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INDIVIDUAL DIFFERENCES

This fourth issue of Volume 3 of ***Coaching Science Abstracts*** reviews articles concerned with individual differences among athletes. There is a paucity of research on this topic since it is primarily an assumption expounded by many coaches. However, it is in practices where the Principle of Individuality is violated. While it remains expedient for many coaches to prescribe training programs for groups of athletes and to consider programming content on a "team" basis, many athletes will be exposed to less than optimal training stimuli.

A major portion of this issue considers common physiological tests that are used to determine changes within athletes and differences between athletes. Often, such testing indicates individual differences. However, because of the coaching "cult-orientation" to groups of athletes ("teams"), important information in good test results is frequently overlooked.

Unless the individual needs of athletes are accommodated in coaching programs and by coaching practices, the vast majority of athletes will have little chance of achieving their sporting potential.

INDIVIDUALITY

1. **THE PRINCIPLE OF INDIVIDUALITY**

   Extracted from Rushall, B. S., & Pyke, F. S. (1990). *Training for sports and fitness.* Melbourne, Australia: Macmillan. (pp. 84-95).

2. **INDIVIDUAL COACHING**

   Carlile, F. (personal communication, July 8, 1991).

3. **NEED FOR INDIVIDUALIZED COACHING IN A WORLD CHAMPION**

   Safe, M. (1992). The loneliness of the long-distance swimmer. *The Australian Magazine,* July 11-12, 8-11.

4. **INDIVIDUALITY OF SWIMMERS' TRAINING RESPONSES**

   Savage, M. V., Brown, S. L., Savage, P., & Bannister, E. W. (October, 1981). *Physiological and performance correlates of training in swimmers.* A paper presented at the Annual Meeting of the Canadian Association of Sports Sciences, Halifax, Nova Scotia.

5. SPRINTERS AND DISTANCE RUNNERS RESPOND DIFFERENTLY TO EXERCISE

Torok, D. J., Duey, W. J., Bassett, D. R., Jr., Howley, E. T., & Mancuso, P. (1995). Cardiovascular responses to exercise in sprinters and distance runners. *Medicine and Science in Sports and Exercise, 27*, 1050-1056.

TALENT DIFFERENCES

6. BIOMECHANICAL NOT PHYSIOLOGICAL FACTORS DISCRIMINATE BETWEEN SWIMMERS OF DIFFERENT PERFORMANCE LEVELS

Chatard, J. C., Collomp, C., Maglischo, E., & Maglischo, C. (1990). Swimming skill and stroking characteristics of front crawl swimmers. *International Journal of Sports Medicine, 11*, 156-161.

7. TALENTED VERSUS LESS TALENTED PERFORMERS

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8. ANTHROPOMETRY NOT DISCRIMINATING

Van Der Walt, R. S. (1988). Antropometriese tipering by topdeelnemers in verskillende Olimpiese sportsoorte. *South African Journal for Research in Sport, Physical Education and Recreation, 11*, 101-120.

9. SWIMMING PERFORMANCE, BODY COMPOSITION, AND SOMATOTYPE

Siders, W. A., Lukaski, H. C., & Bolonchuk, W. W. (1993). Relationships among swimming performance, body composition and somatotype in competitive collegiate swimmers. *The Journal of Sports Medicine and Physical Fitness, 33*, 166-171.

TESTING FOR PHYSICAL CAPACITIES

PROBLEMS WITH TESTING

10. COMMENTS ON "SCIENTIFIC TESTING"

Rick L. Sharp (personal communication, 30 August, 1994).

11. TESTING FOR TESTING SAKE

Rushall thoughts, (1996).

12. PHYSIOLOGICAL TESTING NOT USEFUL FOR ADVANCED ATHLETES

Rushall thoughts, (1997).

13. SPECIFICITY OF TRAINING EFFECTS

Mahler, D., Andrea, B., & Ward, J. (1987). Comparison of exercise performance on rowing and cycle ergometer. *Research Quarterly for Exercise and Sport*, *58*, 41-46.

14. FITNESS VARIATIONS IN ELITE ATHLETES

Koutedakis, Y. (1995). Seasonal variation in fitness parameters in competitive athletes. *Sports Medicine*, *19*, 373-392.

15. MANUAL HEART RATES ARE USUALLY INACCURATE

Norton, E., Vehrs, P. R., Ryan, N., & Jackson, A. S. (1997). Palpated vs electronically monitored heart rates in predicting VO2max with submaximal exercise tests. *Medicine and Science in Sports and Exercise*, *29(5)*, Supplement abstract 275.

16. AGE AND TIME OF DAY AFFECTS VO2max

Bergen, J. L., & Grubbs, L. M. (1966). Effect of age and time of day on VO2max. *Medicine and Science in Exercise and Sports*, *28(5)*, Supplement abstract 718.

TESTING FOR CAPACITIES

17. TESTS FOR CAPACITIES

Telford, R. D., & Minikin, B. R. (1989). The tri-level test for runners - a simple method of general fitness evaluation. *Excel*, *6*, 33-36.

18. TESTING MIDDLE DISTANCE RUNNERS

Sleivert, G. G., & Reid, A. K. (1996). The relationship of aerobic and anaerobic indices to middle distance running performance. *Medicine and Science in Exercise and Sports, 28(5),* Supplement abstract 414.

19. NEUROMUSCULAR AND METABOLIC DETERMINANTS OF 5 km RUNNING

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20. PHYSIOLOGICAL TESTS IN CROSS-COUNTRY SKIERS

Bilodeau, B., Roy, B., & Boulay, M. R. (1995). Upper-body testing of cross-country skiers. *Medicine and Science in Sports and Exercise, 27,* 1557-1562.

21. MUSCLE FIBERS DETERMINE WORK POTENTIAL

Esbjornsson, M., Sylven, C., Holm, J., & Jansson, E. (1993). Fast twitch fibers may predict anaerobic performance in both females and males. *International Journal of Sports Medicine, 14,* 257-263.

TESTING FOR CRITICAL VELOCITY AND POWER

22. CRITICAL POWER MEASURES AEROBIC ADAPTATION

Jenkins, D. G., & Quigley, B. M (1992). Endurance training enhances critical power. *Medicine and Science in Exercise and Sports, 24,* 1283-1289.

23. CRITICAL VELOCITY TESTS

Weir, J. P., & Florence, S. L. (1996). Number of trials necessary for the critical velocity test. *Medicine and Science in Exercise and Sports, 28(5),* Supplement abstract 91.

24. CRITICAL VELOCITY

Rowell, A. L., Williams, C. S., & Hill, D. W. (1996). Critical velocity is minimal velocity. *Medicine and Science in Exercise and Sports, 28(5),* Supplement abstract 101.

25. CRITICAL VELOCITY PREDICTS SWIMMING PERFORMANCE IN FEMALES

Day, Y. J., & Lin, J. C. (1996). Critical velocity as a predictor of female front crawl swimming performance. Medicine and Science in Exercise and Sports, 28(5), Supplement abstract 940.

TESTING FOR POWER

26. STRENGTH AND POWER TESTING (DYNAMOMETRY)

Abernethy, P., Wilson, G., & Logan, P. (1995). Strength and power assessment. *Sports Medicine, 19*, 401-417.

27. TESTING POWER

Various authors.

28. MEASUREMENT OF COMPONENT OF SWIMMING POWER

Sharp, R. L, Troup, J. P., & Costill, D. L. (1982). Relationship between power and sprint freestyle swimming. *Medicine and Science in Sports and Exercise, 14*, 53-56.

29. TESTING EXPLOSIVE POWER

Igna, I., Wygand, J., & Otto, R. M. (1996). A comparison of two measures of explosive power. *Medicine and Science in Sports and Exercise, 28(5)*, Supplement abstract 53.

30. POWER TESTING CONCEPTS

Kraemer, W. J., & Newton, R. U. (1994). Training for improved vertical jump. *Sports Science Exchange, 7(6)*, 1-12.

TESTING FOR ANAEROBIC FACTORS

31. ANAEROBIC THRESHOLD - A RELATIVELY USELESS CONCEPT FOR COACHING

Billat, L. V. (1996). Use of blood lactate measurements for prediction of exercise performance and for control of training: Recommendations for long-distance running. *Sports Medicine*, *22*, 157-175.

32. INCREMENT SIZE AFFECTS ESTIMATION OF MAXIMAL LACTATE STEADY STATE

Foxdal, P., Sjodin, A., & Sojdin, B. (1995). Comparison of blood lactate concentrations obtained during incremental and constant intensity exercise. *International Journal of Sports Medicine*, *17*, 360-365.

33. CONTRARY TO ACCEPTED OPINION, DIFFERENT PROTOCOLS YIELD THE SAME ANAEROBIC THRESHOLD, OR DO THEY?

Santos, T. M., & Comes, P. S. (1997). Reproducibility of metabolic thresholds using two different exercise protocols in long-distance runners. *Medicine and Science in Sports and Exercise*, *29(5)*, Supplement abstract 1160.

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Hill, D. W., Heidbrink, A. M., Low, T. D., & Smith, J. C. (1977). Comparison of indices of anaerobic capacity. *Medicine and Science in Sports and Exercise*, *29(5)*, Supplement abstract 59.

35. QUESTIONABLE VALIDATION OF LACTATE THRESHOLD TEST IN SWIMMING

Barber, J. W., Williford, H. N., Duey, W. J., Pieri, S. R., & Barksdale, J. (1997). Validation of the T-30 and swimming step test in adolescent competitive swimmers. *Medicine and Science in Sports and Exercise*, *29(5)*, Supplement abstract 289.

36. MEASURES OF EXCESS POST-EXERCISE OXYGEN CONSUMPTION ARE UNRELIABLE

Comerford, S. R., Cordain, L., & Melby, C. L. (1997). Reliability of the measurement of excess post-exercise oxygen consumption following two identically controlled cycling bouts. *Medicine and Science in Sports and Exercise*, *29(5)*, Supplement abstract 1108.

37. FURTHER PROBLEMS WITH MEASURING EXCESS POST-EXERCISE OXYGEN CONSUMPTION

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38. EPOC IS SPECIFIC TO THE EXERCISE TASK

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TESTING FOR AEROBIC FACTORS

39. VO2max RELIABILITY

Yule, E., Kaminisky, L. A., Sedlock, D. A., King, B. A., & Whaley, M. H. (1996). Inter-laboratory reliability of VO2max and submaximal measurements. *Medicine and Science in Exercise and Sports, 28(5),* Supplement abstract 87.

40. VO2max TEST REPLICABILITY

Duncan, G. E., Howley, E. T., & Johnson, B. N. (1996). Applicability of VO2max criteria. *Medicine and Science in Exercise and Sports, 28(5),* Supplement abstract 717.

41. VO2max IN TRIATHLETES

Kerr, C. G., Trappe, T. A., & Trappe, S. W. (1996). Maximal aerobic power in triathletes during swimming, cycling, and running. *Medicine and Science in Exercise and Sports, 28(5),* Supplement abstract 754.

42. MEASURES OF OXYGEN COST ARE NOT LINEARLY RELATED TO WORK RATE

Londeree, B. R., Moffitt-Gerstenberger, J., Padfield, J. A., & Lottmann, D. (1997). Oxygen consumption of cycle ergometry is nonlinearly related to work rate and pedal rate. *Medicine and Science in Sports and Exercise, 29,* 775-780.

43. NO VO2 PLATEAU IN MOST CHILDREN

Armstrong, N., Welsman, J., & Winsley, R. (1995). Is peak VO2 a maximal index of children's aerobic fitness? *International Journal of Sports Medicine, 17,* 356-359.

PREDICTING FROM TESTS

44. PREDICTION OF RUNNING PERFORMANCES

Pompcu, F. A., Gomes, P. S., & Flegner, A. J. (1996). Prediction of performance in the 5,000 m run by means of laboratory and field tests in male distance runners. *Medicine and Science in Exercise and Sports, 28(5),* Supplement abstract 89.

45. PREDICTING BLOOD LACTATE FROM HEART RATES IN ROWERS

Keller, B. A., Jones, M. T., Sigg, J. A., Harnish, C., & Ferriss, J. A. (1996). Prediction of blood lactate from recovery heart rate and power in collegiate oarsmen on a Concept II ergometer. *Medicine and Science in Exercise and Sports, 28(5),* Supplement abstract 416.

46. PREDICTING PERFORMANCE FROM PHYSIOLOGICAL MEASURES

Watts, P., Clure, C., Hill, R., & Lish, A. (1996). Applied prediction of cross country skiing performance from physiological test data. *Medicine and Science in Exercise and Sports, 28(5),* Supplement abstract 794

THE PRINCIPLE OF INDIVIDUALITY

[Extracted from Rushall, B. S., & Pyke, F. S. (1990). ***Training for sports and fitness.*** Melbourne, Australia: Macmillan. (pp. 84-95)]

Chapter 7

The Principle of Individuality

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

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

Tolerance of Training Loads

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

There is no guarantee that an athlete who tolerates heavy training loads is going to be the best performer in competitions. They often set the `training standards' imposed by the coach but are not capable of succeeding in contests against the peers whom they have beaten consistently in training. Their performances also suggest that fitness is not the only factor responsible for achieving sporting success. The tolerance of training loads also seems to be related to an athlete's history of involvement. It is simply not possible to withstand the rigors of a heavy training and competitive schedule if the foundation or basic training is weak and insubstantial. Gradual adaptation to training over a number of years provides an essential basis for absorbing later heavy loads. The coach must carefully monitor the capacity of the athlete to cope with the training load and adjust the training program when necessary. The signs, symptoms, and measurement of overtraining are discussed in some detail in the next chapter.

Responsiveness to Training

The capacity to respond to training is related to the initial level of fitness and the physiological characteristics of the individual. The potential for improvement is greatest when the initial level of fitness is lowest. This is clearly illustrated in the change-maintenance training graph (Figure 4.5). When an athlete is not fit, then performance improvements will be obvious and substantial with the onset of training. When an athlete is fit, performance improvements will be small and relatively infrequent. Once maximum fitness has been achieved, it requires much less training to maintain performance than to gain it in the first place. Thus the response of an athlete will vary depending upon the level of fitness and the training program content.

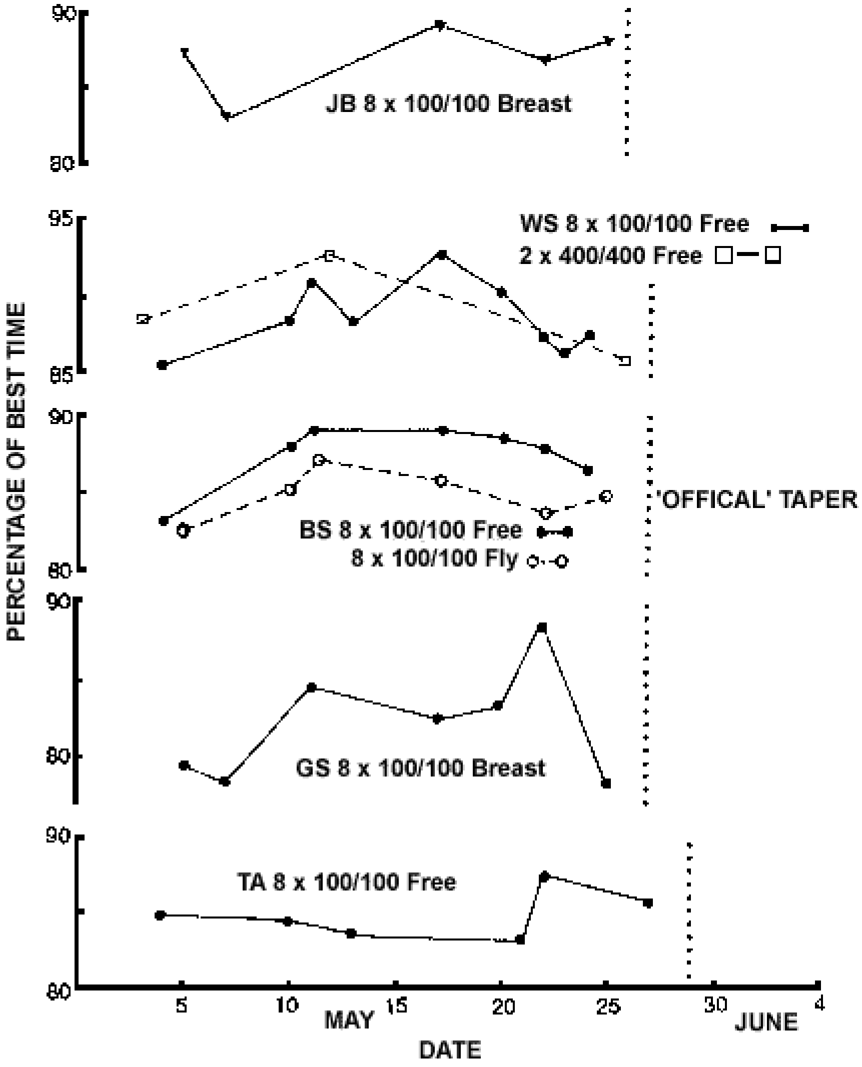
There are some athletes with higher sensitivities to the fitness component being trained. With regard to strength, this becomes very noticeable in males around the time of puberty when some have increased their secretion of testosterone while others have not. Early maturers develop muscle size and definition quickly and often dominate strength and power-oriented sports in a particular age group. No matter how much weight training is completed, a late maturer has to await the arrival of puberty before significant gains are made. But even with the advent of puberty, individuals will differ in their response characteristics and performance levels resulting from programs. Some athletes just cannot become as strong as others.

A further strength-training factor that produces individual responses is the proportion of fast-twitch muscle fibers in the muscles. Those athletes with a high proportion profit more from strength training than do endurance-oriented athletes (those with a high proportion of slow-twitch muscle fibers). This is because the high degree of tension created in the muscles during weight training exercises requires the fast-twitch fibers to become involved. After some time these fibers hypertrophy and, due to their abundance in the muscle, contribute significantly to increases in its size (Dons, Bollerup, Bonde-Peterson, & Hancke, 1979).

Throughout this text, further features that cause differential responses to training between and within athletes will be discussed. A person of one age will respond differently from one of another age, such as in the example of strength training and the maturational factor of puberty. With regard to training loads, young athletes will break down and recover faster in training than they will when they become older, a feature discussed at greater length in Chapter 20. The practice of individualizing training programs requires consideration of the `responsiveness to training' factors.

Figure 7.1 illustrates the training responses of five Canadian Olympic swimmers during the final stages of the `hard' training phase prior to commencing a taper (peaking) period for the 1976 Canadian Olympic Team trials. Throughout the time of the observations, each athlete completed the same training segment on a number of occasions. What is depicted in the figure is the average time for each set expressed as a percentage of the time recorded in the subsequent competitive performance. The data can be interpreted as the percentage of effort when time is used as the basis of calculation. What is noticeable is the variation of performances within and between each individual.

Figure 7.1. Training performances of Five Canadian Olympic Swimmers for a Three-week Period prior to the `Tapering' (Peaking) Phase of Training Leading to the Olympic Trials.



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

A summary of the data follows.

1. Subject JB completed four of five sets within an 86-89 percent intensity range. The remaining set was slightly over 83 percent. Except for the lone lower figure, the training responses were remarkably consistent.
2. Subject WS performed two events, one a 100-meter sprint, the other a more endurance-oriented 400-meter event. The intensities of training for both events fell within the same range, 86-93 percent. The commonality of the training intensities is surprising since sport science suggests that endurance event training should be performed at a lower intensity than sprints.
3. Subject BS performed two 100-meter sprint events. The freestyle performances were consistently three to four percent higher in intensity (range 87-89 percent) than were the butterfly performances (range 83-87 percent).
4. Subject GS's performances ranged 78-88 percent for the 100-meter breaststroke event. This included the lowest intensity of any training segment and widest individual variation of the five athletes.
5. Subject TA exhibited four consistent levels of performance with two subsequent performances being elevated prior to the commencement of the taper. Performances ranged in intensity from 83-87 percent.

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

Recovery from Training and Competition

The recovery time from heavy training or intense competitions is longer in some athletes than in others. This is particularly the case with older athletes. Many players of contact team sports late in their careers find that they are only able to train lightly from one week to the next. Such light loads are required to facilitate recovery and negate the possibility of further overload training to produce altered fitness states. Coaches should recognize these differences either by reducing the training load or lengthening the recovery period in athletes who display the symptoms of chronic fatigue described in the next chapter.

Athletes with different physiological profiles also seem to require different tapering regimes. Strength-trained athletes show a level of maintenance of strength-related variables during periods of inactivity. Hence, reduced or tapered training loads can be extended without fear of deterioration in strength or explosive power performance. On the other hand, endurance qualities are lost quickly, and extended periods of reduced training in distance-oriented athletes are not recommended. Thus an athlete's type of training will require different programming considerations with regard to what occurs in recovery periods. However, even within like sports, individuals will recover at varying rates.

Training Needs

The coach should aim to develop a balanced profile of attributes in each athlete that have been determined through objective measures. The individual case for fitness training must be weighed against the need for skill and mental training. More particularly, the prescription of fitness training should be based on known strengths and weaknesses in the physical profile of each athlete (see Chapter 12). For example, a pursuit cyclist with well-developed endurance capabilities but a weak sprint, would be best advised to spend training time on improving anaerobic power and capacity which would contribute to improved sprint performances. Another alternative for improving sprinting would be to develop a race strategy aimed at maintaining a fast pace throughout rather than relying on a sprint finish. Such an athlete would need to train with a program that was different from others with dissimilar needs.

Team game players should have individualized programs that not only round out their fitness profile but also allow them to meet the specific requirements of selected playing positions. For example, in soccer a set position player is more dependent on strength and speed than a mid-fielder who has a greater requirement for endurance. While modern team-game coaches increasingly encourage versatility in players they should still have, in the back of their minds, an ideal arrangement of personnel requiring specialized and individualized attention while training.

Training Preferences

In order to maximize the productivity of training, a coach should try to cater to each athlete's likes and dislikes. Some athletes thrive on the formal requirements of interval training accompanied by exact timing of distances and regular monitoring of heart rates. Others prefer a mix of continuous, over-distance, and Fartlek work. Although athletes should not be encouraged to work only on their strengths and ignore their weaknesses, it is important for them to develop and maintain a positive attitude and adhere strictly to a training schedule. Chapter 10 discusses the major factors that are associated with constructive programs and the atmosphere of training that encourage the best training responses. These factors require some understanding of athletes' training preferences.

Nutritional Preferences

The important role that nutrition plays in optimizing training was stressed in Chapter 5. While it is relatively easy to maintain a balanced diet in the Western world, it is important for coaches to understand that small deficiencies can become major obstacles to improvement in the hard-training athlete. For example, vegetarians need to take special care to ensure that they get enough minerals and vitamins in their diet. This can become a particular problem for the Vitamin B complex and iron and may require multi-vitamin and mineral supplementation. Coaches should be particularly aware of the potential for poor nutrition in young athletes who are living away from home for the first time. Some form of regular dietary counseling is advisable to keep track of and correct any dietary inadequacies. Poor dietary habits can cause differential energy responses and fluctuations in body composition. These variations will affect individual needs for training programs.

Environmental Tolerance

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

It is also known that altitudinal and polluted environments affect some athletes to a greater extent than others. Symptoms of mountain sickness, such as headache and insomnia, can be debilitating for some individuals at quite moderate altitudes whereas others can tolerate more severe hypoxic stress without encountering problems. In a similar manner, some athletes experience respiratory distress in only mildly polluted air while others are unaffected. The negative psychological effects associated with the mere smell of ozone, one of the major constituents of pollution, and the irritation it causes the eyes, nose, and throat, can make training difficult for some. A coach must be able to adapt training loads according to the perceived tolerances of individuals for varying environmental conditions.

Physical Characteristics

Variations in body physique and composition can influence the capacity to withstand a training load. More heavily built athletes have a low tolerance for heat and are more prone to injuries in sports in which they have to fully support their own body weight. For winter sports, care should be taken during the late summer preparatory training phase to ensure that larger team-game players do not overheat. If distance-running training is prescribed, heavy individuals are also at risk of incurring orthopedic injuries. Progressions in training intensity and duration should be gradual, and appropriate footwear should be worn to avoid injuries due to a sudden increase in one specific form/surface of training. There is less concern for heavy-bodied athletes when they engage in weight-supported sports such as swimming and rowing, since the environments of these sports usually facilitate the removal of heat.

Life-style Variations

Within a training squad there are often athletes from all walks of life. Some might be students, manual laborers, or office workers, while others may work different shifts. Since the demands of their working life often compete with those of their sport, the coach should be aware of such commitments when planning training loads. These commitments may change from time to time. Peak external stresses for a student may occur at the time of final examinations, for the office worker at the end of the financial year, and for a laborer at the deadline for a job completion. Life stresses are cumulative and so training loads should be adjusted to compensate for any variations in life-style that will affect the degree of stress imposed upon the serious athlete. Chapter 8 describes a measurement tool for assessing life variations and impacts.

Social Interactions Within the Group

Training squads usually contain an assortment of individuals with different interests, tastes, and personalities. Because of the stress of hard training and intense competitions, these differences can produce interpersonal frictions that have a negative effect on performance. It is the responsibility of a coach to monitor the development of such problems and to affect a program alteration that will alleviate their occurrence. Chapter 10 discusses some of the strategies for designing training situations that will prevent such problems.

This chapter has listed a number of factors that produce individual variations in training requirements. The individual needs of each athlete have to be met to maximize training responses. Each denial of an individual factor will lessen the training experience for the majority of athletes. Recognition and the accommodation of this principle will require radical departures from the common handling procedure of having all athletes in a squad follow the same program. It has been traditional to treat the training of all athletes as if they were clones. Such a singular approach to control is easy and the least time-consuming for a coach. However, because it is easy does not mean that it is the best approach; the deficiency was highlighted by Rushall (1975b). His advocacies are still largely unheeded but are reproduced below to illustrate what it might be possible to organize in order to satisfy the needs of individual athletes, and to produce an optimal training response (Rushall, 1975b, 167-172).

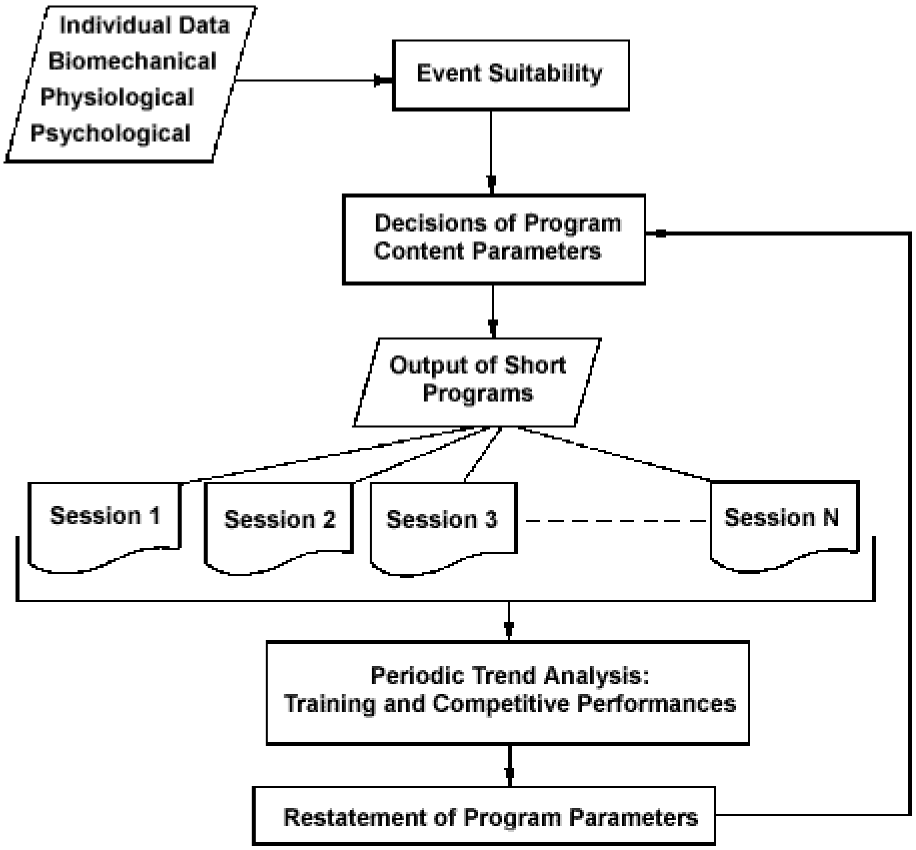
". . . The thrust of this incontrovertible argument is that by using the same program for a group of swimmers the development of most of them is reduced.

The technological procedures exist for analyzing swimmers so that their suitability for particular swimming events can be determined. Once a swimmer's capacities and event suitabilities have been established appropriate training programs should be devised. This will require a complete reversal of orientation for developing swimmers, a change from general/group to specific/individual programs . . .

[Figure 7.2] presents a flow diagram of the programming process for developing the specific/individual content. A computer is used to print each day's program of training for each individual. The coach monitors the swimmer's progress, adaptation, and behavioral reactions. The parameters for program content are altered at any time, but usually only when a change is required (taper, failing adaptation, etc. The task of completing this information is not as great as one would think. It is assumed that in advocating this method, the common unproductive and inefficient time usage procedures of the normal coaching role do not exist.

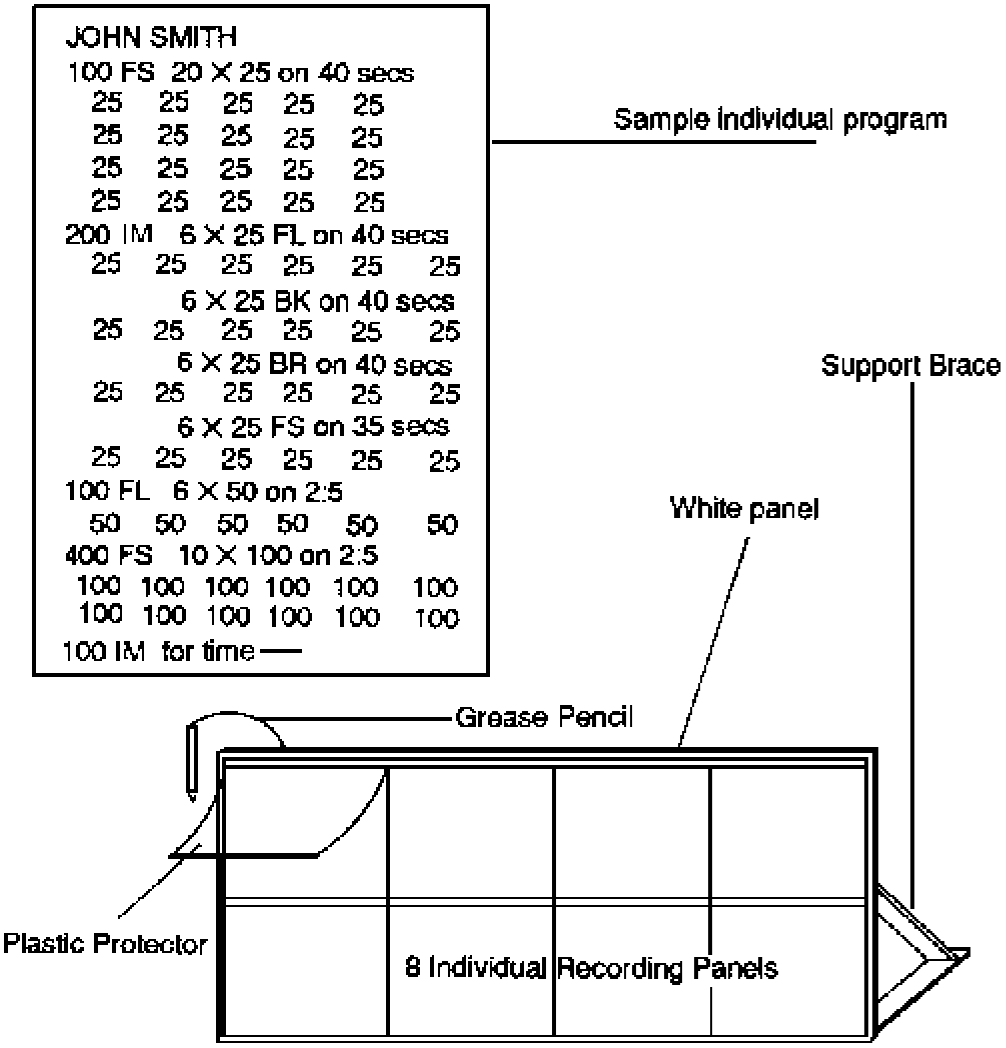
The psychological features of this process are involved with the use of program boards. Rushall (1975a) described these as being motivational because of their direct effect on training work quantity and quality. The procedure of publicly registering a program unit completion generated social, performance information, material, and performance progress reinforcers. However, those boards were used for small groups. This can be improved upon by having separate programs for each swimmer, but still retaining the public recording procedure. This will provide individual training programs under motivated conditions. [Figure 7.3] illustrates such a board. The change that is required of coaches here is that they will have to be prepared to relegate the control of the training program to a psychological technology through indirect control rather than through direct personal control. The implementation of specific individual programs is designed towards optimizing the swimming development of all swimmers."

Figure 7.2. A Flow Diagram of the Steps for Producing Specific/Individual Training Programs by Using a Computer (Rushall, 1975a, 171).



[The critical feature is the number of decision parameters that need to be considered.]

Figure 7.3. A suggested Structure for Program Boards for Displaying and Using Individualized Computer-generated Training Programs.



[The computer generates an individual prescription for the training session. In this example, the output includes the event for which each training segment is targeted, the training segment, and each training unit for each segment (to be marked immediately after completion). The board itself contains panels for each athlete, is waterproofed with plastic protectors, and is constructed for easy access and use (Rushall, 1975a, 172).]

Savage, Brown, Savage, and Bannister (1981) demonstrated the individuality of training responses after they had assessed four physiological parameters over 75 days of intense training in a top collegiate swimming team. Group training produced different individual response profiles for ostensibly the same workout program. Different physiological and performance profiles also were evidenced during a peaking program. They concluded that to train an athlete appropriately, individualization in programming is essential.

References

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2. Dons, B., Bollerup, K., Bonde-Petersen, F., & Hancke, S. (1979). The effects of weight lifting exercise related to muscle fiber composition and muscle cross-sectional area in humans. ***European Journal of Applied Physiology, 40,*** 95-106.
3. Rushall, B. S. (1975b). Psychological aids for swimming coaches in R. M. Ousley (ed.), ***1975 American Swimming Coaches Association World Clinic Yearbook,*** Fort Lauderdale, FL: American Swimming Coaches Association.
4. Rushall, B. S. (1979a). Coaches and sport psychology. ***International Journal of Sport Psychology, 10,*** 164-7.
5. Savage, M., Brown, S. L., Savage, P., & Bannister, E. W. (1981). ***Physiological and performance correlates of training in swimmers.*** Paper presented at the Annual Meeting of the Canadian Association of Sport Sciences, Halifax.

6. INDIVIDUAL COACHING

7. Carlile, F. (personal communication, July 8, 1991).
8.
9. It comes through loud and clear that no longer must coaches coach "squads" but a number of individuals--as few as possible (like the Hungarians today, Russians, and I should think the E. Germans). Clearly, in order to correctly minister to the differing requirements of **each** individual there will need almost to be as many programs as there are swimmers. In the "old" days all we did was put up a program and fit everybody into the mould. If your training was reasonable, the coach succeeded against ever more poorly coached opposition.
10. When the strongly anaerobic-endowed swimmer hung in the corner of the lane or hid underwater or in the toilet he/she was reckoned to be a slacker and often **out** went the swimmer. I fear there is still a lot of training just like this.

11. NEED FOR INDIVIDUALIZED COACHING IN A WORLD CHAMPION

12. Safe, M. (1992). The loneliness of the long-distance swimmer. ***The Australian Magazine***, July 11-12, 8-11.
13.
14. Coach Graeme Carroll commenting on the coaching needs of Shelley Taylor-Smith (world champion marathon swimmer).
15. *" . . . People say, 'It's great you've got the world champion; anyone could coach her.' But that's not true. You've got to have the right temperament. I can't see her at the Institute of Sport, for example, because they wouldn't treat her as an individual. The uniqueness of*

> *her event takes her into new realms. A lot of coaches when I was swimming had this tunnel-vision approach: "Get in the water and do what I say." Out of that, they eventually get someone who'll be a champion. But coaches have to get away from that and start being more individualistic with their swimmers."* (p. 11)

INDIVIDUALITY OF SWIMMERS' TRAINING RESPONSES

Savage, M. V., Brown, S. L., Savage, P., & Bannister, E. W. (October, 1981). ***Physiological and performance correlates of training in swimmers.*** A paper presented at the Annual Meeting of the Canadian Association of Sports Sciences, Halifax, Nova Scotia.

Several physiological measures (VO_{2max}, Hb, ferritin, lactate at rest and post-exercise) were taken during and after 75 days of training.

It was found that:

- group training produced different individual training profiles within the group for the same "workouts;"
- physiological factors and performances reflected the training profile (improving as the volume of training lessened);
- there were phase differences between physiological measures, that is, the measures responded over different time periods (e.g., Hb changes crested and declined earlier than VO_{2max} during peaking); and
- individuals in groups following the same peaking program demonstrated different concomitant physiological and performance profiles.

Implication. Because of the individuality of training responses to "standard" or "group" training programs, there is no alternative other than to apply individual training programs based on individualized training responses to produce the best experience for athletes.

SPRINTERS AND DISTANCE RUNNERS RESPOND DIFFERENTLY TO EXERCISE

Torok, D. J., Duey, W. J., Bassett, D. R., Jr., Howley, E. T., & Mancuso, P. (1995). Cardiovascular responses to exercise in sprinters and distance runners. ***Medicine and Science in Sports and Exercise, 27,*** 1050-1056.

This study examined the cardiovascular responses of sprinters (M = 6) and distance runners (M = 6) to isometric and dynamic exercise. Testing was performed on a cycle ergometer and for isometric measures a handgrip test at 30% maximum grip strength was used.

It was found that sprinters and distance runners had different hemodynamic adjustments to exercise. Isometric exercise produced a greater blood pressure response in sprinters which was associated with an elevated heart rate response. During dynamic exercise at the same relative work rate, both groups had similar blood pressure values. However, distance runners responded with higher cardiac indexes and lower systemic vascular responses.

It was suggested that fiber type and/or alterations in micro-vessel density induced by training may influence the cardiovascular responses to these forms of exercise stress.

Implication. Individuals respond to exercise according to their capacities. Sprinters should be expected to respond differently to distance athletes when given the same exercise stimulation. This fact undermines the value of expedient training programs where all athletes perform the same activities because a coach believes that all responses would be similar.

BIOMECHANICAL NOT PHYSIOLOGICAL FACTORS DISCRIMINATE BETWEEN SWIMMERS OF DIFFERENT PERFORMANCE LEVELS

Chatard, J. C., Collomp, C., Maglischo, E., & Maglischo, C. (1990). Swimming skill and stroking characteristics of front crawl swimmers. ***International Journal of Sports Medicine***, ***11***, 156-161.

The relationships between swimmers' biomechanical arm pulling pattern and technical ability were assessed in four "skilled" and five "less-skilled" athletes (the grouping being determined by a statistical method using all measures). The freestyle stroke was divided into five phases: entry (plus flight), downsweep, insweep, outsweep, and upsweep (round-out). VO_{2max}, height, arm span, hydrostatic lift (maximum weight to maintain a balanced position under water), speed on a standardized 400-yard swim, and competition 500-yard time were measured. VO_{2max} explained 64% of a 400-yard swim performed at 94% of 500-yard pace. Hydrostatic lift was the next most important structural variable. *There was no significant difference between the two performance groups on any anthropometric, performance, or physiological variable.*

Biomechanical variables did differentiate the groups although there was great variation between individuals (e.g., as much as four times for entry duration and more than twice the time taken on other stroke sections):

- stroke rate was higher in the skilled group;
- stroke rate was negatively related to stroke length;
- stroke length was shorter in the skilled group;
- both entry and stroke pattern were related to hydrostatic lift;
- downsweep phase was inversely related to upsweep; and
- longer outsweep and superposition of arm actions favored better swimming efficiency.

Swimming mechanics were the primary factors differentiating the two groups. Even though the size of the groups was small, these variables were strong enough to overcome that limitation.

Implications. The following implications for coaches are derived from this work.

1. Having a good aerobic capacity is the basic requirement for fast long-distance swimming performances.
2. The stroke pattern should emphasize the last part of the underwater stroke rather than the entry.
3. Gliding and excessive stretching under water after the entry should be minimized so that deceleration between individual arm cycles is reduced.
4. Swimming improvements are likely to be greater and more easily achieved through technique developments rather than through physiological and anthropometric factors.

TALENTED VERSUS LESS TALENTED PERFORMERS

Troup, J. P. (Ed.). (1990). Energy contributions of competitive freestyle events. In ***International Center for Aquatic Research annual: Studies by the International Center for Aquatic Research 1989-90.*** Colorado Springs: United States Swimming Press.

One of the differentiating factors between talented and less talented swimmers is the size of the energy systems.

1. The faster the swimmer, the greater the anaerobic capacity.
2. The better distance swimmers have greater aerobic capacities.
3. More talented swimmers use a greater percent of their energy from the aerobic energy system.
4. More talented swimmers use energy at a faster rate than lesser talented swimmers.

These differences may be explained because of the comparatively higher volume of training that talented athletes can tolerate and perform.

Implication. A drop-off test of maximum swimming or double-arm swim bench pulling can indicate capacities. The total work for 45 seconds can indicate the anaerobic capacity of an athlete. The lower the fall-off from start to finish, the greater the endurance capacity.

ANTHROPOMETRY NOT DISCRIMINATING

Van Der Walt, R. S. (1988). Antropometriese tipering by topdeelnemers in verskillende Olimpiese sportsoorte. ***S. A. Journal for Research in Sport, Physical Education and Recreation, 11,*** 101-120.

Thirty-two measurements were taken on Montreal Olympic Games athletes in gymnastics, boxing, canoeing, swimming, sprinting, cycling, rowing, hockey, wrestling, judo, and weightlifting. All types of analyses were used to look at differences and clusterings.

Implication. *"Even amongst the world's best, identification of participants by means of anthropometric variables is difficult."*

SWIMMING PERFORMANCE, BODY COMPOSITION, AND SOMATOTYPE

Siders, W. A., Lukaski, H. C., & Bolonchuk, W. W. (1993). Relationships among swimming performance, body composition and somatotype in competitive collegiate swimmers. ***The Journal of Sports Medicine and Physical Fitness, 33,*** 166-171.

Women (N = 43) and men (N = 31) performed a competitive 100-yard swim. It was found that only significant relationships existed for women; height (***r*** = -.466), mesomorphy (***r*** = .404), ectomorphy (***r*** = -.398), percent body fat (***r*** = .351), and fat-free weight (***r*** = -.332). These relationships existed at the start and end of the swimming season.

Implication. Anthropometric measures may be related to performance in women but not in men.