622
FAX	719/632-5352

OLYMPIC TRAINING CENTERS

Mike English—Managing Director of Athletes, Facilities and Service	719/866-4501
FAX	719/866-4645

LAKE PLACID

Favro, Jack—Director	518/523-2600
FAX	518/523-1570

SAN DIEGO

Milkovich, Pat—Director	619/482-6101
FAX	619/482-6200

SPORTS MEDICINE

Ryan, Ed—Director	719/866-4668
FAX	719/632-9282