Dr mouwafk al mola documents

Spore Research

mouwafak.mola@aspire.qa
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GOAL-SETTING

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FUEL AND ERGOGENIC AIDS
GOAL-SETTING

This second issue of Volume 2 of Coaching Science Abstracts reviews articles concerned with goal-setting. This is a topic that is treated very lightly by many coaches and athletes. However, when the impact of goal-setting on performance and participation is realized, it can be deemed worthy of much greater and detailed attention.

Goal-setting is a set of skills that involves using goals in particular ways to achieve a variety of effects. The simple erroneous notion that there is only one type of goal-setting and that all an athlete needs is an awareness of its existence is too prevalent in the practices and literature of coaching.

This set of abstracts should awaken coaches to the recognition of the importance, scope of effect, and different requirements of the various types of goals that are necessary to produce a more complete sporting experience for and to enhance the performances of athletes.

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GOAL ACHIEVEMENT BECAUSE OF TEAM SUPPORT


An individual's success in attaining goals was closely related to close interpersonal relationships. A partner's support enhanced persistence and satisfaction in the individual. The voluntary support that was provided was critical.
Implication. A coach should structure team building activities allowing input from and voluntary participation of members. It is essential that athletes develop the skill of interacting in a positive manner and that they be reinforced for doing so. The mutual support generated will increase the performance levels and enhancement of athletes in the group.

EAM GOALS AFFECT PERFORMANCE DEPENDING UPON HOW THE GROUP IS PERFORMING


This study investigated the relative effects of three factors upon the choice of group aspiration:

- success or failure of a member's own group;
- prior success or failure of a larger organization unit to which the group belongs; and
- the strength of external pressures toward unreasonably high goals brought to bear on a group which is responsible to a larger organization.

Results

1. Members of high-success teams with low need and facing weak opponents/pressures selected group aspirations in line with the mean amount of performance improvement, that is, they make accurate performance estimates.
2. Members of low success teams with high need and facing strong pressures selected group goals greatly in excess of their mean performance improvement, that is, they overestimate their performance capabilities.
3. Members of success groups rated their performances higher than members of failing groups.
4. Members of success groups rated their own individual performance better and accepted more responsibility for the team score than members of failing groups.
5. Members of success groups attached greater importance to the necessity of setting official team goals than did members of failing groups.
6. Successful teams performed better than failing teams, and low need teams performed better than high need teams.
7. Setting unattainable goals not only ensured nominal failure to achieve goals but also has a detrimental effect on actual performance, that is, the team was "self-defeated" before the contest began.

Implications. Four actions are important for keeping any team's goal-orientations in the correct perspective.
1. Teams should set realistic attainable goals irrespective of the caliber of the competition or the success need of the contest.
2. Team goals should be evaluated and restructured periodically. When conditions change constantly, such as when playing different opponents on a weekly basis, the goals should be independently structured for each new challenge.
3. Teams perform better when they face weak external pressures (e.g., from the press, the school, team owners). Goals should only originate from and be relevant to the team members.
4. Each team member should have his/her own personal goals as well as team goals. This will provide a rich multi-incentive condition.
5. Team goals should be set in a group-setting with everyone perceiving a valuable contribution to the process.

WHAT HAPPENS WHEN GROUP GOALS ARE ADDED TO INDIVIDUAL GOALS


What happens when group goals are added to individual goals was assessed by impacting a group goal on anonymous and noninteracting group members' performances on an additive group task. This is analogous to imposing a group aspiration onto a sporting team where each individual has a particular defined responsibility (e.g., a member of a swim team as opposed to a member of a rowing crew). Ss for the study were undergraduate students (N = 75).

Results. Four major findings emerged from the study.

1. Those working toward a performance goal outperformed those without a goal.
2. Information about a group's previous performance did not influence commitment to the group goal or performance. Only existing conditions influenced the approach to the group-augmented task condition.
3. Changes in individual performance strategies modified the group goal effect but self-reports of effort invested in the task did not. That means that what resulted affected what the group would do rather than what members said they did or felt.
4. Group members working toward a group goal felt more personal challenge than group members working without a goal.
5. Self-set individual goals could not account for the group goal effect.

Implication. Adding group goals to individual goals raises the level of aspiration of group members. However, behavior is only influenced by the performances and results that occur within the group, not statements of intent or appreciation. Thus, for group influences to be effective members must perform and demonstrate their intentions rather than talk about them.

WHEN TEAMS LOSE

When in teams, the reaction of individuals to success or failure is slightly different to when they perform alone. Members of winning teams attributed their success to their own team whereas members of losing teams attributed the loss to their opponents. This occurred for both males and females.

Within-team attributes however, were unusual. Members of winning teams assigned primary responsibility to their teammates while losing team members accepted primary responsibility for the loss themselves. This suggests two strategies for handling winning and losing team situations.

1. After winning, in a team-meeting atmosphere, single-out each player and comment on something that was done well in the contest.
2. After losing, in a team-meeting atmosphere, single-out each player and comment on something done well in the contest but also add something which is possible to be improved upon. The item for improvement should be an activity over which the athlete has control and, as well, most probably should be a skill.

Implication. The content of after game team appraisals should differ depending upon whether the contest was won or lost. In both situations individual praise for well-performed elements are necessary, but after losing an addition of constructive criticism about self-controlled skill elements should be added

GROUP GOALS ARE AN ADDED INCENTIVE


Individuals tend to strive harder to improve task performance when a norm of high achievement exists within the group.

Implication. When groups of athletes set goals, the achievement level needs to be on the difficult or high-aspiration side rather than comfortably low. With high goal standards, performances are likely to be maximal.

GOAL-SETTING AND PRODUCTIVITY

This study assessed the dynamics of job satisfaction and productivity.

- Job enrichment had a substantial impact on job satisfaction but little effect on productivity.
- Goal-setting had a major impact on productivity and a less substantial impact on satisfaction.

Making a sporting experience "interesting" and enjoyable will make participation satisfying but will not increase the level of training productivity and achievement. It only affects motivation to participate and removes one possible reason for complaint. Performance changes will only come from goal-setting.

Implication. While athletes need to be kept "happy" with their participatory experience, goal-setting is one major avenue for stimulating performance improvements.

GROUP-SELECTED STANDARDS (GOALS)


Groups of students were exposed to conditions where they determined their own collective goals and where the goals were imposed by the teacher (externally-selected goals). The pupil-selected standards group showed a significantly greater number of correct responses in writing and math tests than the externally selected (teacher) standards group. The literature review reported that self-selected standards are at least as effective as externally determined standards imposed by a teacher (coach).

Implication. Athletes should have input into the standards that are expected for performance. When they are solely established by the coach performance should not be expected to improve.

EFFECTS OF GROUP-SET GOALS


[Additional References]


When individuals participate in a group goal-setting procedure, the level of performance and commitment to achieve the goals increases. Participation involves contributing to the deliberations, not having someone, such as a coach, impose goals on the group.

Implication. A coach should allow a group of athletes to form the group's goals. It most probably will be necessary to teach inexperienced groups how to organize and come to such decisions but this eventually will be more effective than the imposition of coach-determined goals on the group.

**GOALS - MASTERY VERSUS OUTCOMES**


1. Those involved in organized sports were higher in task mastery than social comparison goals.
2. Those in recreational sports, drop-outs, and never involved, were higher in social comparison (outcomes) than mastery goals.
3. Organized sport only, drop outs, and never involveds, showed:
   - a failure to attain goals led to non-participation, and
   - skill improvement was expected and not a factor in greater motivation.

Implication. Task-mastery goals lead to more success. This relates to what athletes should be expected to include in the goals of their sporting experience. It does mesh accurately with the universal interest of athletes in improving the skill elements of their sport.

**TYPES OF GOALS**

Rushall Thoughts, 1992.

Very long-distant goals, such as career goals, are related to performance in that they provide standards against which current or shorter-term standards can be evaluated. They have no effect upon performance of relatively immediate tasks because they function more in performance evaluation rather than performance direction. They assist in some knowledge of progress toward some ultimate definition of performance. They do not direct behavior at all. They provide an adequate framework for feedback about performance progress/assessment.

Short-term/immediate goals direct behavior and affect behavior. They structure the content of performance and assist in self-generated concurrent feedback.
These two perspectives indicate how the distance of a goal changes its function and relationship to sporting behavior.

GOALS/PROCESS OUTCOME EFFECTS


It was found that:

- Social comparison results (e.g., W-L-D outcomes) reduced interest in a task.
- Task evaluation of a particular goal led to more thought being put into a task. Even less competent persons may increase their motivation through the provision of task evaluation.

Implication. When goal-setting, a coach should emphasize task-evaluation not comparisons with others. Short-term or immediate goals can provide more opportunities for task-mastery and evaluation than long-term goals, and so motivation can be increased. Competition produces social comparisons and so is not as important for affecting performer application as is commonly claimed.

PROCESS GOALS


When performance and performance evaluation focuses on a particular goal, rather than relative standings, more thought is put into the task.

Implication. Tasks will be completed better if concentration is focused on what is to be done to achieve a specific behavioral outcome rather than on something that is not so directed toward behavior

MULTIPLE ARE BETTER THAN SINGLE GOALS FOR AFFECTING PERFORMANCE

A one-goal and two-goal condition were compared. Both groups were assumed to have an aroused motive to achieve. The second group also had an added $5.00 bonus for a best score on the task. The multi-incentive group performed better. Where achievement was the only goal, those with high achievement motives performed better than those with low levels.

Implication. Performance is enhanced by multi-incentive conditions. Athletes should perform and attempt to achieve a number of performance features (e.g., self-improvement in some aspect of technique, consistency of performance, use of strategy, etc.) rather than to focus on one item such as producing a best performance.

Although this is a very old study its implication is as true today as it was 40 years ago. Multiple-performance goal-setting is a better orientation than a singular incentive.

TOUGH GOALS WORK


The effects of negative or positive feedback on group goal-setting, strategy development, and task performance were observed in 177 undergraduates assigned to three-person groups to complete a group word-recognition task. Upon completing the task, groups were given either positive or negative feedback. Then the groups rewrote strategies to perform the task again.

The negative feedback groups were less satisfied but they set higher goals, developed more strategies, and performed at higher levels than the positive feedback groups.

This study supports the need for continual challenges to improve in a learning task.

Implication. In a learning task, some of the goals that are established should be oriented to improving in factors that are not performed proficiently. The best feedback would be a mix of positive indications of successfully performed elements plus further indications of where other elements could be improved (veiled negative feedback).

CHARACTERISTICS OF GOALS THAT CHANGE PERFORMANCE


The factors that determine how and why goals affect performance were described. The two strongest variables were:

1. An increase in goal-specificity (detail) increases performance. Vague, distant, or "general" goals have little effect on the quality and level of performance.
2. The degree of acceptance of set goals affects performance. Who sets the goals is important. The higher the athlete’s self-efficacy for achieving the goals, the greater will be the improvement in performance. This is not to be confused with "forcing" athletes to accept goals. The acceptance has to be natural and uncoerced.

A second tier of "weaker" variables was determined.

1. Goal-difficulty. The more difficult the goals, the higher is the performance standard.
2. Participation in goal-setting. When athletes are able to contribute to the determination of the goals, the higher is the performance standard.
3. Feedback on goal effort. Upon completing a performance, feedback and analysis have a moderate effect upon succeeding goals. When the follow-up procedure is a standard part of the goal-setting process it will have some effect on how and what goals are established.

One further variable, peer competition, was considered and found to have no effect upon performance. The common practice of coaches challenging athletes on the same team to compete against each other is not likely to have any lasting beneficial effect on performance.

PERFORMANCE SEGMENTING: STRUCTURING FOR MORE EFFECTIVE GOAL-SETTING


"If an event is of long duration, it needs to be broken into segments. Those partitions or segments should be short enough for the athlete to totally concentrate on what needs to be thought of and done in that period. This assists focusing on the completion of successful competition elements. Structuring performances in this manner is called "segmenting." In the US Navy, a similar approach to combat missions is known as "compartmentalizing" (e.g., TOP GUN).

Segmenting originates from two sources. First, the goal-setting literature has shown that distant goals have less effect on performance than do more proximal goals (House, 1973). Short-term performance goals that focus on the processes needed for successful behavior enhance performance (Harackiewicz, Abrahams, & Wagerman, 1987). Second, individuals faced with extensive tasks usually break them down into more manageable segments (Heads, 1989, describing the across-Australia run by Tony Rafferty). Botterill (1977) noted successful young athletes spontaneously reconstructing an endurance strength-task into shorter performance segments each having its own goal or goals. A skier overcame difficulties with traversing a slope when attention was shifted to progress by parts of the task that eventually lead to completion of the total run (Syer & Connolly, 1984). World-champion target sportspersons have reported attempting to fire "one shot at a time"
during extended shooting contests (Wiggers, Anderson, Whitaker, & Harmon, 1980). Performing artists have intuitively divided long performances into stages (e.g., acts and scenes, movements) so that performance quality can be maintained. Thus, theory and practice support the notion of segmenting extensive tasks for improved performance outcomes.

Manges (1990) and Wahl (1991) both tested the segmented versus total performance goal-orientation in runners. Using intrasubject research designs, the value of short-term process goals over terminal or distal goals was conclusively demonstrated. The performance differences could not be accounted for in terms of altered physiological functioning, a phenomenon noted long ago by Wilmore (1970). The effects of segmented running performances in the Ss of two studies are listed in Table 1.

Segmenting performances is a recommended procedure for performance strategy construction (Rushall, 1979, 1995a). It has recently been hypothesized that segments need to be shorter, the more intense the activity. The way segments are structured and their content is particularly individual (Rushall, 1995b). Differences in segmenting strategies and moderating factors need to be determined to understand this factor more clearly. The anecdotal and goal-theory literature at present is inadequate for fully explaining this phenomenon.” (pp. 3-5)

Table 1. Performance Changes in Male Recreation Runners Under Segmented Task Conditions.

<table>
<thead>
<tr>
<th>STUDY</th>
<th>Ss</th>
<th>Task</th>
<th>Segments</th>
<th>% Change</th>
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<td>3200 m run</td>
<td>8 x 400 m</td>
<td>2.1%</td>
</tr>
<tr>
<td></td>
<td>S2</td>
<td>3200 m run</td>
<td>8 x 400 m</td>
<td>2.7%</td>
</tr>
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<td></td>
<td>S3</td>
<td>3200 m run</td>
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</tr>
<tr>
<td>Wahl</td>
<td>S1</td>
<td>1600 m run</td>
<td>4 x 400 m</td>
<td>5.4%</td>
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<td>S2</td>
<td>1600 m run</td>
<td>4 x 400 m</td>
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<td>S6</td>
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REFERENCES

PROBLEMS WITH GOAL-SETTING RESEARCH


That goal-setting improves task performance is one of the best established findings in management and psychology. However, there are studies in sport and exercise psychology that have had anomalous results. This article highlights the errors in research that have produced these results.

1. The failure to manipulate the "no-goal" or "do best" condition so that spontaneous goal-setting does not occur. When Ss are given feedback about performance, they often use it to set goals. It has been found that Ss do spontaneously set goals, particularly when given feedback in laboratory settings. When "do-best" Ss, for some reason, do not set goals or are prevented from doing so, the value in setting goals for improving performance can be observed. Thus, it is important that "do-best" Ss do not receive feedback and/or are prevented from doing so in comparative studies.

2. Measure personal/actual goals. It is imperative to know what personal (actual) goal each person sets in response to the external goal that was assigned. Goal theory asserts that assigned goals affect performance through their effects on personal goals. Knowing that a person is not committed to an assigned goal is not very
helpful unless the goal which was substituted is known. Ss should be required to record actual goals in writing or on a voice tape to locate the real goals used in studies.

3. Make specific goals difficult. Specific goals that are actually easy usually lead to lowered levels of performance. To display effects goals must be difficult. A suggested level of difficulty is that no more than 10% of Ss can reach them.

4. Make sure subjects are committed to achieving the goal. Commitment reveals if an S has accepted an assigned goal. A personal goal indicates what new personalized goal has been set. It is necessary to obtain some indication (usually marking a position on a 5-point commitment scale) to indicate if the goal-setting that is being manipulated in the experiment is being used that way.

5. Baseline. It is important that experimental groups do not start from different baseline levels. One way of controlling this is to perform single-subject studies.

6. Competition. The effects of competition, which is a variation of goal-setting, have not been controlled well. The measurement of this factor is very difficult. If A's goal is to beat B, then A's personal goal becomes B's performance level or better. It is best to use single-subject designs so that goal-aspirations will be reliably set.

7. Measure self-efficacy, not subjective difficulty or effort. Subjective difficulty is not a very useful measure because it is confounded. It reflects the level of objective goal-difficulty and the S's perception of his or her ability to achieve the goal. Subjective difficulty is correlated positively with objective difficulty but negatively with self-perceived ability. A better measure is self-efficacy, one's confidence in being able to execute a course of action.

Many of these problems can be alleviated by recording a S's plans and reactions and using single-subject designs. It is not appropriate to assume any path of action with goal-setting research because of the common tendency of Ss to personalize and modify externally imposed goals in challenging settings.

SELF-CONTROL FACTORS ASSOCIATED WITH SUCCESS


Performance outcomes which were understood by athletes were attributed to internal factors, that is, factors over which the athlete has control. When outcomes were ambiguous (not clear or could be interpreted a number of ways), they were attributed to external events. This suggests that certainty and decision-making will be elevated when the activities to be performed in a contest are self-controlled (internal).

Implication. Contest goals and plans should consist of events over which the athlete has control.

PERCEIVED VALUE OF ACTIVITY
It was concluded: "...although there is a definite psychological benefit following consistent exercise and physical change, this benefit results not from the physical improvement, per se, but from the emotional or psychological perception of the physical and personal value of continued exertion." (p. 408).

Implication. What individuals get out of exercise is what they think they get out of it, not the actual fitness improvement.

EXTERNAL PRESSURES ON GOAL-SETTING


Under interesting task conditions, assigning specific difficult goals reduced subsequent task interest, persistence, and satisfaction with the task. Under boring task conditions, assigning specific difficult goals increased on-task interest.

The negative effects of goal-setting on intrinsic motivation seemed to be especially important for those individuals who failed to achieve the prescribed goal.

The assignment of goals may interfere with performance, stimulate it, and may alter the reasons for performing depending upon the nature of self-set goals that exist prior to the imposition of external goal-setting.

Implications

1. When an individual is very motivated to perform a task, that is, intrinsic motivation is high, the imposition of coach-suggested goals will cause motivation and performance to deteriorate. Before considering imposing goals, such factors as importance of the contest to the athlete, the extent of self-set goals, and the self-efficacy of the individual for the intended performance, need to be considered. If intrinsic motivation is high, the coach should resist suggesting further goals.
2. On the other hand, when intrinsic motivation is low, coach-imposed goals, particularly if they are agreed upon by the athlete, increase interest in the task or contest.
3. If a coach does not analyze the status of the athlete with regard to personally-set goals, the imposition of goals could be a destructive procedure when an athlete is already highly motivated.
4. EXPLICIT GOALS

6. Commitment to task completion and standard of performance were enhanced when goals, intentions, or contracts were stated explicitly.

7. Implication. Practice and competitive tasks should be stated behaviorally and without ambiguity. Concepts such as "determination," "aggressiveness", etc. do not direct behavior in an exact manner. The statements of performance goals need to be limited to observable and measurable actions and outcomes.

8. INTENTIONS AND LEVEL OF PERFORMANCE


10. The notion of a linear relationship between level of intended achievement and level of performance was supported. The easy or lowest levels of expectation failed most.

11. Ss set moderate levels of intended achievement if given the choice and told to do as well as possible. External suggestions to raise standards resulted in a marked increase in performance. When standards were very hard Ss still continued with high output although they were rarely able to beat the standards.

12. This study does not support the contention that performance is maximized when the probability of successful goal achievement is 50%.

Implication. Goals need to be challenging and difficult without being considered "impossible." Athletes who constantly set moderate goals will not improve optimally in their sport.

PERCEIVED TASK DIFFICULTY


Goal-setting has a positive effect on performance through its effect on motivation. Individuals working under high goals have high levels of intended performance and put forth more effort to reach the high performance levels. Task difficulty appears to increase performance by providing individual incentives to increase skills to deal with more complex situations and challenging physical tasks. The mobilization of increased skill levels leads to performance increases.

Implication. A coach's and athlete's expectations for training and competitive performances should err on the side of difficulty rather than being "soft" or easy. Sufficient task challenge has to be perceived by athletes to extend the level of effort and the degree of skill mobilized to performing experience.

EFFORT AND GOALS

The ability to apply voluntary effort in getting over difficulties, which emerge in the course of a sports activity, plays a decisive role in the realization of high sport achievements. The dynamics of this involvement were studied.

Ss consisted of 30 students, 15 sportsmen, and 10 children (5-7 yr). Fatigue was induced by running 30, 50, and 80 m with a high knee lift and sideways lifting of 4 kg dumbbells with straight arms. These tasks involved high-speed, force, and mental work. Ss were instructed to work to failure after providing a quantitative description of the task goal.

The results of this study were many.

1. The greater and more remote the goal set, the greater the voluntary effort.
2. The consideration of terminating effort (the "stopping-wish") always appeared before goal-attainment no matter what the type or difficulty of the goal.
3. Overcoming the sensation of fatigue involved extreme voluntary effort.
4. The "stopping-wish" occurred about 80-85% of the way through the task and was independent of the goal distance.
5. The volume of work was least when Ss had to perform to failure. This means that when failure was imminent, effort was reduced.
6. The volume of work increased when public commitment to goal-achievement was demonstrated.
7. The volume of work was most when public commitment to goals occurred and when concurrent feedback was provided as the task progressed (performance progress).
8. Goal-setting increased work output by as much as 50% over conditions where no goals were set.
9. Directing attention to fatigue feelings reduced performance output.
10. The clearer and more detailed are goals, the greater was the tolerance of fatigue. This can be accommodated by saturating the goal image (Ss' potentialities for goal-achievement, attitude towards the goals) during preparation.

Implication. Effective goals should be detailed and associated with high self-efficacy for goal-achievement. The balance of these two factors broadens the scope of goals and retards the onset of debilitating fatigue.

**PERFORMANCE EXPECTATIONS**

This study had two purposes: (a) to consider the relationship of satisfaction to the difference between expected performance and reported performance, and (b) to investigate the effect of the difference between expectations and experience on performance satisfaction without ignoring the level of expectations, or confounding level with experience.

Ss were given performance feedback independent of their actual performance after estimating what performance would be prior to each trial.

The following features resulted:

1. Once Ss received some performance feedback their expected performance outcomes approached feedback levels.
2. Satisfaction with performance increases as the performance difference between predicted and feedback levels increases regardless of the comparison standard.
3. Ss with low expectations performed worse than Ss with high expectations.
4. The level of expectation governed the degree to which Ss used feedback as a basis for judging their satisfaction.
5. Public commitment of expected outcomes (goals) had individual effects.

Implication. The type of feedback provided for performance will govern the satisfaction levels of athletes. For it to have its most impact feedback needs to be: explicit, accurate, relevant to goals, and relevant to the individual.

WHAT GOALS DO


1. Goal setting directs attention. The more specific and behavioral a goal, the greater the control an athlete has over it. This is evidenced when one contrasts winning as a goal with shooting a rifle exactly the same on each successive shot.
2. Goals must be coupled with feedback (KR). Knowledge of results or goals alone are not as effective as both together. Once again, the role of feedback as the primary medium for behavior change is substantiated.
3. HOW GOALS ARE USED CHANGES WITH FAMILIARITY
5. As individuals learn to use goals, relationships between goal-related variables and behavior change. This feature has not been emphasized by goal theorists and researchers. The modified relationships need to reflect salient aspects of the exercise setting for the participants examined.
6. In this investigation, it was observed that exercisers reported goals and action plans that revealed their knowledge about some of the specific behavior strategies and exercise behaviors required to attain their goals. In future studies, employing a specific efficacy measure of a participant's perceived ability to complete an exercise-related behavior with which they are familiar, may aid in predicting exercise frequency. Perceptions of goal clarity, commitment, and influence increased as adherers experienced the program.

7. Exercisers became quite knowledgeable about what they should do, but the frequency and nature of their participation often is not in concert with that knowledge.

8. Implication. When using goals, it is what the individuals do, not say, that is important. Behavioral compliance should be the main assessment criterion when assessing the effectiveness of goal-instruction and goal-setting programs.

SEGMENTING PERFORMANCE INTO INTERMEDIATE PERFORMANCE GOALS IMPROVES PERFORMANCE


Ss were boys (N = 75) ranging in ages from 11 to 14 years attending an ice-hockey camp. A pretest/posttest control group design was used. Ss were blocked (controlled) into groups of high, medium, or low levels of strength.

Ss were pretested on an endurance task of squeezing hand-grip dynamometer, he task load being 25% of maximum strength, under control group conditions (no concurrent or terminal feedback). Ss were led to believe that they were working against different resistances so as to avoid interpersonal competitions. A ceiling level of 12 minutes of performance that produced 720 contractions was established.

Results. A great range of scores were demonstrated but it was evident that psychological factors play an extremely important role in physical endurance testing.

1. Simple goal-setting more than doubled the performance of some athletes.
2. Goal-setting procedures have differential effects. The way goals are set is important.
3. Difficult goals produced better performances.
4. Explicit goals produced better performances.
5. Difficult, explicit goals when combined with group-set goals was the best condition and indicates that these factors should be used together rather than to rely on only one feature in a procedure.
6. The best performers spontaneously reset their goals during the performance. They would set an intermediate goal, achieve it, and then reset the next one, and continue on through the task in self-determined segments.
Implications. Performance goals for young athletes should be difficult, very explicit, and mixed with group-set goals. The group-set items are the framework against which the individuals establish their own aspirations.

The best structure for attempting the extended task was to develop a series of intermediate goals that would provide an indication that performance was progressing satisfactorily. The intermediate stages for self-evaluation of progress are best set by the athletes themselves. This study was the first sporting-environment justification for segmenting extended performances.

THE NEED FOR RELATIVELY SHORT-TERM GOALS


As the anticipated delay interval for the attainment of a tangible reward increases, the subjective value of the reward decreases. This basic principle is applicable to most reward situations. For example:

1. When athletes intend to train for a long-distance goal, such as making a commitment to train for an Olympic Games in four years time, there should be more emphasis on much shorter goals than the long-term one. Doing the best possible in the current season should take on greater importance than the distant intention.

2. In an extended performance, such as playing a soccer game or running a 1500 m race, it is more effective to construct intermediate goals that can be evaluated during the single performance than it is to focus only on the terminal outcome. Thus, evaluation stages of the ongoing performance are much more important for affecting performance than distal goals.

Implication. No matter what the final goal, athletes must be kept attuned to the ongoing process that will eventually lead to the ultimate goal. Long-term goals are not very influential although they can be easily verbalized.

GOALS CHANGE WORK EFFICIENCY WITHOUT AFFECTING PHYSIOLOGICAL COST


The task of riding a bicycle ergometer in competition with a matched work output was compared to a pre- and posttest solo control condition. The competitive condition was termed "motivated."
The motivated condition was better than either control condition but the second control condition was also better than the first. This demonstrated a significant learning/training effect that was not attributable to physiological factors. It showed that goals should be behind every performance if maximum performance parameters are to be stimulated.

The learning effect from the first to the second control trial was not accompanied by any significant alternations in maximal physiological responses. This suggests that there is a reserve in work output above a predetermined capacity that needs to be stimulated by goal-setting.

Implication. Physical performances without set goals will not produce the best form of physical response. Coaches who disregard the value of this simple manipulation will not stimulate the best form of training in athletes. As has been demonstrated by champion athletes, every task of training and competitions must be oriented to some particular explicit goal that will focus the athlete on functioning with the greatest efficiency in performance.

A physical activity at training without a goal-orientation is a wasted opportunity for improvement.

SUCCESS AND FAILURE ATTRIBUTIONS


In boys, success was attributed to internal factors (events over which the athlete has control) while failure was attributed to external events. This reflected the pre-contest orientation of the athletes in terms of the source of their goal-setting. It suggests that when formulating contest goals, the factors which should be emphasized should be internal.

Implication. Contest goals and plans should focus on events over which the athlete has control. This will yield a success-oriented preparation.

EFFECT OF SUCCESS ON MOTIVATION


After a successful experience, Ss exhibited higher intrinsic motivation when compared to Ss in failure conditions. Males displayed more intrinsic motivation after success whereas females demonstrated more after failure.

There appears to be a sex difference in the nature of the response to success. Males increase their intrinsic motivation while females respond similarly after failure. This suggests a need
for a teacher or coach to respond differently to the way tasks are performed depending upon the sex of the individual. Two possibilities are:

1. Respond to males' success with positivism and focus on the events over which the athlete had control.
2. Respond similarly to females' success, but also emphasize errors which were made and then suggest internal control actions which could be used to correct the faults.

Implication. The way success is handled depends upon the sex of the athlete. While males should be showered with attributions to self-controlled events, females can handle some negative appraisal, particularly if it is related to gaining self-control to remove the fault or failure in the future.

INTERNAL AND EXTERNAL REACTIONS TO FAILURE


Some attributions to performance outcomes are ability, effort, task difficulty, and luck. Some characteristics of individuals relate to reasons acknowledged as causes for outcome failures.

Internal individuals perceive reinforcements as being a consequence of their own actions, that is, factors over which they have control. Externals perceive reinforcements as being a consequence of external forces such as luck, chance, and fate.

In a study involving university students and an anagrams test, following expected failure internals blamed themselves and externals blamed outside factors. However, findings were not as simple as theory would predict when unexpected failure was experienced.

1. For internal Ss unexpected failures are attributed to variable external factors whereas for expected failures they are attributed to internal factors.
2. Internal Ss recorded higher ratings of lack of ability to account for expected than unexpected failures.
3. When compared to externals, internals paid more attention to and utilization of cues providing information to help make decisions and resolve uncertainties.
4. When a goal is other-determined, externals explain failure in terms of task difficulty.
5. When goals are self-determined, there is no difference between internals and externals for failure attribution. Both evaluate their goals as being too high for the task.
Implication. For athletic performances which are largely athlete determined, goals should be primarily self-determined. Athletes should be taught how to set goals and to develop considerable levels of self-control.

**KNOWLEDGE OF RESULTS**


The literature concerning knowledge of results (KR) and goal-setting was reviewed. Four categories of studies were determined.

1. KR and goal-setting were explicitly confounded. Usually, KR groups perform better but possibly because KR and no-KR groups have different goals.
2. KR is given in relation to a standard or record of previous performance. These studies yield the benefits of knowledge of performance progress.
3. Goals set by KR and no-KR groups are not measured. Usually KR is given on each trial. It was suggested that KR functions as a "standard of performance" which tends to cause effort to be prolonged during work periods. Since this form of concurrent consequence is not available to no-KR groups, performance is not affected.
4. Some studies tried to separate the effects of KR and goal-setting. When goal-setting was partialed-out statistically, KR was found to have little effect on performance.

**Implications.** KR and goal-setting are interdependent for affecting performance.

1. It is important to have standards of evaluation. They direct the magnitude and form of performance.
2. KR is "motivational" in that it leads to goal-setting, not the other way round.
3. Following the receipt of KR is a period of evaluation which entails the formulation of behavioral intentions linked to goals for the next behavior. Time is needed for this consideration and so repetitions should be separated by reflection intervals. It is possible to have trials (e.g., when shooting baskets) too close together which does not provide time for this phenomenon to occur.
4. Athletes should be taught to use KR and goal-set for every behavior at practice and in particular, in sets of repetitious activities.

**KNOWLEDGE OF RESULTS, GOAL-SETTING, AND PERFORMANCE**

An attempt was made to measure: (a) the effect of performance information (PI) on a future pursuit, (b) the influence of set performance goals on effort level, and (c) the effect of learning relevant rules on performance.

A mental activity involving complex computation tasks according to rules was used to indicate performance. Three groups performed in the experiment: Group 1 - aim for trial score plus 15 points (higher than on previous task); Group 2 - provided with self-evaluated correct knowledge of performance, and Group 3 - given no knowledge of total scores but provided with knowledge of correct answers. After six trials, Ss were asked to explain their goals and how they viewed the task procedures.

It was found that there was no effect of knowledge of score on performance (Group 3). Trying for a hard standard led to higher levels of performance than occurred when goals were set with only KR (Group 1). The group which first memorized rules for setting goals and performing the task performed better earlier.

Implications. If practice behaviors are to be influenced favorably and result in meaningful experiences, the following characteristics need to be employed.

1. Tasks should be explained and understood by athletes before they are attempted. This constitutes establishing rules for the process of the activity. This needs to be clearly communicated in the activity introduction.
2. Directed practice programs will lead to more rapid and higher levels of achievement than those which allow athletes to self-set goals (permissive practice).
3. Improvement progress in the activity is a major influence, more so than just receiving performance feedback or PI.

It is the nature of the goal or the intention for the practice activity rather than PI which affects performance.

**KNOWLEDGE OF RESULTS AND GOAL-SETTING**


Addition problems were performed for 20 minutes. The following relationships between knowledge of results (KR) and goal-setting were revealed.

1. KR influences the levels of goals set for subsequent behaviors.
2. Correct KR is better than no-KR or false-KR. The practice of giving false performance information serves no constructive value.
3. The performance of one trial affects the goal levels set for the next trial. Generally, the greater the performance change, the higher will be the subsequent goal.
4. When the effects of a performance are explained and accounted for, KR still influences the goal levels set for the next trial.
Implication. Persons do not normally aim for goals that their previous performance indicates would be unrealistic or non-challenging. Coaches have to be honest and realistic in performance analysis and when suggesting goals. Attempting to "motivate" by setting "impossible" goals (as perceived by the athlete), is unlikely to improve performance and more likely will cause performance to worsen.

PERFORMANCE FEEDBACK AND SELF-SET GOALS


It was found that the effects of receiving performance feedback after task performance were significantly greater than when no feedback was experienced. Also, feedback increased the relationship between performance and self-set goals.

1. Performance feedback is necessary for goals to affect performance.
2. Feedback alone does not affect performance, nor do goals alone. It is when the two are combined that performance changes.

Implication. Practice trials (activities) should yield feedback in terms of performance information that is measurable and observable. Practice trials without feedback are wasted trials. Rules for using performance information and adjusting consequent self-set goals should be established by athletes, probably after instruction by the coach

PRACTICAL GOAL-SETTING


The following is copied from the introductory section dedicated to goal setting in the book: Mental Skills Training for Sports.

INTRODUCTION

Goals serve two general functions in sport settings.

1. They can be used as reference standards for athletes to assess:
   - performance content and mood;
   - pre-competition task-difficulty and self-efficacy; and
   - in-competition performances.
2. They also can be used as the focal point for athletes to determine precompetition and competition strategies and content.
Goals influence two important factors in sports. Firstly, how a performance is viewed and how an athlete considers he/she will perform. Their effect is to govern performance efficacy. Thus, despite excellence in physiological conditioning and skill preparation, it is an athlete's appraisal of what is to be done, how well he/she is prepared to do it, and whether he/she thinks it can or cannot be done, that affects the quality of a performance. Goals underlie the majority of performance applications which are made in the training and competitive circumstances. An athlete without goals will lack direction, purpose, and adequate assessment criteria, deficiencies which will degrade the motivational qualities of a sporting experience.

There are numerous types of goals, each being defined by its potential effect on performance and its purpose as a standard of reference. A hierarchy of sporting goals is: i) career goals, ii) relatively long-term goals, iii) performance goals, iv) performance progress goals, v) activity goals, and vi) intermediate goals. Those goals are described below.

Career goals. Career goals stipulate the final major outcome of participation in a sporting career. They are usually established by the athlete and are not likely to be changed by a coach or club official. When these goals are not achieved, the athlete is likely to cease serious participation in the sport. If they are altered at an important stage in an athlete's career that alteration is likely to be accompanied by some performance deterioration. Examples of career goals are:

- participating until the Olympic Games in the year 2000;
- playing the sport until the age of 35 years; and
- playing at least five years as a professional.

Being long-term goals, career goals have virtually no effect upon immediate performances. The coach should not appeal to career goals in an attempt to alter an athlete's state of enthusiasm or level of performance. Career goals serve as the final reference point for sporting career achievements.

Relatively long-term goals. Although these goals are distant, they specify the achievement of some standard or outcome at some defined stage in time. Examples are:

- being selected for the next Olympic team;
- performing one's personal best in some international event; and
- obtaining a player's contract.

These goals can span more than one competitive season but do delineate an exact time period for accomplishment. They are established by the athlete and have a very low potential for being influenced by a coach. If they are not achieved, they will be followed by a period of demotivated participation or the athlete quitting the sport. They may be altered on the basis of performance goals that occur as the athlete progresses. Those changes usually are to increase the standard of the goal.
Performance goals. These are goals which indicate some performance standard or outcome that is to occur at a particular time. They differ from relatively long-term goals in that they relate only to performance. They serve the function of being the performance outcome upon which all training plans and competitive schedules are based. Examples are:

- breaking a record at the national championships;
- achieving a certain scoring percentage for a season; and
- learning a particular repertoire of skills.

These goals are established by the athlete but can be influenced by a coach if he/she performs in the capacity of consultant during the goal formulation period. There is a need for the athlete to be able to justify why these goals can be achieved. Those justifications should be reinforced periodically as the athlete progresses to the exact day of goal assessment. Performance goals are not likely to be altered, except to marginally upgrade them. They serve as a standard for appraising on-going performances. A failure to achieve performance goals usually results in an extended period of demotivation.

Performance progress goals. These goals function as indicators of training progress towards the achievement of performance goals. They usually contain a specified date for evaluation that will allow the timeliness of progress also to be considered. They should be established by the athlete in consultation with the coach. When they are explicitly determined they serve as a schedule of expected self-improvements and constitute the basis for predicting future performance capacities. These goals need to be expressed in positive terms, such as running a certain time for 200 meters, making a number of tackles, or achieving a particular score in an archery competition. Goals such as not missing the cut, avoiding problems, and performing to not let the side down are unacceptable because of their negative expression and connotations. A failure to achieve performance progress goals leads to emotional reactions, such as frustration, depression, and demotivation. Corrective steps such as altering the training program, monitoring future progress more closely, and/or conducting an efficiency analysis to locate deficiencies can be made as a response to goal-failure. Performance progress goals affect performance in a constant manner over a short period of time.

In this section there are four exercises which focus on establishing the goals which have been discussed above. Since those goals are interrelated, they are best determined in sequence. Thus, the sporting career goals exercise should be completed first, then followed by the relatively long-term goal exercise, the performance goal exercise, and finally, the performance progress goals.

Activity goals. These goals stipulate the factors to be achieved in a specific performance attempt. Champion athletes designate specific goals for every training item and competitive experience. This type of goal serves to focus the attention of an athlete on what is to be done in a single performance. Examples are:

- to execute a new technique feature in a race;
- to try and alter posture in a training trial; and
to concentrate on the function of the hand when holding a rifle.

These goals are equally affected by the coach and athlete. Performance information as a consequence of the performance trial is the main ingredient for determining if the goals were or were not achieved. A failure to achieve them usually results in some alternative approach being tried in order to produce the desired outcome.

The procedures for developing activity goals are described in the sixth exercise of this section. They are also described in the first exercise "The establishment of a daily positive focus" in the section that describes the development of commitment. The use of specific goals for competitive performances can be located in the section concerned with establishing competition strategies.

Intermediate goals. These are the appraisals and assessments which occur during a performance which indicate progress towards specific goals. They serve as the goals of activity segments and directly affect the nature of a performance.

The procedures for establishing intermediate goals are described in the sections involved with the formulation of pre-competition and competition strategies.

Characteristics of Setting Goals

Since one can rarely do anything about an opponent's performance in a contest, specific goals should relate to an athlete's own performance quality. A football player can tackle an opponent in an attempt to halt progress but it is the quality of the tackle that will determine the outcome. It would be better for a player to focus on performing the skill elements that will result in the best tackle possible rather than attempting to achieve a more general end such as stopping the player. The latter focus does not ensure a desirable result whereas the former does promote the best attempt possible that, if achieved, will produce the outcome.

This is a difficult concept for some coaches and athletes to grasp. It requires concentration on the process of performing sport activities rather than striving for some score or effect. A typical example of this factor often occurs in basketball when players start to look at the scoreboard with increasing frequency as a close game progresses in its later stages. Such a behavior suggests that the player is trying to close the score or get ahead. However, that approach does not direct the athlete's play in any particular manner. A better goal-oriented focus would be to perform better in defensive roles and improve offensive skills, maneuvers, and strategies. If those features are attended to in detail then the quality of play should improve which, hopefully, will produce a more desirable balance in scoring. Put simply, if the skills and strategies are in place, the score will look after itself. Goals should focus on what has to be done in the activity, not what will result from it.

Goals should be restricted to performance expectations over which an athlete has control. There are advantages to having self-control goals; they are listed below.
It does not matter what the competition is, where it is, or who the competitors are, the athlete only has to compete against him/herself. No other athlete can prevent the athlete from reaching his/her goals. The athlete knows in advance what needs to be done in the training item or competition. If strategies and knowledge have been developed adequately, uncertainty will be reduced and the athlete will have a high likelihood of reaching the goals. Self-control goals direct the content of training and performance and establish a high level of self-efficacy. The probability of achieving a self-control goal can be calculated. The periodic "check-points," which indicate progress towards a performance goal, are self-determined and so are very relevant to the athlete.

With goals that rely on the ability of athletes to control what they do, training and competing become contests between the athlete and stable pre-defined goals. This leads to athletes developing a mastery orientation and having clear purposes behind practice and competitions. A competition or training task should be a challenge to control oneself to achieve a set of defined, self-oriented outcomes. In that context athletes are totally responsible for what they do.

The above description of self-control goals should be contrasted to goals such as "winning" and "making the team." The major influence that differentiates the two types of goals is the role of external factors in "winning." A large component of external elements which cannot be controlled produces uncertainty in an athlete. Uncertainty destroys confidence and self-efficacy. The resulting realization that there is not much that can be done to control what others do, decreases the motivation to perform well. One response to this realization is that the athlete "quits" before the contest and performs in an inferior manner. Another is that a desperation contest strategy is developed and usually produces poor results. For goals to be effective, they need to involve practiced features that can be controlled by the athlete.

Steps in Goal-setting

There are a number of steps that should be followed when setting goals. They are explained briefly below and are included as the steps for setting each goal-type included in this section. These steps were first described by Lars-Eric Unestahl of Sweden.

1. Goal-awareness. Former goals which have and have not been achieved should be listed. This leads to better goal-setting skills and establishes an historical framework for developing realistic goals for the individual.
2. Goal-inventory. The athlete should establish a list of possible goals. This could be done in consultation with the coach and should include all types of goals including those with a low-probability of attainment. This step defines the range of possible goals.
3. Goal-analysis. The goal-inventory should be evaluated with each goal being assessed for its appropriateness and possibility. A hierarchy of possible goals should be established for each classification.

4. Goal-selection. The hierarchies of possible goals should be evaluated and the goals selected. The criteria for selection are that they be:
   - as difficult as possible but reachable while erring on the side of being too difficult rather than too easy;
   - agreed upon by the athlete and coach;
   - established in priorities when more than one goal exists;
   - aimed at improving performance, not merely maintaining it or causing it to regress;
   - related to performance, not vague entities such as pride or aggressiveness; and
   - measurable.

5. Goal-formulation. When goals are selected, they should be formulated and analyzed according to the following characteristics:
   - contain only individual self-control items;
   - be expressed positively (no negative or avoidance wordings);
   - be appropriate for the athlete (not restricted to what the coach wants);
   - have optimal probability (the athlete should be able to justify why each goal can be achieved);
   - have maximum believability (no doubts, all factors are controllable); and
   - be measurable and observable.

The above characteristics also suggest why "winning" is not an adequate goal. "Winning" is not concrete, for one does not know exactly what has to be done - others influence that. It does not have individual self-control, does not fit optimal probability, is not maximally believable (too many unknowns), and could be restricted to the point that it may not have strong incentive value for the athlete.

Multiple goals. If possible, there should always be more than one goal established for a classification. The intent of performing should always be to achieve a number of outcomes. The reason for establishing multiple rather than single goals is that the incentive value of goals accumulates. The selection of multiple goals should always ensure that the attainment of the majority of them is highly probable. This will produce a positive orientation towards performance with high expectations of success. The higher the expectation of success, the better will be the performance.

The setting of goals is not a simple task. It is not purely giving the instruction to "make up some goals" with the coach leaving it at that. It is a series of involved procedures that affects performance and participation in a dramatic way. Because of that it is worthwhile to take the time to establish goals with athletes according to the criteria that have been described above and the procedures indicated below. If that is not done, then goal-setting will be a feature of effective coaching that has been neglected.
The exercises that are included in this section should be completed in order for they are interrelated. These are important exercises and therefore, should not be hurried in any way. There is the possibility that, with time, goals may need to be changed and so athletes should be encouraged to make entries on the various worksheets in pencil. That will allow changes to be made with relative ease at some later stage.

[Two other goal-setting skills are described and appropriate developmental exercises presented. "3.5 Setting group training goals" focuses on coordinating the activities of several athletes at practice to achieve one or more collective goals, and "3.6 Setting and evaluating personal activity goals" aims at developing the skill of establishing goals for each practice item as well as the practice session in general.]

Implication. Goal-setting is an important set of involved skills which will determine success and improvements that result from practice and competitive activities. It must be treated with detail and concerted effort for its potential benefits to be derived.

Exercise titles in Mental Skills Training for Sports.

3.1 Setting sporting career goals
3.2 Setting relatively long-term goals
3.3 Setting performance goals
3.4 Setting performance progress goals
3.5 Setting group training goals
3.6 Setting and evaluating personal activity goals

GOAL-SETTING INVENTORY FOR SPORTS


An assessment tool that evaluates the factors involved in the process of establishing and using goals by athletes in specific sporting environments was constructed according to rigorous scientific standards. The resulting questionnaire underwent a variety of developmental processes and in its final form (see below) contained 98 items. The inventory was shown to be a valid, readable, reliable, objective, and standardized assessment tool. It provokes honest and accurate responding in Ss. The test is capable of providing information to coaches about individual and groups of athletes. Responses to questions will reflect; (a) consistent, (b) inconsistent, and (c) the absence of behaviors related to the goal-setting processes.

This inventory differed from past psychological tests because it considered:

- behaviors rather than personality characteristics, and
- each item of response as an important datum of information for interpretation.
If a coach truly wants to implement a goal-setting program that will be maximally effective, the content of the *Goal-setting Inventory* has to be known and its implied actions followed.

The inventory is accompanied by standardized testing instructions and an answer sheet. The internal instructions, questions, and response alternatives of the *Goal-setting Inventory* are reproduced below.

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**GOAL-SETTING INVENTORY**

Brent S. Rushall, Ph.D., R.Psy. and Jorge G. Fisdel, M.A.

First produced 1988, Revised 1992

A psychological inventory that is valid for use with athletes 15 years of age and older. The information gained from this test is analyzed by a computer. The analysis results are then used to indicate to the coach the best procedures that can be used for coaching and handling the athlete who has completed the inventory.

This inventory contains questions that deal with goals, goal-setting, goal-evaluation, and goal-achievements. The answers that you give will be used to indicate to your coach what is the best way to coach you.

This evaluation is appropriate only for athletes who believe they have goals in their sport. If you believe that you have no goals then discuss with your coach the reason for your being asked to take the test.

It is necessary that you answer each question as truthfully as possible. False or inaccurate answers will cause the inventory results to suggest improper coaching techniques. Take your time in answering each item so that you can answer what is true for you.

Provide only one answer to each question. Answer every question unless you are specifically directed not to in the booklet. Do not mark the question booklet but put your answers on the answer sheet that is supplied.

**WHAT ARE GOALS?** Goals are what an individual or team tries to accomplish in their sport. They are the objects or aims of the activities of training and competing. Goals influence sport behaviors. They serve as standards against which performance is evaluated.

1. **GENERAL**

1.1 I am ready to answer each question as truthfully as possible.
   
   a. true            b. uncertain           c. false

1.2 I understand how my performance is measured in my sport.
   
   a. true            b. uncertain           c. false
2. GOAL-PERCEPTIONS

This series of questions asks how you view the values, uses, and effects of having goals.

2.1 There are times in my sport when I do not have any goals.
   a. always   b. sometimes   c. never

2.2 I have specific goals to aim for in my sport.
   a. always   b. sometimes   c. never

2.3 The goals that I have in my sport are challenging but not too difficult.
   a. always   b. sometimes   c. never

2.4 I have deadlines for accomplishing goals in my sport.
   a. always   b. sometimes   c. never

2.5 When more than one goal is to be achieved, I know the order of preference in which they should be attempted.
   a. always   b. sometimes   c. never

2.6 Upon reaching my goals I am rewarded/recognized in some way.
   a. always   b. sometimes   c. never

2.7 Having goals makes my sport more enjoyable.
   a. always   b. sometimes   c. never

2.8 I feel that my goals pressure me too much.
   a. always   b. sometimes   c. never

2.9 My goals are much too difficult.
   a. always   b. sometimes   c. never

2.10 The goals that I have for my sport conflict with my personal values.
    a. always   b. sometimes   c. never

2.11 Some goals that I have for my sport are not specific enough for me to understand how I can achieve them.
    a. always   b. sometimes   c. never

2.12 When others set goals for me they are used to help me.
2.13 Team goals make me try harder.
a. always  b. sometimes  c. never

2.14 Other people understand my goals because of the way I explain them.
a. always  b. sometimes  c. never

2.15 Sport goals are important to me.
a. always  b. sometimes  c. never

3. GOAL-SETTING INTERACTIONS WITH THE COACH

This section asks you to describe those features of the interactions that occur with the coach with regard to goal-setting and goal-assessment.

3.1 My coach gives me the reasons for setting the goals that are designed for me.
a. always  b. sometimes  c. never

3.2 My coach encourages me to reach my goals.
a. always  b. sometimes  c. never

3.3 My coach lets me participate in the setting of my goals.
a. always  b. sometimes  c. never

3.4 My coach lets me have some say in deciding how I will go about achieving my goals.
a. always  b. sometimes  c. never

3.5 When I reach my goals, I know that my coach will be pleased.
a. always  b. sometimes  c. never

3.6 When evaluating goals in relation to my performance, my coach is negative and critical.
a. always  b. sometimes  c. never

3.7 When I fail to reach my goals, my coach suggests ways to improve.
a. always  b. sometimes  c. never

3.8 If my coach makes a mistake that affects my ability to attain my goals, he/she will admit the error.
a. always  b. sometimes  c. never

3.9 My coach makes sure that my goals are not stated negatively.
3.10 I do not like my coach to set my goals for me.
   a. always             b. sometimes          c. never

3.11 There are some things I want to achieve in my sport about which my coach is not aware.
   a. always             b. sometimes          c. never

Answer each of the following by considering what your coach does when your goal-achievements are evaluated in a meeting.

3.12 The coach and I evaluate the status of my goals and whether or not they have been achieved.
   a. frequently         b. seldom             c. never

3.13 My coach asks me if there are any areas of training in which he/she can assist me.
   a. frequently         b. seldom             c. never

3.14 My coach tells me what I have done that deserves recognition.
   a. frequently         b. seldom             c. never

3.15 My coach listens to my explanations and concerns regarding my performance problems.
   a. frequently         b. seldom             c. never

3.16 My coach comes to agreement with me on the steps to be taken by each of us to solve any performance problems.
   a. frequently         b. seldom             c. never

3.17 My coach makes sure that at the end of a goal-setting meeting, I have a specific goal or goals to be achieved.
   a. frequently         b. seldom             c. never

3.18 My coach schedules a follow-up meeting so that we can discuss progress in relation to the new goals that have been set.
   a. frequently         b. seldom             c. never

3.19 My coach lets me leave the meeting feeling that I had much input into the decision-making that occurred.
   a. frequently         b. seldom             c. never

4. THE EFFECTS OF GOALS ON THE ATHLETE
This section lists the reactions that athletes have about goal-setting, goals, and goal-evaluations. Answer as these apply to you.

4.1 Having goals makes my sport more interesting.
   a. frequently   b. seldom   c. never

4.2 I feel proud when I achieve my goals.
   a. frequently   b. seldom   c. never

4.3 My teammates and I compete to see who can achieve their goals in contests.
   a. frequently   b. seldom   c. never

4.4 When I fail to achieve my goals I am disappointed.
   a. frequently   b. seldom   c. never

4.5 I feel that I disappoint other people (e.g., coach, parents, etc.) if I do not achieve my goals.
   a. frequently   b. seldom   c. never

4.6 The more goals that I achieve, the more confident I become.
   a. frequently   b. seldom   c. never

4.7 The more times that I do not reach my goals, the less confident I am of being able to perform and achieve further goals.
   a. frequently   b. seldom   c. never

4.8 The more times that I fail to achieve my goals, the more I want to lower them.
   a. frequently   b. seldom   c. never

4.9 As I achieve my goals, the more I want to increase their difficulty.
   a. frequently   b. seldom   c. never

4.10 If people know what my goals are it bothers me.
    a. frequently   b. seldom   c. never

5. GOAL-SETTING ACTIONS

This section asks questions about the activities that surround the goal-setting and goal-evaluation process. Answer the questions as they apply to you.

5.1 My teammates encourage me to achieve my goals.
5.2 I plan the way that I will go about achieving my goals.
   a. frequently  b. seldom  c. never

5.3 I work together with other athletes when setting goals.
   a. frequently  b. seldom  c. never

5.4 I like to work with other athletes in setting goals.
   a. frequently  b. seldom  c. never

5.5 Many people in my sport suggest to me what my goals should be.
   a. frequently  b. seldom  c. never

5.6 When I set goals for myself, I make them:
   a. easy to achieve;
   b. in between; or
   c. relatively difficult to achieve.

5.7 I set my goals low so that I am guaranteed of attaining them.
   a. frequently  b. seldom  c. never

5.8 I prefer to set my own goals.
   a. frequently  b. seldom  c. never

5.9 Once I establish goals for a particular performance, I do not change them.
   a. frequently  b. seldom  c. never

5.10 When I establish goals for myself, I write them down.
   a. frequently  b. seldom  c. never

5.11 I have an established time-table for achieving my goals.
   a. frequently  b. seldom  c. never

5.12 Before establishing a goal, I weigh my strengths and weaknesses to determine what is the best goal for me.
   a. frequently  b. seldom  c. never

5.13 My goals are related to the benefits that I will derive when they are achieved.
   a. frequently  b. seldom  c. never

5.14 When team goals are set, I have input into what they should be.
5.15 I like to have detailed records of all my contests so that I can monitor my own progress.
   a. frequently  b. seldom  c. never

5.16 I like to set the ultimate goals for my sporting career myself.
   a. true  b. uncertain  c. false

6. FACTORS WHICH AFFECT THE SETTING OF GOALS

This section evaluates those factors which affect goals, goal-setting, and goal-evaluation. Answer as they apply to you.

6.1 I feel that my training is good enough to allow me to reach my goals.
   a. frequently  b. seldom  c. never

6.2 The way the team/club is run helps me achieve my goals.
   a. frequently  b. seldom  c. never

6.3 How well I expect to do in a performance affects the way I apply myself to achieve goals.
   a. always  b. sometimes  c. never

6.4 When my goals are established, my abilities are taken into account.
   a. always  b. sometimes  c. never

6.5 My goals are changed when I fail to achieve them.
   a. always  b. sometimes  c. never

6.6 My goals are changed when I achieve them.
   a. always  b. sometimes  c. never

6.7 Vague goals such as "try to do your best", "go for it", etc. help me to perform well.
   a. true  b. uncertain  c. false

6.8 Goals that indicate exactly how I am to perform help me do well.
   a. true  b. uncertain  c. false

6.9 My "short-term" goals are of more interest to me than are my "long-term" goals.
   a. always  b. sometimes  c. never
6.10 I have control over the events that will determine whether I do or do not achieve my goals.
   a. always   b. sometimes   c. never

6.11 Spectators at competitions cause me to change my goals.
   a. always   b. sometimes   c. never

6.12 I understand my goals well enough to evaluate my progress towards achieving them.
   a. always   b. sometimes   c. never

7. RELATIONSHIP OF GOALS TO PERFORMANCE

This section evaluates the relationship that goals, goal-setting, and goal-evaluation have to an athlete's performance. Answer as they apply to you.

7.1 I fail to achieve my goals.
   a. always   b. sometimes   c. never

7.2 My performance is helped by the goals that have been established for me.
   a. true   b. uncertain   c. false

7.3 Before attempting a skill or task in training, I set a goal for what should be done.
   a. always   b. sometimes   c. never

7.4 When I have a good chance of achieving goals, I perform well.
   a. always   b. sometimes   c. never

7.5 When I have a poor chance of achieving goals, I am not able to perform my best.
   a. always   b. sometimes   c. never

7.6 When I am uncertain about achieving a goal, I try harder.
   a. true   b. uncertain   c. false

7.7 The more difficult the goal, the harder I try.
   a. true   b. uncertain   c. false

7.8 After failing to achieve my goals in a competition, the level of effort that I put into my next training session is:
   a. harder;
b. in between; or
c. reduced.

7.9 I am prepared to train for many years to achieve specific goals in my sport.
   a. true               b. uncertain  c. false

8. OTHER FACTORS RELATED TO GOAL-SETTING

This section evaluates other factors which affect goals, goal-setting, goal-evaluation, and goal-achievement. Answer as they apply to you.

8.1 It is important for me to continually improve my performances in training.
   a. true               b. uncertain  c. false

8.2 It is important for me to perform well in training.
   a. true               b. uncertain  c. false

8.3 I prefer competitions that are more difficult than easy.
   a. true               b. uncertain  c. false

8.4 It is important for me to compete well in every contest.
   a. true               b. uncertain  c. false

8.5 I like goals that, if achieved, indicate I have improved my performance standard.
   a. true               b. uncertain  c. false

9. TYPES OF GOALS

This final section asks you to describe the types and features of goals that you have.

A. Career Goals are the ultimate things that an athlete wishes to attain through participation in the sport. They describe the final major outcomes that are sought through training and competing. Examples are: 1) to participate until 1996 to make the Olympic Games team; 2) to become a professional athlete.

9.1 I have established career goals.
   a. yes                b. uncertain  c. no

If you answered "no" to the above question go to section B on "Relatively long-term goals".

9.2 My career goals were established by:
   a. myself              b. my coach and myself  c. my coach
B. Relatively long-term goals are one or two major sets of goals that have been established to occur on the way to achieving career goals. Examples are: 1) participating in the national championships by the year 1992; and 2) to make a national team by the year 1994.

9.3 I have established relatively long-term goals.
   a. true       b. uncertain       c. false

   If you answered "false" to the above question go to section C on "Performance goals".

9.4 My relatively long-term goals were established by:
   a. myself       b. my coach and myself       c. my coach

9.5 If I fail to achieve my relatively long-term goals I will have to seriously consider if my participation in this sport is worth it.
   a. true       b. uncertain       c. false

C. Performance goals are goals which are to be achieved at some time in the current competition year. Examples are: 1) to qualify to go to nationals, and 2) to break a record in a particular category.

9.6 I have established performance goals.
   a. true       b. uncertain       c. false

   If you answered "false" to the above question go to section D on "Progress goals"

9.7 My performance goals were established by:
   a. myself       b. my coach and myself       c. my coach

9.8 I believe that I can achieve my performance goals.
   a. true       b. uncertain       c. false

D. Progress goals are goals that indicate your training progress toward achieving your performance goals. An example is: "Does my performance at this time indicate that I am progressing satisfactorily?"

9.9 I establish progress goals.
   a. always       b. sometimes       c. never

   If you answered "never" in the above question go to the end of the inventory.

9.10 My progress goals were established by:
    a. myself       b. my coach and myself       c. my coach
COMPUTER ANALYSIS OF THE GOAL-SETTING INVENTORY


A variety of programs are supplied within the Sport Psychology Consultation System (SPCS) to analyze the Goal-setting Inventory (Rushall & Fisdel, 1992). Computer analyses can be developed for individuals or groups and can be output to computer video or printer.

Each analysis indicates features of the total goal-setting process which occur consistently, inconsistently, or never at all. This allows a coach to determine what factors need to be developed in a tested athlete. Some guidance as to what to do is supplied. A sample partial printer output for an individual is provided below. This is provided on the understanding that the reader will recognize that every individual will have a different set of characteristics printed, the diversity of results being quite large. It is also possible to produce "group" or "team" analyses where every feature is printed with the names of each team member to whom the feature is appropriate being listed below.

The Goal-setting Inventory and its associated software is available as a single item, discrete from the total SPCS. Materials are provided which allow a user to produce as many copies of the inventory, answer sheet, and standardized directions as is needed as well as full directions for using the software. The current price of this package is US$350 and can be obtained from Sports Science Associates.

REFERENCES


A Sample Goal-setting Inventory Analysis for an Individual Athlete

*************************************************
*                                               *
* A PSYCHOLOGICAL ANALYSIS OF ATHLETE BEHAVIORS * *
*                                               *
* AS REVEALED BY THE                             *
*                                               *
* GOAL-SETTING INVENTORIES                      *
*                                               *
* (Authors: B. S. Rushall & J. Fisdel, 1987)     *
*                                               *
*************************************************
ATHLETE
A. Sample
08-24-96
=================================================================
A. Sample                                                  Page 1
PART 1: INTRODUCTION
The responses to the GOAL-SETTING INVENTORY are described on the following pages. They indicate what the athlete believes. Those features which are undesirable or inconsistent indicate areas where the coach must take corrective steps to enhance the effects of goal-setting.
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
This athlete answered the inventory honestly.
This individual understands how performance is measured in the sport.
=================================================================
A. Sample                                                  Page 2
PART 2: GOAL-PERCEPTIONS OF THE ATHLETE
This part describes how the values, uses, and effects of having goals are viewed by the athlete.
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
A. ESTABLISHED FEATURES
This person always has goals.
Goals direct this athlete's sporting activities.
The goals that this athlete has have achievement deadlines attached to them.
This person has a preferential order for the attainment of the several goals that he/she has.
Having goals contributes to making the sport enjoyable.
Goals are perceived as being achievable.
No sporting goals are perceived as conflicting with this athlete's personal values.
All goals are understood.
Goals in the sport are considered as a help to this person.
Team goals motivate this individual to try harder.

This person's goals are stated clearly enough so that others understand them.

B. GOAL-PERCEPTIONS WHICH NEED TO BE ALTERED IN A DESIRABLE MANNER

Goals are occasionally considered to be unreasonable or too difficult.

When goals are achieved, the rewards or recognition that should ensue occur intermittently.

Sporting goals are sometimes perceived as pressuring this person too much.

Sporting goals occasionally are important to this individual.

C. PROCEDURES SHOULD BE STARTED TO DEVELOP THE FOLLOWING FEATURES

The establishment of sporting goals.

=================================================================

A. Sample

PART 3: GOAL-SETTING INTERACTIONS WITH THE COACH

How the athlete's interactions with the coach are perceived with regard to goal-setting

* * * * * * * * * * * * * * * * * * * * * * * * * * *

A. ESTABLISHED FEATURES

Reasons for setting this athlete's goals are always given.

The coach encourages this person to reach his/her goals.

This athlete considers he/she participates in the goal-setting process.

This person believes he/she has some say in how goals should be achieved.

The coach is considered to be pleased if this person achieves his/her goals.

Goal-related performance evaluations by the coach are considered to be positive and constructive.

When goals fail to be achieved, the coach is helpful in suggesting ways to improve.

If the coach makes a mistake that affects this athlete's ability to reach goals he/she is perceived to admit to the error.

The coach makes sure that this athlete's goals are stated pos-
This athlete does not like the coach to set his/her goals. There are no things that this person wants to achieve in the sport about which the coach is not aware. The coach and athlete frequently evaluate goal-achievements together. The coach frequently asks this individual if there are areas in training in which he/she can be of assistance. The coach often tells this athlete what he/she has done that deserves recognition. The coach listens to the athlete's explanations and concerns regarding performance problems. Steps to solve performance problems are agreed upon by the athlete and coach. The athlete leaves a goal-setting meeting knowing specific goals to be achieved. Follow-up meetings to goal-setting meetings are scheduled.

B. ATHLETE-COACH INTERACTIONS WHICH NEED TO BE ALTERED IN A DESIRABLE MANNER - THE FREQUENCY OF OCCURRENCE OF THE DESCRIBED BEHAVIORS SHOULD BE INCREASED.

Sometimes after a goal setting meeting this athlete feels he/she had only a little input into any of the decisions made.

PART 4: THE EFFECTS OF GOALS ON THE ATHLETE

A. ESTABLISHED FEATURES

Having goals makes this person's sport more interesting.
This athlete derives considerable pride from achieving his/her sporting goals.
This individual is always disappointed when he/she fails to achieve goals.
The act of attaining goals increases this person's confidence.

B. GOAL-PERCEPTIONS WHICH OCCUR INCONSISTENTLY AND NEED TO BE ALTERED TO BECOME A CONSISTENT FEATURE OF THIS ATHLETE'S BEHAVIOR
Sometimes this person feels he/she disappoints others when he/she fails to achieve goals.

This athlete is bothered sometimes if other people know what his/her goals are.

PART 5: GOAL-SETTING ACTIONS

This section describes activities that surround the goal-setting and goal-evaluation process.

A. ESTABLISHED FEATURES

This individual never sets goals so low that he/she will be guaranteed of attaining them.

This person's goals are related to the benefits that he/she will derive when they are achieved.

B. THE FOLLOWING INCONSISTENT FEATURES OF GOAL-SETTING AND GOAL-EVALUATION NEED TO BE MODIFIED SO THAT THEY BECOME PERMANENT OR HIGHLY-OCCURRING FEATURES FOR THIS ATHLETE

Teammates sometimes encourage this athlete to achieve goals.

Plans for achieving goals are made only occasionally.

Sometimes this athlete works with other athletes when setting goals.

This individual occasionally likes to work with other athletes when setting goals.

This person sometimes prefers to set his/her own goals.

Goals are sometimes written down.

Occasionally this athlete has a time-table to follow to reach his/her goals.

Only sometimes does this athlete weight his/her strengths and weaknesses when setting goals.

When team goals are set this person sometimes has input into what they should be.

C. FEATURES WHICH NEED TO BE DEVELOPED IN AND FOR THIS ATHLETE

This person should be taught not to change performance goals once they have been established.
The athlete needs to be encouraged to set ultimate goals for his/her participation in the sport.

=================================================================
A. Sample                                                  Page 6

PART 6: FACTORS WHICH AFFECT THE SETTING OF GOALS

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

A. ESTABLISHED FEATURES

This individual feels that his/her training is good enough to allow him/her to achieve his/her goals.

The way the team/club is run helps this person to achieve his/her goals.

How well this athlete expects to perform affects the way he/she goes about trying to achieve goals.

When goals are established this individual's abilities are taken into account.

Goals which are expressed vaguely help this athlete to perform well. This is a strange answer and should be questioned by the coach.

Goals that indicate exactly how this athlete is to perform help him/her to do well.

This athlete is in control of the events which will determine whether he/she achieves goals.

This athlete understands his/her goals well enough to be able to understand his/her progress towards them.

B. THE FOLLOWING FEATURES OCCUR INTERMITTENTLY AND SHOULD BE MODIFIED SO THAT THEY BECOME PERMANENT OR HIGHLY OCCURRING FEATURES FOR THIS ATHLETE

When this athlete fails to achieve goals they are sometimes altered.

=================================================================
A. Sample                                                  Page 7

PART 7: RELATIONSHIP OF GOALS TO PERFORMANCE

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

A. ESTABLISHED FEATURES

The goals that have been established for this individual are viewed as being helpful.
This athlete establishes a goal for every skill or task that is attempted in training.

This individual always performs well when he/she has a good chance of achieving his/her goals.

When this individual is uncertain about achieving a goal, he/she tries harder.

When goals are made more difficult this athlete tries harder.

=================================================================
A. Sample Page 8

PART 8: OTHER FACTORS

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

It is important for this athlete to continually improve performance in training.

It is important for this person to perform well in training.

This individual prefers competitions which are more difficult than easy.

This individual likes goals that indicate improved performance standards when they are achieved.

=================================================================
A. Sample Page 9

PART 9: TYPES OF GOALS

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

This athlete has established career goals.

This person's career goals were established jointly with the coach.

This person has established relatively long-term goals.

This person's relatively long-term goals were established by him/herself.

If this athlete fails to achieve his/her long-term goals he/she may consider whether continuing participation is worth it.

This athlete has established performance goals.

This person's performance goals were established jointly with the coach.

This individual believes he/she can achieve his/her performance goals.
This person is uncertain whether he/she has established progress goals.

END OF ANALYSIS
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FUEL AND ERGOGENIC AIDS

Special Associate Editor
Mark Kern, Ph.D., R.D.
Department of Exercise and Nutritional Sciences
San Diego State University

This third issue of Volume 2 of Coaching Science Abstracts reviews articles concerned with food and food supplements which are often considered to fuel exercise performance. Mostly, the substances considered are used with a view to enhance performance. Research on some of the less popular substances is far from complete. However, a relatively broad range of possible additives is presented while recognizing that deficiency.

Appended to the end of the compilation are references that evaluate the effects of nasal dilators. It is recognized that this entry is not of the same "class" as the remainder of the issue.

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68. NASAL DILATORS ARE NO HELP IN SPRINTS


**DEFINITIONS**

Rushall notes (1988).

"Aerobic": fats and carbohydrates are broken down into H2O and CO2 with the release of energy.

"Anaerobic": carbohydrates are broken down to release energy and form lactic acid.

**MUSCLE FIBER RECRUITMENT AND THE TRAINING RESPONSE**

The selection of the muscle fiber bundles which are stimulated in exercise occurs according to the following principle. The smallest alpha-motoneurons (the nerve axon serving the muscle unit) have the lowest functional threshold. In any exertion they are contracted first. With increasing muscular forces, successively larger motoneurons are recruited. Thus, the force of contraction will determine which fiber bundles contract. The recruitment is according to motoneuron size and fiber type, the order being:

- slow-twitch oxidative;
- fast-twitch oxidative; and
- fast-twitch glycolytic fibers.

The relationship between motoneuron size and excitability is known as the "size principle". Small motoneurons innervate slow-twitch fibers while the largest innervate fast-twitch fibers. In between the two extremes are bundles of fibers that are served by graded sizes of neurons. At some point the bundles change from slow-twitch to fast-twitch fibers. Where the change occurs to fast-twitch and the servicing neuron is of moderate size, the fibers often contract in response to the need for exertion in endurance type activities. Those fast-twitch fibers adapt and become fast-twitch oxidative fibers, that is, they have the contractile properties of fast-twitch fibers but can use oxygen for energy purposes. At the end of the continuum of distribution of fiber bundles are the pure fast-twitch glycolytic fibers that never take on any of the properties of "endurance-adapted" fibers.

Several implications of these adaptation and recruitment phenomena are:

1. Continuous low level workloads usually excite only slow-twitch fibers resulting in endurance adaptation. Some minor speed improvements occur but only when training is initiated from an untrained or marginally trained state. Thus, continuous training of this type is limiting with regard to its potential to make athletes complete events faster.
2. For speed to improve, higher forces have to be developed in the muscles. This is best done through interval training where volumes of higher forces can be tolerated because of the intermittent rests that are involved. The increased forces recruit slow and fast-twitch fibers and with moderate training intensities adapt both fiber types aerobically. Higher intensities increase the threat of lactic acid accumulation.
3. Interval training that requires very high levels of force (possibly 80%+) also recruits pure fast-twitch glycolytic fibers which produce lactic acid and could cause fatigue to occur rapidly if work intervals are too long. To develop speed through repetitive training it is necessary to employ fast-interval training (high exertion levels and long rest periods to allow the resynthesis of glucose from lactate) or ultra-short training (very high exertion levels of sufficiently short duration to avoid the accumulation of lactic acid and short rest periods).

There is no option for improving speed and endurance in training other than to design training items that stimulate both types of muscle fiber bundles. That is best accommodated through interval work rather than continuous training (Le Rossignol, 1985).
ATP AND CP STORES


A muscle cell stores about 6 mM of ATP per kilogram of muscle. That amount is sufficient to sustain one second of sprinting and is therefore used for single maximum efforts. However, there is sufficient CP stored to support about 6 seconds of further sprinting (CP is used to resynthesize ATP after it has been broken down by muscular contraction). These are the primary fuels for very short or single maximum efforts.

OXYGEN-INDEPENDENT GLYCOLYSIS


Theoretically, there is enough muscle glycogen to sustain a maximum sprint for about 75 to 80 seconds. However, in practical terms this cannot be achieved. The by-products of glycolysis are lactic acid and protons (H+), positively charged ions which are highly acidic and cause the muscle pH to fall. This increased acidity causes the breakdown of at least two essential components of muscle contraction; (a) reduced activity of phosphofructokinase (the key glycolytic enzyme), and (b) interference with calcium regulation of the cross-bridge cycle by preventing calcium binding by troponin-C in a muscle contraction. Thus, the by-products of glycolysis lead to its own downfall as a source of energy supply. Lactic acid itself is not the cause of fatigue, but the accumulated protons are. Lactic acid accumulates because the H+ protons are handled for a short period of time by (a) binding to negatively-charged buffers (usually proteins in the cell), or (b) combining with pyruvate to form lactate.

Accumulated lactic acid is removed from blood and muscles and returned to normal levels within one hour of recovery. The principal reason for soreness and stiffness after exercise is not lactic acid staying in the muscles but some form of muscle-cell damage usually resulting from performing an untrained skill intensely or a modified existing skill. Thus, any stiffness and soreness that occurs after exercise is not due to lactic acid still being in the muscles as claimed in the popular misconception. The two symptoms usually are an indication of training having been altered to make demands on an athlete that have not been previously adapted.

THE DEMANDS PLACED ON FUEL SUPPLIES BY EXERCISE PARAMETERS


Duration of Exercise
As an exercise duration extends at any intensity, fat becomes an increasingly important energy source. This means that in the early stages of a very intense competition the body may use as much carbohydrate as fat to fuel the work of exercise. However, as the competition progresses the demands on carbohydrate lessen and fat utilization takes its place. The change is largely due to a slowing of the rate of muscle glycogen breakdown and the body's shifting to fat oxidation possibly as part of a survival mechanism.

**Intensity of Exercise**

As exercise intensity increases, the contribution of carbohydrates to energy production increases. There is a gradient of exercise intensity that demands certain levels of carbohydrate and fat utilization at the outset of exercising: (a) mainly fat oxidation sustains exercise for intensities below 50 percent of VO$_{2\text{max}}$; (b) the use of muscle glycogen increases markedly at 75 percent of VO$_{2\text{max}}$; and (c) at intensities beyond 95 percent of VO$_{2\text{max}}$ primarily carbohydrates are burned.

However, exercise intensity and duration interact to produce another effect. What proportions of fuels that are used at the start of any exercise intensity are altered as the exercise progresses with fat being increasingly important and for all but the very most intense efforts, the dominant source of fuel.

**State of Training**

As specific athletic fitness increases the call on carbohydrate oxidation is reduced and thus, glycogen depletion is stalled. In the early stages of training carbohydrate is used as the preferred fuel when each training activity is initiated. However, as a result of training the body adapts and goes more directly to fat oxidation, that is, it learns to use that source of fuel early in an exercise bout as part of the training response.

Pre-exercise diets affect ensuing performance fuel use. Additional glycogen that is stored as a result of a high carbohydrate diet is used rapidly to fuel higher intensities of performance. Even though a performance is started with an elevated glycogen level, at the end of a contest the depleted carbohydrate level is similar to that which occurs without carbohydrate loading.

The rate of energy production from free fatty acids is determined by the supply of blood to the muscles. Since circulation is improved as a result of training, better fat utilization is possible because of that increased supply. Thus, the use of fats as fuel is improved by training because: a) the body "learns" to use them earlier and in greater amounts (mainly because of an increase in oxidative enzymes and the number of mitochondria), and b) their transport to the muscles is improved because of better circulation.

There are a number of artificial means by which the fuel for exercise can be altered.

1. The ingestion of caffeine in sufficient quantities (about 5 mg/kg of body weight) can cause free fatty acid levels to peak after about 60 minutes and remain elevated for
about three hours at about three to four times that of normal levels. The effect is
delayed by about two hours if sugar is also taken at the same time.

2. The drug Heparin has similar properties to that of caffeine. Although it has been
used in an attempt to extend endurance performances, research has not been
consistent in replicating the effects and benefits that it is suggested to produce.

3. A high carbohydrate meal causes blood insulin to rise and stay elevated for 60 to 90
minutes. Since insulin inhibits performance because it slows free fatty acid
mobilization and the breakdown of glycogen in the liver, the body has to rely
primarily on muscle glycogen and a small amount of glucose in the blood for energy.
Those sources are used rapidly, hypoglycemia could result (evidenced by dizziness, a
feeling of weakness, or nausea), and endurance is reduced. Foster and Costill (1978)
found reductions of 19 percent in endurance capacity in subjects who ingested 75
grams of glucose prior to performing a maximum exercise at 80 percent of VO2max.
This would suggest it is not wise to ingest any form of carbohydrate within two
hours before a performance. This no longer is generally recommended although it is
necessary for individuals who are susceptible to reactive hypoglycemia. Thus,
testing for reactivity in athletes is important so that the best precompetition regimen
can be established.

performance. Medicine and Science in Sports and Exercise, 10, 65. (abstract)]

4. The ingestion of glucose or carbohydrates during exercise can marginally prolong
performance. It has no effect on muscle glycogen but it does spare the use of liver
glycogen if it can be assimilated into the circulatory system in time. The rate of
emptying from the stomach and absorption into the blood stream determine the
value of this supplement. Emptying is facilitated by the glucose being diluted as a
cool drink taken in resting or calm circumstances.

5. The rate of muscle glycogen use appears to be increased in hot conditions

6. MUSCLE GLYCOGEN DEPLETION

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

8. With two-hour training sessions, when some elite swimmers graduate to being able
to handle these twice daily, it seems that the carbohydrate-glycogen story for each
individual is of critical importance. I would hazard a guess that 90% of hard
training swimmers are chronically depleted of muscle fiber glycogen.

9. DIET AND PERFORMANCE


11. Endurance runners who consumed a 50 percent carbohydrate diet experienced a
decrease in muscle glycogen stores, a decrease in running economy, and an
increased perception of fatigue following a five-day increase in training load. For a
group that was placed on an 80 percent carbohydrate diet, only limited glycogen
depletion was recorded. Thus, the concentration of carbohydrate in the diet will
affect performance efficiency, recovery, and the psychological perceptions of training intensity.

12. Not only the amount but the type of carbohydrate that is ingested is important for competitive and training performances. Costill, Sherman, and Fink (1981) looked at the effects of simple carbohydrates (e.g., pancakes, syrup, candy, a glucose drink) and complex carbohydrates (e.g., potatoes, pasta, whole wheat bread) on the recovery of muscle glycogen after glycogen depletion. They found no difference within the first 24 hours of recovery. However, complex carbohydrates produced significantly more muscle glycogen synthesis within the next 24 hours. This finding is important. Not only does it support the use of complex carbohydrates over simple sugars as a dietary necessity, but it also indicates that what is consumed between stages in a prolonged staged-competition, such as the Tour de France, will directly affect recovery and energy stores. Carbohydrates can be readily replaced in fluid form as well as in appropriate foods. After each day’s event it is necessary to ensure that complex carbohydrate loading is continued to maximize the restoration process. Thus, diet within prolonged competitions is an important factor for determining recovery speed and quality between exercise bouts or events.

13. TRAINING MODIFIES FUEL USE


15. Long-term endurance training in originally untrained males induced a progressive increase in fat utilization. Less reliance was placed on plasma free fatty acid oxidation and a greater oxidation of intramuscular triglycerides.

16. Implication. Through training, the body learns to increase its reliance on fat utilization in exercise.

17. DIET AND RUNNING PERFORMANCE


19. Healthy males (N = 6) were subjected to an endurance task, each trial being preceded by a normal or three adjusted diets. Diets were modified in percentage proportions of proteins, carbohydrates, and fats. Running on a treadmill to exhaustion (approximately 75% VO2max for 42 min) was the exercise performed.

20. There were mostly no significant differences between any condition on all variables except that the normal condition resulted in lower blood glucose levels during the task.

21. Implication. Dietary manipulations are not likely to be effective in individuals who are untrained for a performance task. It is only when the body is attuned to task demands that dietary manipulations, particularly CHO supplementation, become beneficial.

SUMMARY OF FUEL ADDITIVES AND THEIR EFFECT ON PERFORMANCE
Carbohydrate Loading

Evidence now supports carbohydrate (CHO) loading with a pre-event meal of 60-70% CHO content. This is potentially beneficial for events requiring very extended endurance activities (e.g., marathon running, an all-day swim meet, a soccer game, very demanding practice sessions). It was recommended that CHO drinks should be consumed during the event and/or training and up to 40-60 gm of CHO taken hourly for five hours after the activity.

Fat Loading

The recently promoted "fad" of increasing dietary fat so that during an activity the body will use it as fuel and save ("spare") CHO for later is unsupported by facts. It could even be dangerous.

Branch Chain Amino Acids

These are promoted as a means to stimulate an increase in the brain's level of serotonin, a central nervous system neurotransmitter that could reduce fatigue sensations recognized by the brain. At this time there is little evidence that this works. More research is required.

Protein and Amino Acids

Both are widely used by body-builders wishing to "bulk-up." Nutritionists claim that normal dietary intake is sufficient. Some dietitians claim 1 gm/kg of body weight per day is all that is needed, whereas a German scientist (Stegeman) has reported that double that amount is required. [A general rule-of-thumb is that an appropriate diet would include 15% protein.]

Most athletes probably have adequate intake of protein if they are not vegetarian. There is likely to be little benefit derived from excess ingestion of protein and/or amino acids.

Caffeine

This is a banned substance over a set blood level. Recent research has shown that any level of caffeine, including below the illegal limit, can improve performance. The amount is not relevant to performance.

Caffeine works because it increases the use of fat as an energy substrate and thus, spares CHO. It is also beneficial for events up to five minutes because of its stimulatory effects.

It is likely that caffeine will be banned completely or totally deregulated.
Creatine

Creatine is involved in the regeneration of energy (adenosine triphosphate - ATP). Its availability limits performance in short explosive activities. The administration of 5 gm doses over five days will significantly enhance muscular performance and enhance recovery. Some research suggests that it may allow athletes to train with reduced fatigue at an intensity higher than normal.

Bicarbonate

This is intended to increase the buffering capacity of the blood and thus, delay the onset of debilitating levels of hydrogen ions and lactate. Increased blood acidity inhibits glucose oxidation and energy production.

If 0.3 gm/kg of body weight is ingested, speed performances are benefited. However, the frequent side-effects of gastro-intestinal distress warrants thorough experimentation before it is tried in competitions.

L-Carnitine

Carnitine's main function is to transport fats into muscle tissue for energy provision. Supplementation does not increase performance or enhance fat burning although it may correct deficiencies in some persons.

Implications

The following ergogenic aids are suggested by the literature.

1. For sprint-type performance, creatine, and bicarbonate. CHO loading should enhance the volume of and recovery from training.
2. For endurance athletes, caffeine and CHO loading should enhance the volume of, and recovery from, training.
3. ABSORBED GLUCOSE
5. Glucose is absorbed in the form of glucose, fructose, and galactose and transported to the liver. There it is converted to glycogen and stored or transported to the muscles as glucose and used for energy or stored as muscle glycogen. Other amounts are circulated as blood glucose. Some blood glucose is metabolized by the brain, kidney, and blood cells as part of normal functioning. Once liver and muscle glycogen stores are filled excess glucose is stored as fat, in the form of triglycerides, in adipose tissue.
6. Blood glucose levels represent a balance between the rate of glucose and glycogen production by the liver and use by muscle and other tissues. Muscle lacks the enzyme glucose 6-phosphatase and is unable to produce glucose from glycogen.
Thus, correct liver functioning is an important aspect of performance potential because it is a primary reservoir of glucose.

7. The lactacid energy system supports glycolysis (anaerobic), an action where glucose is converted in the absence of oxygen to produce lactate. In aerobic glycolysis, pyruvate crosses the mitochondrial membrane and ultimately produces electrons which are used to produce mitochondrial ATP, the fuel for muscle contraction in aerobic activities.

8. ENERGY COST AND REPLACEMENT IN SWIMMERS


10. National caliber swimmers participated in three days of two workouts per day with 50% of the work at an intensity > 85% VO2max.

11. Decreases in muscle glycogen occurred between the a.m. and p.m. workouts and did not recover to pre-testing levels over the following days even though carbohydrate consumption was elevated to 8 +/- 2 gm/kg of body weight per day.

12. These results suggest that multiple workouts per day result in chronic glycogen depletion and it appears that a 12-hour recovery phase is needed for glycogen resynthesis to take place. For better use of training, 12 hours of recovery is needed between sessions even though CHO consumption is adequate.

13. CARBOHYDRATES AND PERFORMANCE


15. Different forms of carbohydrates have different rates of digestion and provide varying rates of release of glucose into the blood.

16. After consuming a high CHO meal (84% CHO, 11% protein, 5% fat) two and one half hours before a 90 min bicycle ride, a high glycemic (HG) or low glycemic (LG) candy bar was ingested. A no-feed control condition was also employed. [Examples of high glycemic foods are honey, bagels, most candies, raisins, most sport drinks. Low glycemic foods are applies, cherries, dates, figs, milk, and yogurt.]

17. Blood glucose and insulin were found to be higher in the low glycemic candy bar group than either of the other two conditions. Blood free fatty acids (FFA) were highest in the unfed trial while the LG trial was higher than the HG trial during the ride.

18. Implication. A low glycemic confectionery will continue to provide sustained energy during prolonged exercise by maintaining plasma glucose and FFA at higher levels during an extended endurance performance

19. CARBOHYDRATE SUPPLEMENTATION AND PERFORMANCE

21. Pre-exercise ingestion of a glucose polymer solution (30 gm in 10% sweetened) resulted in less drop-off in power output during one hour of maximal effort endurance performance than did a placebo. No further benefit was observed when the same amount of glucose polymer was ingested every 15 min during exercise.

22. Implication. Glucose polymer ingestion prior to endurance exercise can benefit performance. There is no benefit taking it during performance.

23. CARBOHYDRATES DO NOT ALLEVIATE POST-EXERCISE SORENESS


25. Ingesting large amounts of CHO immediately after high intensity eccentric exercise was not effective in reducing DOMS or indices of muscle damage (serum creatine kinase activity).

26. NUTRITION AND SOCCER PERFORMANCE


28. Soccer is a glycogen-depleting activity and its work volume and rate are influenced by the level of muscle glycogen. It is imperative that glycogen stores be fully replenished to work at the rate and volume demanded by the game.

29. Glycogen repletion occurs most rapidly when CHOs are ingested immediately postexercise. A glucose polymer solution pregame and at intermission significantly increased the work volume by 20% in the first half and 30% in the second half of a game as well as improving significantly in a second game.

30. Implication. The restoration of glycogen stores at times during and surrounding soccer games should be a preferred activity.

31. MANY CARBOHYDRATE FEEDINGS IS PREFERABLE


33. After a review of publications it was concluded: "Whether the amount of carbohydrate ingested was small or large, more frequent feeds maintained more stable plasma glucose levels. Therefore, if carbohydrate supplementation occurs during exercise the frequency of feeding should be considered of the utmost importance."

34. CARBOHYDRATE AND PERFORMANCE


36. Carbohydrate is an important energy source. It is stored as glycogen in the muscles and liver and glucose in the circulating blood. During intense exercise, muscle glycogen is the primary energy source but circulating glucose also is used. As the duration of intense exercise increases, glucose becomes more important. Depletion of either source of fuel results in fatigue.
37. Athletes who burn more calories than they consume cannot produce glycogen efficiently. This occurs even if the majority of the limited diet is carbohydrates.

38. The form of carbohydrate for replenishment is not critical. Although complex carbohydrates are preferred, simple sugars are satisfactory if they are the only source available.

39. During exercise, muscle glycogen serves as a limiting energy source. Virtually no synthesis takes place during activity. Consequently, muscles in long term exercise depend upon glucose as a fuel source. Blood and liver glucose may supply as much a 30-40% of total energy needs. If blood glucose declines to half its normal value, exercising muscle fibers cannot obtain enough sugar to maintain activity. As a result, muscle glycogen is used and fatigue is accelerated.

40. The ingestion of CHO during exercise can delay the onset of exhaustion. A CHO replenishment system should be used that will give the athlete as much energy as possible without delaying the absorption of water (a solution of less than 2.5% of glucose). A solution of 5% glucose polymers and 2% fructose may be comparable.

41. The timing of feedings is critical in some persons who are exhibit reactive glycemia. CHO sources should not be delivered any closer than one hour prior to the onset of exercise. A large dose can cause an elevation in insulin which promotes glucose uptake from the blood and suppresses the mobilization of free fatty acids from adipose tissue. This is called "insulin backlash." It results in the early onset of hypoglycemia and a premature utilization of glycogen stores leading to a decreased endurance capacity. However, if CHO is ingested after exercise (i.e., vigorous warm-up), the backlash does not occur.

42. CARBOHYDRATE REPLACEMENT IN THE HEAT


44. The effects of a 7% CHO-electrolyte drink and a placebo (water) on physiological responses, hydration status, and exercise performance were evaluated during a simulated outdoor 40 km road race under warm, humid conditions. Ss (N = 8) were highly trained, heat acclimatized, male distance runners. Beverages were consumed during a brief respite once every 5 km loop of the test track.

45. CHO-electrolyte trials showed significantly higher blood glucose levels throughout the trial and recovery periods than did placebos. Percent of VO2max declined drastically during the last 20 km in the placebo condition, but remained steady in the CHO-electrolyte condition. Running time was also significantly faster in the CHO-electrolyte group.

46. Implication. The consumption of a 7% CHO-electrolyte solution is similar to water as a fluid replacement in terms of thermoregulation, maintenance of physiological function, and hydration status. However, the CHO-electrolyte solution increased blood glucose levels and had a significant ergogenic effect on prolonged running. This is a significant advantage when competing in the heat.

47. CARBOHYDRATE SUPPLEMENTATION REVIEWED

49. Recovery is governed by the length of time taken to fully restore muscle glycogen. Muscle glycogen is depleted after 2-3 hours of continuous exercise at 60-80% VO$_{2}$max. Glycogen depletion can also occur after 15-20 min of very intense exercise at 90-130% VO$_{2}$max. Low muscle glycogen levels increase the risk of injury.

50. Restoration of muscle glycogen can take 20 hours with correct diet and supplementation. Less than an optimal diet will increase recovery time.

51. CHO replenishment during exercise seems to be optimal at 7-8% concentration in water. However, after exercise it can be of a much higher concentration.

52. Implication. For intermittent high intensity sports (e.g., soccer, hockey) the ingestion of CHO throughout the game, and during any rest period will result in muscle glycogen being restored and increased sprinting ability towards the end of the game. This will not happen when only water is consumed.

53. **CARBOHYDRATE DRINK CONCENTRATIONS AFFECT ASSIMILATION**


55. CHO solutions of 0, 4, 6, 8% concentrations were ingested during 90 min cycling ergometer rides in 14 Ss. The 8% solution slowed gastric emptying significantly more than the other concentrations.

56. Implication. If an athlete attempts to drink to replenish CHO and fluid during practice or competitive tasks, it is best to have a dilute solution rather than one that is concentrated. The maximum concentration should be less than 8% if the ingredients contain glucose, sucrose, fructose, and maltodextrin.

57. **CARBOHYDRATE INGESTION AT PRACTICE DOES NOT HELP MUCH**


59. The ingestion of a glucose polymer solution occurred regularly during swimming practice in male collegiate swimmers (N = 9). On one day a placebo was ingested and the other a CHO solution. Hard training bouts were performed on both occasions one week apart.

60. The ingestion of a glucose polymer solution did not significantly increase blood glucose levels or improve performance. However, CHO ingestion did benefit the performance of individuals whose blood glucose levels dropped markedly in the placebo condition.

61. Implication. There is a possibility that responsiveness to the benefits of CHO supplementation during training might be a variable to consider when determining the value of the practice. It is likely not to be of benefit to individuals whose constitution is such that blood glucose levels do not fall normally at training. For
those who do experience significant reductions in blood glucose, the supplementation will enhance the standard of performance.

62. PROBLEMS WITH DR. BARRY SEAR'S ZONE DIET

63. Response by Dr. Larry Weisenthal (runnswim@aol.com) to the following question posted on the bulletin board rec.sport.swimming, 15 May, 1996.

64. Can anyone send me, post, or refer me to articles or references that challenge the recent protein propaganda of Dr. Sears ("The Zone")?

65. O.K. As concise as I can make it:

66. Zone Claim # 1: The "Fattening of America" is related to an increased consumption of carbohydrate and a decreasing consumption of fat:

67. Fact #1: According to US government figures, total per capita fat consumption has actually increased, but sugar consumption has increased faster. Thus, Americans are consuming slightly more fat, vastly more sugar, more total calories, but a slightly reduced percentage of fat in the diet. As pointed out by Dr. Jay Kenney, this is equivalent to drinking whole milk alone or whole milk with several tablespoons of sugar. The latter may have a decreased percentage of calories as fat, but there is no reason to suppose that this would lead to weight loss, compared to drinking the whole milk alone.

68. Additionally, exercise has gone down and smoking cessation (which promotes weight gain) has gone up. 15% of adult Californians smoke today, compared to 60% two decades ago. Thus, the fattening of America is not owing to low fat/high carbohydrate diets.

69. Zone Claim # 2: Scientific studies conclusively show that high carbohydrate/low fat diets worsen blood lipids, raise blood pressure, and cause weight gain compared to lower carbohydrate/higher fat diets.

70. Fact #2: Every last one of these studies is fatally flawed, in that an isocaloric design was used. Subjects were forced to eat a set amount of food, the calories of which was the same in the high carbohydrate versus low carb arms of the study. They were also required to adjust caloric intake to maintain weight. The problem is that numerous studies have shown that when percent of fat in the diet is reduced, caloric intake is also spontaneously reduced. Put a person on a low fat diet, and that person will consume fewer calories and lose weight. Covertly adjust the fat content of the diet (make it equally palatable but just adjust the fat content covertly) and people eat more calories as the fat content is increased. Measure percent dietary fat as a function of body fat. The fatter people consume a greater percentage of their total calories as fat. And so on. Finally, ask the subjects in the isocaloric studies how they feel. The subjects in the low carbohydrate/high fat arm say that they feel fine. The subjects in the high carbohydrate/low fat arm say that they are being force fed, like a goose being fattened into foie gras.

71. In the real world, when you put people on high carbohydrate/low fat diets and they are allowed to eat what they want and are not forced to eat more, their blood lipids and blood pressure and blood sugar and serum insulin and body weight all improve. Published data confirm that they improve to a greater and more significant extent on the high carbohydrate/low fat diet than they do on the "Zone" Diet.
72. Zone Claim #3: Up to 75% of the people in this country are "carbohydrate sensitive" and will be harmed by a high carbohydrate/low fat diet.

73. Fact #3: Fewer than 12% of people develop even a minor rise in serum triglycerides on a high carbohydrate/low fat diet. This rise tends to be minor and occurs even as the "big time" lipids (total cholesterol, LDLs) are getting better. And, with time, triglycerides tend to normalize or become reduced, compared with baseline levels, in the majority of this 12%. Also, triglyceride levels are very misleading for a number of reasons such as timing of the measurement (after eating vs. fasting) and types of triglycerides circulating ("fluffy/puffy" vs. "dense pack"), which I won't go into here.

74. Zone Claim #4: A high carbohydrate/low fat diet is harmful to your health. Eskimos prove that a very low carbohydrate diet can be healthful.

75. Fact #4: The longest-lived populations on Earth eat high carbohydrate/low fat diets. Vegetarians (80% carbohydrate/10% protein/10% fat) live longer than omnivores and have healthier, stronger bones. The longest-lived, healthiest industrial population (the Japanese) eat a high carbohydrate/low fat diet. Eskimos have a high incidence of cancer, tend to die young, and develop osteoporosis an average 10 years earlier than Canadians or Americans as a whole, despite a diet which is usually rich in both calcium and vitamin D.

76. Zone Claim #5: The Zone Diet is great for swimmers.

77. Fact #5: Swimming (workouts and competition) are largely anaerobic. Anaerobic metabolism is primarily carbohydrate. Swimming muscles use carbohydrate disproportionately to running or cycling muscles. Swimmers are much more carbohydrate depleted than are runners after workouts of comparable duration and intensity. Swimmers should consume a high carbohydrate/low fat snack immediately after a workout, to suppress an appetite for carbohydrate repletion which would otherwise cause the athlete to consume more calories, if the carbohydrate were to be repleted by food with a higher fat content. This may be one reason why it is harder to lose weight with swimming than with running. But weight control will be aided by suppressing appetite through the repletion of carbohydrate with pure carbohydrate, rather than with mixed carbohydrate/fat. A high carb snack post-workout will also help prevent muscle breakdown to liberate protein for conversion to glucose through gluconeogenesis to replete carbohydrate stores.

78. Even if you could train swimming muscles to "burn fat," this would be a disadvantage from the point of maximum performance. Aerobic carbo metabolism is faster (i.e. fuel can be provided faster to the exercising muscles) than is aerobic fat metabolism. Muscles fueled with carbohydrate perform better than muscles fueled with fat ("high octane" vs. "low octane" fuel). Aerobic fat metabolism consumes MORE OXYGEN per unit of ATP produced than does aerobic carbohydrate metabolism. Provided that fuel (carbohydrate or fat) is available, oxygen delivery and consumption are rate limiting. Because aerobic carbohydrate metabolism consumes less oxygen than aerobic fat metabolism, a carbohydrate burning muscle will perform at a higher level than a fat burning muscle.

79. Zone Claim #6: A high carbohydrate diet makes you sleepy because insulin secretion drives your blood sugar down and your glucose-starved brain goes to sleep.
80. Fact #6: A very large, high carbohydrate meal does make you sleepy, but it has nothing to do with glucose or insulin. High carbohydrate meal tend to promote a temporary alteration in serotonin levels in the brain, which make many people sleepy. This is probably why Italians take 2 hour lunches. Serotonin is a natural neurotransmitter and most experts agree that a post-noon nap is a natural thing, circadian-rhythm wise. There are practical ways to deal with the post-lunch yawns, however, which do not require the consumption of protein and fat. First, don't eat so much at one time (see below). Second, if you must gorge, follow it with a double espresso (as the Italians do). Third, go ahead and gorge and then just take a 10-15 minute nap when you get sleepy. This is a natural solution to a natural circadian rhythm phenomenon, which was figured out nicely by our ancestors, going back centuries.

81. Zone Claim #7: The only way to control an insulin system run amok is to eat food in 40/30/30 proportions.

82. Fact #7: If moderating insulin levels is one's goal (and it is really not all that important for the vast majority of normal people), this may be accomplished by (a) "nibbling" or "grazing," rather than gorging. This is actually recommended by Sears, himself. (b) eating preferentially carbohydrates of low caloric density, such as vegetables, rather than grains, and/or eating cooked grains (spaghetti, rice, cooked cereal), rather than dry grains of higher caloric density (licorice, Snack Wells, and, to a lesser extent, bread, crackers, and pretzels).

83. Zone Claim #8: The Zone Diet is good, because protein stimulates glucagon release, which does several good things for you.

84. Fact #8: If you take protein along with carbohydrate (as you always do on the 40/30/30 Zone diet plan), your glucagon levels don't go up. They only go up if you take in protein by itself, and this is only to compensate for the hypoglycemia which is produced when protein absorption stimulates insulin secretion (which it does) in the absence of dietary carbohydrate for the insulin to work on.

85. Zone Claims #s 9,10,11: The Zone Diet will prevent cancer, cure AIDS, help autoimmune disease, prevent Alzheimers, reverse heart disease, and make you live longer.

86. Facts #s 9,10,11: And I know of a nice bridge between Manhattan and Queens which is for sale, cheap.

87. Zone Claim # 12: The Zone Diet has favorable effects on eicosanoids (for those of you who care).

88. Fact #12: One important place where "good" eicosanoids play a role is in platelet aggregation. It is "bad" to have platelets which aggregate, since this can lead to heart attacks. Aspirin prevents heart attacks by inhibiting platelet aggregation, which is controlled by eicosanoids. Guess what. A high carbohydrate/low fat diet inhibits platelet aggregation, while a high monosaturated fat diet (advocated by Sears to improve eicosanoids) enhances platelet aggregation.

89. Zone Claim #13: Lowering your cholesterol doesn’t lead to improvements in overall mortality.

90. Fact # 13: Yes, it does.

91. Zone Claim #14: Having a too-low cholesterol is dangerous to your health, leading to suicide, violence, cancer, and increased overall mortality.
92. Fact #14: No, it doesn't. [Although Dr. Weisenthal is unequivocal in this answer the research world is still debating this feature.]

93. Zone Claim #15: Dean Ornish's patients will have more heart disease and death, because they are not having all that much reduction in their coronary artery narrowing and their triglycerides are going up.

94. Fact #15: This is irresponsible scare mongering, which is likely to cause at least some heart patients to abandon their low fat diets, which will lead to some otherwise avoidable deaths. Coronary blood flow is proportional to the lumen diameter raised to the 4th power! Thus, even minor reductions will lead to major improvement in blood flow and heart muscle blood supply, as was clearly shown in a recent Ornish publication in JAMA. Also, his patients did NOT have significant elevations in triglyceride levels, which is, as noted above, not an important issue, for a variety of reasons.

95. Why I am so anti-Zone?

96. It's not that the diet is so gosh-awful horrible, it's that Sears is in the process of wrecking 25 years of slow, but steady improvements in public health awareness, without any foundation whatsoever in fact, for his own personal gain.

97. POST-TRAINING CARBOHYDRATE INGESTION MEDIATES STRENGTH TRAINING DAMAGE


99. The ingestion of a CHO supplement (1 gm/kg) immediately following completion of resistance training can significantly decrease myofibrillar protein breakdown and may slightly increase muscle protein synthetic rate resulting in a more positive protein balance.

100. Implication. CHO replenishment and supplementation is beneficial for moderating post-strength training damage.

101. CARBOHYDRATE FEEDINGS AND PROLONGED ENDURANCE CYCLING


103. Carbohydrate (CHO) feedings have been shown to improve endurance performance at moderate intensities (60-70% VO2max) and of more than two hours duration. This study found that ingesting CHO at a rate of 1 gm/min during exercise, improved performance in a cycling task of approximately one hour duration.

104. Implication. CHO feeding during exercise improves performance when the task duration is of one hour or longer.

105. CARBOHYDRATE PASTE INGESTION DURING RUNNING

Trained endurance runners (N=10) completed two 2-hour treadmill runs at 70% VO_2max in a fasted state one week apart. One run used 25 gm dissolved in 200 ml of water taken every 30 minutes. The other followed the same regimen but used a placebo.

The CHO supplemented trial maintained an elevated blood glucose level during the two hour trial while in the placebo trial, there was a gradual decline.

Implication. Ingesting 25 gm of glucose paste with water every half hour will maintain blood glucose levels in moderately hard steady-state work.

CARBOHYDRATE LEVELS AND RESISTANCE EXERCISE


The effects of high and low pre-exercise carbohydrate (CHO) diet on performance and metabolic responses during multiple sets of resistance exercises were analyzed.

CHO status did not affect resistance exercise performance. There was an increased reliance on blood glucose to fuel performance when pre-exercise CHO status was low.

Implication. CHO status is not a critical factor for resistance exercise performance. However, when multiple training sessions, recovery times, and other forms of training are important, CHO levels should be maintained at their highest levels.

CARBOHYDRATE INGESTION EFFECTS IN EXERCISE DURING THE MENSTRUAL CYCLE


Elevations in estrogen and progesterone during the luteal phase of the menstrual cycle have been associated with increased lipid metabolism and decreased glycogen utilization. During prolonged exercise, the elevation in plasma free-fatty acids (FFA), which may increase the availability of plasma-free tryptophan to the brain and thus promote "central fatigue" through enhanced serotonin production, is reduced by carbohydrate (CHO) supplementation.

Four women performed exhaustive ergometer cycling tasks on four occasions, two in the follicular phase and two in the luteal phase. A placebo or 6% CHO solution was consumed at 5 ml/kg volume.

The beneficial effects of CHO on performance time, glucose, and FFA concentrations in fatigue were not influenced by the menstrual cycle.

Implication. Menstruation does not affect the beneficial effects of CHO supplementation in exhaustive endurance tasks.

FUEL SUPPLEMENTATION AND ENDURANCE RUNNING CAPACITY

123. The effects of a carbohydrate-rich meal (CHO) three hours before exercise when a CHO-electrolyte solution is ingested during the exercise were investigated. Males (N = 10) ran to exhaustion on a treadmill working at 70% VO2max. Two trials were performed, including a control trial ingesting a placebo meal. Both tests used the same CHO-electrolyte replacement procedure during the exercise.

124. The CHO-meal plus CHO-electrolyte solution condition extended performance (147+ min) over the control condition (125+ min).

125. Implication. A combination of a pre-exercise CHO meal and CHO-electrolyte fluid ingestion during exercise improves endurance running capacity to a greater extent than the ingestion of CHO-electrolyte solution alone.

126. CARBOHYDRATE INGESTION AND RUNNING PERFORMANCE


128. Trained endurance athletes (M = 4; F = 7) completed three trials on a treadmill (90 min; fixed intensity of 67% VO2max followed by a 10 km time trial also on the treadmill) after an overnight fast. During trials 2 and 3, Ss were given a placebo drink or a carbohydrate (CHO) drink (.25 gm CHO/kg BW every 15 min in an 8% solution).

129. Oxygen consumption and heart rates were consistent in the 90 min runs. When consuming the CHO solution, time-trial performance was significantly faster than in the placebo condition. Ratings of perceived effort were similar at 40 min of the 90 min run but lower in the CHO condition at 80 min.

130. Implication. The consumption of .25 gm CHO/kg BW per 15 minute period improves endurance running performance and reduces the perception of effort in the latter stages of the effort.

131. LOW GLYCEMIC PRE-EXERCISE MEAL IMPROVES PERFORMANCE


133. Whether foods with a high soluble fiber content and low glycemic index optimize glucose availability and improve performance were evaluated. Active females (N = 6) ate 75 gm of available carbohydrate (CHO) in the form of breakfast cereals (sweetened whole grain rolled oats (RO) or sweetened whole oat flour (OF) and 300 ml of water) or water alone (CON). These were consumed 45 minutes prior to performing semi-recumbent cycling exercise to exhaustion (intensity of 60% VO2max). Blood free-fatty acids (FFA), glycerol, insulin, epinephrine, norepinephrine, and muscle glycogen (through biopsies of vastus lateralis) were
measured before the meal and after exercise. Diet was controlled by having Ss reside under supervision for 3 days before each trial.

134. At 90 and 120 min of exercise, plasma FFA levels were lower in the RO and OF conditions than CON. At exhaustion there was no difference between conditions in the measures. The RO trial produced enhanced performance when compared to the CON trial. OF performance was similar to CON performance.

135. Implication. Eating a meal with a high soluble fiber content and low glycemic index 45 minutes prior to a prolonged moderately intense level of exercise enhances performance.

136. PATTERNS OF CARBOHYDRATE REPLENISHMENT


138. Lightweight rowers usually reduce body weight by food and fluid restriction and increased energy expenditure. Six female rowers were assessed on their CHO replenishment response after five days of weight reduction to at least 59 kg.

139. Ss were given carbohydrate (CHO) in 6 gm/kg BW in either one large feeding or four equal feedings at 90 min intervals. A 5000 m rowing ergometer trial was performed 15 hours after the initiation of the feedings.

140. No significant differences were observed between the treatments for trial time, blood glucose, lactate, plasma volume changes, oxygen consumption, or respiratory exchange ratio. The weight reduction methods resulted in significant changes in blood glucose and plasma volume. However, neither protocol was superior to the other.

141. Implication. CHO replenishment protocols alter blood glucose and plasma levels whether given in single large or intermittent doses.

142. POLYLACTATE BETTER THAN GLUCOSE POLYMER SOLUTION DURING EXERCISE


144. [Polylactate is a combination of lactate and an amino acid.]

145. Five fasted male cyclists served as Ss and rode a cycle ergometer three times at 50% VO$_{2\text{max}}$ for 180 minutes. In a double-blind experiment, Ss were given a solution to be ingested during the performance (5 min before and then every 20 min during the exercise). A glucose polymer solution (7% of multidextrin), polylactate solution (80% polylactate, 20% sodium lactate as a 7% solution), and water sweetened with aspartame were used.

146. The glucose polymer and polylactate solutions produced similar effects in perceived exertion, sodium, potassium, chloride, lactate, heart rate, oxygen consumption, rectal temperature, and selected skin temperatures. However, the polylactate solution produced higher pH (less acidity) and bicarbonate (better buffering capacity) readings than the glucose condition.
147. This suggests that a polylactate solution might produce the same effects as a glucose polymer solution but with the added advantage of a better buffering effect.

148. Implication. One should consider using a polylactate over a glucose polymer solution as an intraexercise fluid replacement regimen for it produces an increased buffering effect.

149. CARBOHYDRATE USE IN MEN AND WOMEN


151. At an exercise intensity of 65% VO2max, women oxidize more lipids, and therefore decrease carbohydrate (CHO) and protein oxidation, compared with men. This investigation assessed the effects of trained state and increased carbohydrate intake on this phenomenon.

152. Similarly trained endurance athletes (M = 7; F = 7) were subjected to an increase in dietary CHO from 55-60 to 70% of energy intake for a period of 4 days (carbohydrate-loading).

153. Men increased muscle glycogen by 41% and performance at 85% VO2max by 45% whereas women showed no change in glycogen and performance improved only by 5%. During exercise at 75% VO2max, women oxidized significantly more lipid and less CHO and protein than men.

154. Implication. Endurance trained women do not respond to CHO-loading. It is a male phenomenon mainly caused by females' capacity to use fat as fuel while at similar exercise intensities males use CHO and proteins.

155. AMINO ACID SUPPLEMENTATION


157. There is no consistent evidence to support a beneficial effect of amino acid supplementation for performance enhancement. There is a possible detrimental effect of excessive supplementation that could influence the health, and therefore the performance, of the user. It is suggested that there is no substitute for hard sound training, a good diet, and a positive attitude for influencing the quality of performance.

158. AMINO ACID SUPPLEMENTATIONS HELP SWIMMERS FEEL BETTER


160. Branched-chain amino acid supplements improved perceptions of mental, physical, arm/shoulder, and leg fatigue, general tiredness, and tiredness of school in 10 swimmers but not in 10 controls. BCAA supplementation may affect psychological status and/or the perception of fatigue during high volume training.

161. AMINO ACID SUPPLEMENTATION

163. Female collegiate students (N = 30) ingested 11 gm of BCAA or a placebo 30 minutes prior to performing an incremental bicycle ergometer task and on another occasion a prolonged exercise test (at least one hour). The prolonged exercise was at three different intensities for three subgroups of Ss: lactate threshold, onset of blood lactate accumulation (OBLA), and 90% OBLA.

164. It was found that BCAA administration improved endurance capacities and RPE during prolonged exercise of moderate intensity.

165. Implication. Branched-chain amino acids may have a beneficial effect on prolonged moderate-intensity endurance performance.

166. SODIUM BICARBONATE INGESTION FOR ROWING


168. The purpose of this study was to determine the effect of sodium bicarbonate (NaHCO₃) ingestion on work production during a 2000 meter rowing time trial. Ten varsity level oarsmen served as subjects. A dosage of 300 mg/kgLBW was given one hour prior to the time trial. Power, work produced, and trial time reduction (4.3 s) were significantly different to those of a placebo control group.

169. SODIUM BICARBONATE INGESTION NOT FOR STRENGTH


171. Six trained males were studied prior to, during, and in recovery from exhaustive resistance training, 105 min after ingesting 300 mg/kgLBW of NaHCO₃. Exercises were on a universal machine with five sets of 12 repetitions, the last being to fatigue. The usual load was 70% of 1 RM.

172. While NaHCO₃ has been shown to improve running, cycling, and swimming performance, it was not shown to enhance exhaustive resistance exercise performance in strength training.

173. BICARBONATE INGESTION DOES NOT ALWAYS WORK


175. Five male and four female trained track athletes, between the ages of 18 and 30, participated in a total of four competitive 1600 m races scheduled at least three days apart. Ss ingested a treatment (400 mg/kg NaHCO₃ or 500 mg/kg sodium citrate) or placebo (calcium carbonate) 2 hours prior to three of the races; one race was used as a control. Order of treatments was randomized. The buffering agents
had no effect on racing time. Bicarbonate loading was associated with uncomfortable side effects in the majority of athletes.

176. Implication. Bicarbonate loading should be practiced several times before determining if it can be tolerated. Even then there is no guarantee that it will improve 1600 m running race performances.

177. GINSENG DOES NOT IMPROVE PERFORMANCE


178. Ginseng saponin ingested at either 8 or 16 mg/kg body weight for 7 days did not improve either submaximal or maximal cycling performance.

179. Implication. Ginseng is not an ergogenic aid.

180. PHOSPHATES DO NOT ASSIST PERFORMANCE


181. [Phosphates are supposed to act as a lactic acid buffer. Although research on its value for improving performance is equivocal, some studies have shown it to be associated with increases in VO2max.]

182. Phosphate supplementation (e.g., sodium and potassium phosphate) has been reported to result in an elevation of erythrocyte 2,3-diphosphoglycerate (2,3-DGP) to increase peak oxygen uptake and to enhance exercise performance. This study did not support such a finding in groups of different fitness levels.

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CRITICISM OF META-RX AND SIMILAR PRODUCTS


I am concerned with the indiscriminate use of products like MET-Rx due to the potential for intake of toxic levels of some nutrients, not to mention very un-balanced diets. My major concerns are that only 4 packets of MET-Rx provide:

- 1040 kcal.
- Over two times the RDA [recommended daily allowance] for protein for most individuals. Chronic high protein intake may have some adverse effects. Many people are experimenting on themselves, so maybe we will have a better idea when they get to premature kidney failure age.
- 160% of RDA for vitamin A (as retinol). Higher intakes could definitely be dangerous for women at conception or in early pregnancy.
- No fiber.
• About five times the RDA for adults of vitamin D. These levels of intake can be dangerous if consumed chronically according to the RDA manual.
• 2800 mg of calcium. Experts recommend no more than 2000 mg/day. Higher amounts may have adverse effects on bone remodeling rate.
• 29 mg of iron. This level can be dangerous for men and post-menopausal females, especially if they are genetically predisposed to hemocratosis (iron overload disease).
• 24 mg of zinc. Zinc consumed at this or higher levels can interfere with copper utilization (see the RDA manual).

Implication. Use MET-Rx and similar products only in moderation and with care and good sense. Athletes should not indulge these supplements without the advice of a physician or registered dietitian. A natural varied diet can provide the essential nutrients needed for athletic performance.

VITAMIN E


It has been suggested that antioxidant vitamins may beneficially modify potentially detrimental effects of endurance exercise. Whether daily Vitamin E supplementation affected post-race indicators of muscle damage or susceptibility of plasma lipids to peroxidation was assessed 24 hours prior to and immediately after the Hawaii Ironman Triathlon in 34 (M = 22; F = 12) competitors.

It was found that Vitamin E raises plasma levels but has no immediate acute effect on either muscle damage or susceptibility to peroxidation.

Implication. An effect of Vitamin E supplementation on endurance performance is unlikely.

INOSINE SUPPLEMENTATION


[Inosine is not an amino acid but is classified as a nucleoside. It is associated with the development of purines, nonprotein nitrogen compounds that have important roles in energy metabolism. It has been suggested that inosine may improve ATP production in the muscle and thus be of value to strength athletes. It is also thought to enhance oxygen]
delivery to the muscles which would benefit endurance athletes. There are no data to support these claims.]

Male competitive cyclists (N = 10) completed a Wingate Bike Test, a 30-min self-paced endurance cycling performance, and a constant load supramaximal sprint test to fatigue following five days of oral supplementation (5,000 mg/day) with inosine and a placebo.

It was found that inosine supplementation did not improve endurance or power (sprint) performance. It was observed that under some conditions, inosine supplementation might even be detrimental to performance.

Implication. Inosine supplementation does not appear to have beneficial effects on endurance or sprint performance.

CHOLINE SUPPLEMENTATION NOT HELPFUL TO CYCLISTS


Preliminary research suggested that depletion of choline (the neuromuscular transmitter) may limit performance and that oral supplementation may delay fatigue during prolonged efforts. In this investigation the relationships between plasma choline and fatigue during supramaximal brief and submaximal prolonged activities were determined.

Healthy males who trained more than 124 km/wk were randomly assigned to a brief (N = 10; > 150% VO2max) and prolonged (N = 10; 70% VO2max) work group. Each group performed two trials, one after choline supplementation and the other after drinking a placebo. One hour after drinking choline bitartrate increases in plasma choline (37-52%) were observed.

Neither group depleted choline during either the choline supplement or placebo conditions. Fatigue times and work performed were similar under both conditions in each group. It was concluded that choline was not depleted in either condition nor did choline supplementation delay fatigue.

Implication. In the Ss used in this study and for the types of exercise performed, choline was not depleted and its supplementation had no effect on performance or onset of fatigue.

PROTEINS

Rushall notes (1989).
Only under extreme conditions, such as in starvation or prolonged exercise-induced carbohydrate depletion, does their energy contribution approach a 10 percent value. In that role, the main function of proteins is to provide the liver with substrates from which glycogen can be produced. Amino acids are extracted from proteins in the digestive process and are transported to the liver where they may serve as precursors for glucose and glycogen production. Proteins are used mainly for muscle movement. They are used by all body tissues, and in particular, the muscles, to replace proteins that are continually being broken down.

**CAFFEINE AND EXERCISE**


Caffeine is a stimulant that increases respiration, heart rate, metabolic rate, and the secretion of certain hormones. It is found in many foods, beverages (coffee, tea, soft drinks), over-the-counter diet aids, cold remedies, and chocolate products. Many persons use it to increase energy and concentration.

Reactions to caffeine are particularly individual. It can cause indigestion, nausea, diarrhea, and dehydration. The body's ability to cool itself is reduced so it is dangerous for hot and humid conditions. There is some scientific suggestion that it may slow calcium absorption in the bones in women and therefore, may be associated with osteoporosis.

In elite athletes it is used to alter metabolism, in particular, fats, carbohydrate, and protein use. It spares the immediate use of carbohydrates, using more fats for aerobic energy.

Its benefit is not yet always evident because of the individual nature of response. It is a banned drug and if found of sufficient quantity (determined by blood concentration) will result in disqualification.

**CAFFEINE AND PERFORMANCE**


In laboratory settings, caffeine ingestion (3-9 mg/kg BW) prior to exercise increases performance in prolonged endurance exercise and short-term intense exercise lasting approximately 5 min. These ergogenic effects are present even when urinary levels are below the IOC limit of 12 micrograms/ml.

Implication. Caffeine should be considered for banning as an unfair ergogenic aid. That would mean an athlete would have to abstain from ingestion of caffeine for 72 hours prior to competing.
POTASSIUM SUPPLEMENTATION AND AEROBIC CAPACITY


Km is a potassium/mineral supplement. Ninety days of this supplementation was found to have no effect on the aerobic capacity of healthy adults who already consume a nutritionally balanced diet.

Implication. Potassium supplementation does not affect aerobic capacity in healthy adults with balanced nutritional habits.

SODIUM INGESTION DURING EXERCISE


Three concentration levels of sodium were ingested in gel capsule form along with an 8% carbohydrate (CHO) solution during 4 hours of moderate intensity (55% VO2_max) exercise. The high concentration NaCl (100 mEq/l) caused plasma volume to expand.

It was concluded that the addition of high concentrations of NaCl to a CHO solution ingested during prolonged exercise has a positive effect on fluid balance.

Implication. CHO supplementations should be accompanied by salt ingestion during very extended contests.

DIETARY FIBER AND EXERCISE


Soluble fiber reduces the plasma glucose and insulin changes after an oral glucose load by reducing the rate of intestinal absorption of glucose. Moderation of insulin changes after a pre-exercise carbohydrate (CHO) feeding may provide additional fuel sources for exercise in the form of plasma glucose and free fatty acids. The effects of soluble fiber combined with a pre-exercise CHO feeding on substrate availability and endurance performance in college males (N = 8) was investigated. Ss were exercised on a cycle ergometer, an activity for which they were untrained.
Results indicated no effect of the combination of fiber ingestion with CHO feeding on plasma glucose or glycogen use. It is possible that the untrained status of the Ss contributed to the absence of effect as well as the method of fiber presentation (capsule form).

Implication. In untrained individuals, soluble dietary fiber when combined with CHO feeding has no effect on performance. This is another instance where considering research on untrained individuals may lead to erroneous generalizations to trained individuals.

**LIGHTWEIGHT ROWING WEIGHT LOSS CAUSES PERFORMANCE DECREMENT**


The dehydration-rehydration protocol of lightweight rowers was associated with a significant decrease in performance. A significant relationship was established between the deficit in plasma volume after rehydration and performance. Muscle glycogen utilization rate during exhaustive exercise while dehydrated was significantly reduced. The dehydrated trial was also accompanied by a significantly lower blood lactate level. It was apparent that even though muscle glycogen was available during the rehydrated trial it was not possible to be used in a "normal" manner.

Implication. Decreased performance during rowing while dehydrated may be caused by two variables: (a) a decrease in plasma volume and inability to rapidly regain the lost plasma volume during rehydration, and (b) a decrease in the capacity to use oxygen.

**HYDRATION AND PERFORMANCE**


Even moderate levels of dehydration can compromise physical performance. The body attempts to conserve water during exercise by reducing the amount of urine produced. Heat acclimated individuals may have sweat rates in excess of 3.5 quarts per hour.

After significant dehydration (2+%), such as that experienced to "make weight," it takes considerable time to rehydrate. For example, if 4% of body weight is lost as fluid, after five hours of rehydration, performance potential (muscle and aerobic endurance) still will not have recovered.

Dehydration affects power, aerobic and anaerobic parameters, and cognitive functioning. In rifle marksmen, accuracy and detection of cues have been shown to be decreased by between 15-20% of normal.
Thirst alone is not a good indicator of fluid need. Prevention of dehydration during work in the heat requires scheduled fluid intakes.

Affects of dehydration on performance. If water loss is defined as a percentage of body weight loss, the following progressive deteriorations in performance should be expected.

- 0-2%. Impaired thermoregulatory ability.
- 2-3%. Reduced muscular endurance time.
- 3-6%. Reduced muscular strength, reduced endurance time, heat cramps.
- 6+. Severe heat cramps, heat exhaustion, heat stroke, coma, death.

Implication. Serious attention to fluid replacement on a scheduled basis is required for all sports that induce considerable sweating and/or are performed in hot humid conditions.

ELECTROLYTE REQUIREMENTS


Sodium and chloride are the primary electrolytes lost in sweat because of their higher concentration in circulating blood. Potassium, magnesium, and calcium concentrations are smaller because they primarily are located in the cells. Under most conditions, electrolyte replacement is not necessary and can actually hinder performance. Although electrolyte loss in sweat increases with exercise, water loss is larger. Thus, electrolytes (e.g., sodium) actually increase in concentration and so excessive salt intake causes an even greater concentration.

Normal dietary habits are usually sufficient to replace electrolyte losses during moderate dehydration.

However, when individuals are exposed to daily 5-6% body weight fluid losses, there is the risk of an electrolyte deficit occurring. Under such conditions, small amounts of electrolytes should be consumed during physical activity. The ACSM recommends: (a) 218 mg of sodium, (b) 337 mg of chloride, and (c) 183 mg of potassium per quart of water.

FLUID INTAKE DURING SWIMMING TRAINING


Nine male swimmers performed 20 x 50 m repetitions on one minute interval. On every fourth interval, 50 ml of water was consumed. It was found that fluid intake contributed to...
sustained performance and suppressed body temperature. Although swimmers performed in a "wet" environment, fluid intake was necessary to prevent dehydration.

Implication. Swimmers should drink frequently during swimming practices. The frequency is possibly more than one might expect.

NIACIN SUPPLEMENTATION


Large doses of niacin, a B vitamin, reduce fat utilization during exercise. The inhibition of free fatty acid mobilization during moderate exercise caused significant performance impairment. However, at higher intensity exercise levels, where fat utilization plays a lesser role, performance impairment is reduced and not exhibited in some individuals.

Implication. When niacin is taken as part of a vitamin supplementation program, the amount ingested should be carefully considered so that there is no disruption of fat use to fuel activity.

VITAMIN AND MINERAL STATUS IN TRAINED CYCLISTS


It was found that highly trained cyclists (N = 15) following self-selected diets without supplementation were able to maintain plasma vitamin/mineral levels within normal limits. They were also able to consume greater than RDA for almost all nutrients.

Implication. A self-selected diet of good content is sufficient to maintain appropriate vitamin and mineral levels in hard-training athletes.

ANTIOXIDANT STATUS IN HARD-TRAINING RUNNERS


The effects of repeated vigorous exercise on plasma antioxidant vitamin status and biomakers of oxidative stress in 10 well-trained long distance runners attending an 8-day
training camp were assessed. It was found that plasma antioxidant vitamin status remained unchanged but oxidative damage occurred in the tissues including DNA.

Implication. The effects of hard training selectively fatigue bodily structures and functions and do not show in a manner that might be evidenced in untrained persons

ANTIOXIDANTS AND ENDURANCE TRAINING


The total antioxidant capacity of serum after strenuous endurance exercise was evaluated. Male triathletes (N = 29) performed a full competitive triathlon. Blood samples were taken immediately before, after, and one day after the performance.

It was found that total antioxidant capacity of serum was enhanced after the triathlon due to the mobilization of antioxidants and the synergism between antioxidants.

Implication. Endurance exercise mobilizes antioxidants

CREATINE SUPPLEMENTATION EFFECTS ON PERFORMANCE


The research literature is inconclusive regarding the benefit of creatine supplementation on running performance. This study compared creatine and placebo conditions on running performance in 12 male competitive runners. Two 700-m runs were performed on two occasions. Prior to the second occasion, one group of six ingested 6 gm of sucrose four times per day for five days, and the other ingested 5 gm of creatine monohydrate plus 1 gm of sucrose on the same schedule.

It was found that creatine supplementation did not enhance performance nor affect peak blood lactate, body weight, or total body water.

Implication. Creatine supplementation over five days did not affect running performance.

CREATINE AND RESISTANCE PERFORMANCE

Active males (2 groups of N = 7) were given 25 gm of creatine monohydrate per day for 7 days or an equal amount of placebo. Ss were asked to perform sets of 10 bench presses or jump squats to exhaustion. Lactates were determined at rest and 5 min post-exercise.

Creatine performances were significantly better than those in the placebo group. Lactate concentrations were not significantly different after exercise. Lean muscle mass increased in the creatine group although there was no attempt to control diet.

One week's ingestion of 25 gm/day of creatine monohydrate can enhance muscle mass and improve strength exercise performance.

Implication. If creatine monohydrate is effective for an individual, its benefits should be revealed quickly through muscle mass increase and strength exercise performance.

CREATINE AND CYCLING SPRINT PERFORMANCE


This investigation determined if creatine supplementation (20 gm/day for 7 days) and creatine maintenance (2 gm/day) would attenuate muscle ATP loss associated with intense sprint training, and improve performance after sprint training. Effects were compared to a placebo group in a double-blind study.

The following conclusions were reached.

1. The percentage of type IIB fibers modifies creatine effects.
2. Creatine supplementation and maintenance did not decrease ATP loss during intense sprint training.
3. Sprint training decreased plasma levels of products of adenine nucleotide degradation and improved 30 sec sprint performance.
4. Creatine supplementation and maintenance did not alter one-hour cycle distance.

Implication. Creatine supplementation apparently has a differential effect depending upon the muscle characteristics of the individual. Performance effects are limited to short-term anaerobic activities.

CREATINE AND CYCLE ERGOMETER PERFORMANCE


Nine Ss (M = 4; F = 5) performed a 30 sec maximal exercise bout on a cycle ergometer on two occasions. One occasion used a glucose placebo (4 x 5 gm x 4 days) and the other creatine supplementation in the same quantities.

Total muscle creatine increased significantly before and after exercise during creatine supplementation. Performance over 30 sec was not altered by creatine supplementation but muscle metabolism was.

Implication. This study is further evidence that creatine supplementation does not have universal effects.

**NASAL DILATORS AND PERFORMANCE**


It was concluded that "Breathe Right" nasal dilators do not enhance exercise performance.

**NASAL DILATORS AND RECOVERY**


It was concluded that "Breathe Right" nasal dilators do not improve the post-exercise ventilatory response.

**NASAL DILATORS AND EXERCISE VENTILATION**


Moderately-trained Ss (N = 12) completed seven stages of a Balke test (31 minutes duration) with and without a Breathe Right nasal dilator. Neither ventilation expired nor oxygen consumption was altered by the nasal dilator.

Implication. Nasal dilators do not alter the ventilatory response in exercise.
NASAL DILATORS ARE NO HELP IN SPRINTS


Collegiate athletes (M = 9; F = 5) performed four 40-yd sprints with 16 minutes of recovery between each sprint on single afternoon. Mouthpieces, placebo nasal strips, and Breathe-Right nasal strips were used singly and in combination in a random manner across the trials. Heart rates were recorded at a number of times before, during, and after exercise. Oxygen saturation and respiratory rates were also recorded periodically.

Heart rate increased significantly due to the exercise. However, there was no effect due to any treatment (mouthpiece, placebo, or Breathe-Right).

Implication. External nasal dilators are not an effective ergogenic aid in anaerobically dominant activities such as sprinting.