Periodization and Block Periodization in Sports: Emphasis on Strength-Power Training—A Provocative and Challenging Narrative

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Abstract
Stone, MH, Hornsby, WG, Haff, GG, Fry, AC, Suarez, DG, Liu, J, Gonzalez-Rave, JM, and Pierce, KC. Periodization and block periodization in sports: emphasis on strength-power training—a provocative and challenging narrative. J Strength Cond Res 35(8): 2351–2371, 2021—Periodization can be defined as a logical sequential, phasic method of manipulating fitness and recovery phases to increase the potential for achieving specific performance goals while minimizing the potential for nonfunctional overreaching, overtraining, and injury. Periodization deals with the micromanagement of timelines and fitness phases and is cyclic in nature. On the other hand, programming deals with the micromanagement of the training process and deals with exercise selection, volume, intensity, etc. Evidence indicates that a periodized training process coupled with appropriate programming can produce superior athletic enhancement compared with nonperiodized process. There are 2 models of periodization, traditional and block. Traditional can take different forms (i.e., reverse). Block periodization has 2 subtypes, single goal or factor (individual sports) and multiple goals or factors (team sports). Both models have strengths and weaknesses but can be “tailored” through creative programming to produce excellent results for specific sports.

Key Words: athlete development, accumulation, transmutation, realization

Introduction

Contribution to the Field

Although for many years the “concept” of periodization was well accepted by both coaches and sport scientists, several authors have recently criticized and questioned several aspects of the paradigm including underlying mechanisms, room for individualization, and even the historical and evolutionary basis of its development (17,99–101). Although questioning of established paradigms is an accepted method of serving to crystallize thought and promote the evolution of a paradigm, it is not helpful when the questions and criticisms are based on false premises, basic misunderstandings, and incomplete or selective reviews of the existing literature. It is our contention that much of the criticism stems from a basic misunderstanding of the fundamental definition, underlying concepts, mechanisms, and practical applications of a periodized program, especially as it is associated with block periodization (BP). This review is an extension of previous commentaries addressing these criticisms (86,186). In this narrative review, we discuss and provide evidence for the historical coaching and scientific development of periodization, and the basic underlying mechanisms related to periodization. In addition, we address the basic criticisms of periodization that have recently received attention in the coaching and scientific literature. Although the concepts and principles discussed in this article can be useful at any level, the discussion primarily concerns competitive athletes and the coaches training them.

The concept of periodization is a cyclical method of managing training variables such that the adaptive process occurs in a logical developmental order. Furthermore, largely based on descriptive and observational studies, this conceptual paradigm, when appropriately programmed and carried through, allows the coach and sport scientists to qualitatively predict when a performance peak is most likely to occur. The development of this concept has a history going back millennia and, presently, is a paradigm that is accepted by most coaches and sport scientists. Indeed, periodization in some form has been used in various sports, particularly track and field, for over 100 years (90).

However, recently several authors have attempted to highlight the shortcomings in the conceptual paradigm of periodization for sport (17,99–101). We believe that the arguments made by these authors are flawed and are the result of a series of misconceptions or incomplete reviews of the historic literature. These misconceptions include misunderstanding of the basic conceptual nature of periodization, misunderstanding the underlying mechanisms driving adaptation, confusing programming with periodization, the use of inefficient and less efficacious programming methods to drive the selected...
periodization model, and failure to recognize the developmental and evolutionary history of these factors.

Methods

For this narrative review, literature searches using PubMed, Google, Google Scholar, and Web of Science were performed. The pertinent literature was included.

Historical Development

Background: Periodization and Programming. The fundamental idea of periodization can be ascertained from the basic definitions of periodization found in dictionaries.

- “a round of time marked by the recurrence of some phenomenon or occupied by some recurring process or action.” Wordreference.com
- “the attempt to categorize something (e.g., history) into named periods.” YourDictionary.com

Note, from these definitions, that a larger process is being broken into phases or periods, and the periods are recurring (cyclical and nonlinear) in nature. Indeed, periodization is marked by removing linearity (121). Thus, periodization for sports is part of a management process that provides a foundational mechanistic paradigm. Conceptually periodization in a sports context deals with:

- Timelines and fitness phases
- Conceptually (for most sports): higher volume to lower and lower to higher intensity
- Less task specific to more task specific.

We believe this paradigm is best reflected by the following definition:

Periodization is a logical sequential, phasic method of manipulating fitness and recovery phases to increase the potential for achieving specific performance goals while minimizing the potential for nonfunctional over-reaching, overtraining, and injury (40,41,190,194,195).

A periodized training process is considered the principal planning strategy for athlete development and preparation by most coaches and sport scientists. Considerable evidence (Table 1) indicates that periodization is quite efficacious and can produce superior performance adaptations compared with traditional nonperiodized methods (32,40,41,47,52,82,83,87,141,163,166,167,233). Indeed, periodization (and appropriate programming) represents a methodological attempt to manage adaptation to training.

Programming drives the conceptual process of periodization. Programming is the creation and development of the programs (exercises sets and repetitions, rest periods etc.) “inside” the fitness phases to produce the desired fitness effects. Although periodization can be considered a macromanagement process, programming deals with the micromanagement of training (Figure 1).

Historical Development and Evolution of Periodization

Interestingly, a common misconception concerning periodization is that its development was solely a phenomenon of the old Soviet Union and a primary creation of L. Matveyev. Although Matveyev is often recognized as the “Father” of Periodization, the development of any reasonable conceptual paradigm can usually be shown to have a long developmental period. Periodization is no different. Figures 2A–C present a partial historical time-line for the development and evolution of periodization. As can be noted from Figures 2A–C, the development of periodization has a long history and a rich legacy of development.

Matveyev (along with Dyson, Pihkala, and Nadori etc.) was one of the first to present a formalized systematic model of periodization around 1964 (107). Matveyev’s original model (from his dissertation) was developed through the monitoring of Soviet athletes preparing for the 1952 and 1956 Olympic Games—particularly track and field (107). He was particularly interested in why some athletes achieved their best performances at the summer Olympics and others did not. In 1965, based on this research, he published an annual training plan modeled on periodization concepts. English translations of this work and his later writings eventually lead to the popularization and use of “periodization” in the West (107,120,121). Matveyev is often credited for creating the “traditional” model of periodization—however, this is somewhat misleading as the foundations for this concept had already been laid. Nevertheless, Matveyev did formalize this model. Matveyev used the mechanistic ideas of H. Selye, N.N. Yakovlev, and I.P. Pavlov to reason that the same stimulus can be beneficial or detrimental depending on the prevailing circumstances and to provide an explanation of the accumulative effect of training coupled with the supplemental effects of additional “stressors” (107).

Linearity is a mathematical function (relationship) that graphically is represented by a straight line. Thus, a typical programmed incremental reduction in repetitions or workload over time (particularly during a mesocycle) has been termed “linear periodization” (168). Matveyev used Yakovlev’s concept of “supercompensation” (237,238) as a basis for emphasizing nonlinearity and rhythmicity during training (107,230). Although, Matveyev’s model of periodization has provided great insight into the training process and the necessity of cycles, the “classical or traditional” model of periodization is often erroneously termed a “linear” model of periodization. Indeed, Matveyev noted that the removal of linearity and appropriate variation in the form of repeating load oscillations provided a superior method of training:

“wave oscillations characterize load dynamics in both relatively small and more prolonged phases (stages and periods) of the training process.” Correspondingly, we can single out “waves” of several categories: small characterizing load dynamics in the
Periodization:

"Macromanagement" of the training process associated with time periods:

- Time is allocated toward various fitness phases that strategically align in a unilateral fashion based on a competition calendar.
- Provides a blue-print allowing the coach to foresee and assign periods of training in order to target the accession and attainment of specific fitness characteristics.

Programming:

"Micromanagement" of the delineated stages of training:

- When appropriately constructed, the training program should differentiate the time continuum into discernable patterns based upon intended objectives.
- Creates the organization of various components of programming (i.e. frequency of training load, training volume and intensity, exercise selection and order, number of sets and repetitions, etc.).
- Ensures appropriate variation of training factors to modulate fatigue and optimize long-term adaptations.

Figure 1. Periodization (macromanagement) vs programming (micromanagement). Based on Cunanan et al. (32).

Training in microcycles, average, expressing a general tendency of loads in several microcycles, big, which are revealed when evaluating the general tendencies of load dynamics in several average cycles which make up the states of periods of training microcycles (121).

Using earlier developed ideas of subdividing the training process into fitness phases and timelines (35,56,71,92,104,107,148,157,162), Matveyev further developed this idea in the 1960s–90s. As noted previously, timelines were divided into macrocycles, mesocycles, and microcycles. Dyson’s, Kotov’s, and particularly Pihkala’s (56,104,107,162) ideas of the progression of more general fitness (less specific) preparation to specialized to specific preparation, for athletic competition, was expanded into general preparation, special preparation, competition (including a taper), and transition (active rest). Depending on specific sport training practices, Matveyev indicated that many variations of the duration of fitness phases, macrocycles, and subdivisions are possible; so, specific phase timelines were not typically prescribed (107). However, Matveyev emphasized that a basic preparatory phase should be maintained at effective levels long enough to enable an athlete to achieve desired results (107,122). As Platonov indicated (111,112), Matveyev’s views correspond with the preparation of most modern advanced and elite athletes, who are “not aiming at immediate success in second-league competitions, but at planned and effective preparation for the most important competitions, most of all Olympic Games and World Championships.” Although Matveyev’s original model delineated one large macrocycle, however, as the competition calendar changed, this “monocycle” approach was expanded into 2 and later 3 macrocycles (89). Thus, this expansion provided an increased frequency and distribution for re-establishing general preparation (accumulative) fitness characteristics and qualities (89). Figure 3 provides a generalized schematic representation of this paradigm over one macrocycle.

As Figure 3 shows, training proceeds toward a climax (peak) performance, which coincides with the most important competition of the macrocycle. As can be noted from Figure 3, training generally proceeds from less task specificity to greater and from higher volume to lower creating an inverse relationship with training intensity. The transition or active rest is a necessary phase to recover from peaking for an important competition. This recovery not only deals with accumulated fatigue but also injuries and perhaps most importantly the emotional and psychological highs and lows of competition during preparation for competition. The order of phases and cycles during the year should be performed in a manner that would help ensure that peak performance coincides with the major competition that was the primary target for the athlete during the annual plan. A more detailed discussion of these phases can be found in the reviews of DeWeese et al. (40,41) and Plisk and Stone (164).

Although Matveyev originally dealt with elite and high-level athletes, an advantage of Matveyev’s conceptual paradigm was that it could be applied to athletes of any level. Although many coaches and athletes had been using a form or parts of Matveyev’s concept for some time, it was applied to all Soviet athletes for the first time for the 1960 Olympic Games. As the USSR was a facile winner in the medal count, it seemed to work (107). As a result, in 1961, a Soviet Central Planning unit was set up to assure that all of the Eastern Bloc countries could also profit from the periodization concept (107). As sport was (and is) tied to politics, a substantial and impressive improvement in all aspects of the medal table seemed to indicate the superiority of the state planning system over the individualistic capitalist system in maximizing human potential (107). In the German Democratic Republic (East Germany), Harre (79,80) was the first to incorporate periodization theory outside of the Union of the Soviet Socialist Republics (USSR) (107). A common criticism of Eastern Block success has been because of the likely (and in many cases confirmed) use of androgens. However, it is worth noting that androgen use was not confined to the German Democratic Republic and the USSR, in fact, far from it, as androgen use was commonplace in many countries during this time period (48,107,218). Thus, the idea that their success was solely because of drug use is at best an oversimplification.

In the United States, J. Garhammer (66) published one of the first articles dealing with periodization specifically for strength training in athletes, particularly for strength-power events. About the same time, “Doc” Counsilman (30,31) described periodized training for swimmers that he had been using for a number of years. The first experimental studies
directly dealing with resistance training were those of Stone and colleagues (191,192,204) some of which were part of the doctoral dissertation of H. O’Bryant (156). This proliferation of theoretical concepts, practical observations, and objective studies eventually assured world-wide usage of the concept (107).

**Traditional Periodization: Problems**

Several sport scientists and coaches, including Bondarchuk (10,11), Verkoskanskyy (220,221), and Issurin (89), noted potential problems with the traditional periodization paradigm. A contemporary of Matveyev, Y. Verkoskansky was a sport scientist, working primarily with track and field, who developed the

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**Figure 2.** A) Timeline: ancient to middle ages. B) Timeline: middle ages to modern times. C) Timeline: modern times.
Conjugated Successive System of Training as an alternative to traditional periodization models (220, 222–224). Issurin, contemporary with both Matveyev and Verkoshan'ky also noted potential problems with the traditional concept and developed the BP model. The potential problems with the traditional periodization concept included:

**A Performance Peak Cannot be Maintained for Long Periods.** If fitness declines too much, then performance will suffer. The association between fitness (positive effect) and fatigue (negative effect) has been described in the fitness-fatigue relationship paradigm (164). This paradigm (Figure 4) represents the expression of fitness (underlying mechanisms) in relation to preparedness (potential to perform). Essentially enhanced fitness factors are related to enhanced preparedness. However, during training, fitness expression and therefore preparedness is inhibited or masked by accumulated fatigue. The expression of fitness can be enhanced by reducing accumulated fatigue, as occurs with a reduction in training volume (i.e., training taper). However, as the training load is reduced, fitness begins to decay. Because fatigue dissipates at a faster rate than fitness, preparedness is enhanced, thus producing a potential peak performance. However, as fitness continues to decay, preparedness and performance begin to decline. This interplay of fitness and fatigue leaves very little time for the actual preparedness peak (and potential performance) to be maintained.

A change in International Olympic Committee international rules for amateur athletes in 1981, allowing athletes to accept money for competition, precipitated considerable discussion and debate as to whether an athlete should be in good shape over a relatively long time or an excellent shape for a single major competition (216). Because of this change many athletes, particularly in track and field, started to modify their training according to “market” rules (106, 107). Rather than trying to peak when it counted, athletes had to perform over relatively long terms, often to make a decent living (106, 107). This alteration in rules and

![Figure 3](image-url).

**Figure 3.** An example of Matveyev’s general plan for sport training over 1 macrocycle. T = technical training (degree of task specificity), I = intensity of training, V = volume of training.

![Figure 4](image-url).

**Figure 4.** Association of fitness and fatigue. Fitness = underlying mechanisms driving preparedness and performance (e.g., strength, RFD, \( V_{\text{O}2\text{max}} \), etc.), fatigue = inability to maintain or repeat a given force or power output. Accumulated fatigue can increase recovery time and inhibit adaptation to the training stimulus, preparedness = the difference between fatigue and fitness; represents the potential to perform (Based on DeWeese et al. (40, 41), Plisk and Stone (164)). RFD = rate of force development.
changes in the competition calendar of many sports began to alter training considerations and methods.

Based on observation and some experimental evidence, it seems that a true performance peak can be maintained for approximately 3 weeks or less (12,44,141,145,151). Issurin (88) proposed that although measures of fitness, such as maximum strength, can be maintained for up to 30 days, sports performance is a multifactorial process and peak performance for athletes in some sports can be maintained for only about 5–8 days. The exact time period that a performance peak can be held likely depends on factors such as trained state, the type, length, volume, and intensity factors related to the taper and outside stressors. Thus, it seems that the time window for athletes maintaining a performance peak is quite narrow.

Simultaneous Increase in Training Factors. It was noted that during training when various fitness and performance factors were increased simultaneously, as occurred with traditional periodization programming, 3 major problems can occur:

- As training volume increases, all fitness factors can also increase. As long as fatigue is very carefully managed through appropriate variation, training volume can remain relatively high, and typically fitness can be maintained. However, when volume decreases, all fitness factors can also decrease simultaneously (220,222,224). Thus, all aspects of fitness often decline, potentially interfering with the beneficial alterations in preparedness, when the athlete tries to taper and bring performance to a peak.

Figure 5. Example of periodization for a team sport: American Football.

Figure 6. The interplay of detraining and residual effects. Based on (Issurin (91), Plisk and Stone (164), and Stone et al. (201)).
Table 2
Residual effects: decay timelines with cessation of specific training.*

<table>
<thead>
<tr>
<th>Type</th>
<th>Physiological adaptation</th>
<th>Rate of loss‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term†</td>
<td>Musculoskeletal: hypertrophy and architecture</td>
<td>No large alteration</td>
</tr>
<tr>
<td></td>
<td>Transformations (muscle, skeleton, and joints)</td>
<td>Until mid-old age</td>
</tr>
<tr>
<td></td>
<td>Increased body mass.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Neural: improved coordination and general</td>
<td>y</td>
</tr>
<tr>
<td></td>
<td>Movement skills, general event specific skills</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cardiovascular: resting bradycardia, enhanced</td>
<td>mo</td>
</tr>
<tr>
<td>Intermediate-term</td>
<td>Capillary density, resting and exercise SV, CO, myocardial hypertrophy, and volume alterations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Neuromuscular: enhanced effort discrimination</td>
<td>mo</td>
</tr>
<tr>
<td></td>
<td>Force modulation and sport-specific balance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Movement abilities</td>
<td></td>
</tr>
<tr>
<td>Short-term</td>
<td>Cardiovascular and bioenergetic: enhanced</td>
<td>wk</td>
</tr>
<tr>
<td></td>
<td>Vo2peak</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Enhanced lactate threshold</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>Performance alterations</th>
<th>Rate of loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-term</td>
<td>Strength: S &gt; SE &gt; power</td>
<td>wks to days</td>
</tr>
</tbody>
</table>

*S = maximum strength, SE = strength endurance (high intensity exercise endurance), P = power output (85,126,143,144).
†Assumes no substantial alteration in training status.
‡Decay by 5%.

- Attempting to manipulate large volumes of work, as can occur with simultaneous increases in several or all aspects of fitness, requires very careful fatigue management. Thus, very large volumes of work can (and often do) increase accumulated fatigue to a point that it becomes difficult to recover, as a result adaptation and performance suffer (18,19,49,102,200).
- Simultaneous increases of noncompatible fitness factors during training for a few weeks or more can inhibit adaptation of one or more factors, including learning new skills (14). For example, simultaneous increases in endurance factors, tends to favor endurance adaptations and can inhibit development of strength associated factors, such as muscle and connective tissue architecture (e.g., pennation angle, fascicle length, etc.) and especially explosive strength (rate of force development [RFD]) and power (7,15,46,64,65,68,93,119,128,170,171).

It should be noted that the problematic effects of noncompatible factors and higher volumes of training, resulting from noncompatible fitness factors, may be compounded by ineffectual methods of training. These less productive methods include resistance training to failure or short interset rest periods that decrease recoverability or adaptation (65,95,96,125,135,161,174,187,190) and promote nonfunctional over-reaching and overtraining (22,72).

Team Sports. From the beginning, Matveyev himself and other sport scientists and coaches had doubts as to whether his paradigm worked for all sports, particularly team sports (91,190). For example, soccer, volleyball, or basketball and other sports with a long season, in which each game was supposed to be won, were difficult to reconcile with a concept that allowed only a very few peaks in performance to win Olympic or other major championships. Thus, it was suggested that an in-season maintenance phase should be used for these sports with some type of periodized process leading up to the season and postseason (191,200). Figure 3 represents an example of periodized training for American Football.

During the season, it was indicated that training volume in the weight room should be reduced, whereas intensity was held at moderate to high levels. For some sports with very long competition periods (20–40 weeks), such as professional soccer and rugby, periodic return to a brief accumulation period (1–3 weeks) is often necessary to re-establish specific aspects of fitness (e.g., strength and power) and must be carefully planned and monitored. Furthermore, many teams compete in playoffs, conference championships, and regional and national competitions etc.; it is during these periods that team preparedness and potential performance can be increased through appropriate volume and intensity manipulations. In addition, in some sports, for example, professional soccer, there may be player rotations allowing some athletes to periodically “rest and recover” from competition for short periods (1–3 weeks). During these periods, the rotated players may be able to re-establish specific fitness aspects through altered or increased volumes of nonsoccer training. The issue of BP in relation to team sports has been further addressed by Issurin (91).

Block Periodization

The BP training approach is an efficient and efficacious alternative to traditional training design.

The basic premises of BP are:
- The primary premise of BP is the employment of highly concentrated training workload phases (periodization blocks) and the resulting after and residual effects.
- The blocks must be sequenced in a logical order to benefit from the residual effects.
- The BP approach has been proposed in 2 variations: the concentrated unidirectional design (single goal or factor)

Table 3
Percent alterations in endurance-related factors across 8 weeks of resistance training.

<table>
<thead>
<tr>
<th>Factor</th>
<th>T1–T2</th>
<th>T2–T3</th>
<th>T1–T3</th>
<th>Expected decrease (no strength training)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vo2max (L × min⁻¹)</td>
<td>9.2%</td>
<td>-1.1%</td>
<td>8.1%</td>
<td>3–4%</td>
</tr>
<tr>
<td>Vo2peak (ml × kg⁻¹ × min⁻¹)</td>
<td>7.3%</td>
<td>-1.0%</td>
<td>6.3%</td>
<td>3–4%</td>
</tr>
<tr>
<td>Cycle endurance</td>
<td>5.0%</td>
<td>7.8%</td>
<td>12.2%</td>
<td>5–10%</td>
</tr>
<tr>
<td><strong>First summated microcycle</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Second summated microcycle</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Accumulation Periodization Block</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1 = 0 wks</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T2 = 5 wks</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T3 = 8 wks</td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

*Incremental to exhaustion.
and the multitargeted version of the block training design (multi goal or factor)

**Single Factor**

As a result of the observed problems associated with the traditional periodization paradigm, Verkoshansky (221,224) created the concept of a concentrated load (CL) and developed the conjugated successive system of training for athletes, again focusing on nonteam sports. This concept laid the foundation for BP. A CL is a “block” of unidirectional training that emphasizes a single or very few related characteristics, such as strength and rate of force development (221,224). Unidirectional refers to the de-emphasis of fitness characteristics other than the training of the primary fitness characteristic. Issurin (91) noted that residual effects (effects lasting several weeks after the CL was completed) persisted and could potentiate the next phase (block) of training. Residual effects must be considered within the context of “reversibility.” As training load is reduced or removed, improved fitness characteristics return toward baseline (reversal), however, there are always residual effects of improved fitness characteristics that persist for some period of time (Figure 6). It should be noted (Figure 6) that the term “fitness” is used as a summation of all the different fitness residual effects, and the decay rate for different aspects of fitness is different.

Potentially, the fitness characteristic that was emphasized in a specific block would have a relatively long-lasting residual. Furthermore, decay rates can be influenced by the trained state, and sport training that continues after the primary fitness characteristics training is dropped or decreased (143,144). Several studies have investigated the decay rate of fitness characteristics among athletes. For example, even when strength training was discontinued, maximum strength has been shown to decrease ≦2% after 3 weeks (126,143,144) and V̇O₂max approximately 3–5% over 4 weeks with substantial reductions in endurance training (126,143,144). As noted previously, residual effects decay at different rates lasting for years to days. Table 2 shows the potential residual effects and relative decay rates (88,231). These effects may persist for days to weeks depending on the systems being affected, the training state, and the extent and type of preceding training.

Of importance, do residual effects, as the result of sequenced training blocks, actually persist across subsequent blocks during training? Although few studies have addressed this question, Stone et al. (201) investigated the effects of a resistance training accumulation periodization block in which the first summated microcycle (5 weeks) emphasized strength endurance, and the second (3 weeks) had a lower volume and greater emphasis on basic strength. They (201) found that among initially minimally trained subjects, the increases in V̇O₂max and cycle endurance persisted through the second summated microcycle although the volume was markedly decreased. Table 3 displays these results.

Interestingly, although aerobic power plateaued after the first summated microcycle, cycle endurance continued to improve although training volume decreased across the second summated microcycle, indicating a degree of disconnect between aerobic power and cycle endurance. Nevertheless, it seems that although volume was reduced, endurance-related effects did persist and
even improved. So, based on available evidence, it seems that residual effects are sustainable and could potentiate a subsequent phase; this theoretical concept is shown in Figure 7 in which the goal is increased power.

Another important basis of the theoretical BP background are the phasic alterations of training magnitude and sport performances that often follow the execution of one or more blocks (3–12 weeks) of highly concentrated strength-endurance or strength-power training. Among advanced athletes, these alterations typically show a decline during the initial phase and subsequent enhancement of speed, RFD, and related variables on return to “normal” training (91,205,222,224). In addition, achievement of peak performance in the targeted sport activity was often delayed and “supercompensated” above baseline. Verkoshansky (222) proposed that these phasic alterations would have a deterministic effect and termed this phenomenon the “long-term lagging training effect”—or “delayed training effect” (DTE) (88,90,222). Based on these observations and after considerable experimentation with different types and numbers of concentrated loads, a 3-block unidirectional training system was proposed (91,225). This unidirectional system used a work-loading sequence that progressed from power and strength development (2–3 months) to more training emphasizing specialized sport-specific power oriented movements (≈2 months) and event-specific technique enhancement (along with a taper) with competitive performance practice (≈3–5 weeks). Verkoshansky termed this 3-block sequence (blocks “A,” “B,” and “C”) the “big adaptation cycle,” the duration of which was 22–26 weeks (91,226,227). This 3-block cycle became the basis of the 3 “periodization” blocks: accumulation, transmutation, and realization = stage. A stage roughly corresponds to a mesocycle. Because of continued alterations in the competition calendar, specific needs of different sports and individual athlete, the exact length of these blocks have been further altered and blocks may range from 2—8 weeks (40,41,195–197,200). In addition, blocks may be aggregated (summed) such that 2 or more smaller blocks make up a BP block. For example, in strength-power sports, a 4 weeks block of strength endurance may be combined with a subsequent 4 weeks block of basic strength training to form an 8 weeks accumulation block. The individual blocks (3 ± 2 weeks) have been termed summated microcycles as the fitness characteristic being emphasized is constant throughout (40,41,195–197,200).

A fundamental axiom of BP (and periodization in general) is that within a stage, the blocks must be sequenced logically in order to produce the desired effects. For example, if explosive strength (RFD) and power output are the primary goals, the sequence typically proceeds as shown in Figure 8.

In this example (Figure 8), during the realization phase, note that a short (1 week) planned overreaching (POR) period precedes the taper. Some evidence and careful observation indicate that a brief return to higher volume training with relatively high loading will further enhance the accumulation phase adaptations and enhance the residual effects thus leading to greater realization of performance (8,9,24,25,199,200).

<table>
<thead>
<tr>
<th>Table 4</th>
<th>Primary differences between block and traditional periodization.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td>BPm</td>
</tr>
<tr>
<td>Development of skills and fitness characteristics</td>
<td>Simultaneous</td>
</tr>
<tr>
<td>Training variable compatibility</td>
<td>Low</td>
</tr>
<tr>
<td>Training load concentration</td>
<td>Low</td>
</tr>
<tr>
<td>Relative difficulty for</td>
<td>High</td>
</tr>
<tr>
<td>Fatigue management</td>
<td>Training periods</td>
</tr>
<tr>
<td>Focal emphasis</td>
<td>Cumulative</td>
</tr>
<tr>
<td>Background/framework</td>
<td>Moderate</td>
</tr>
<tr>
<td>Potential compatibility with calendar</td>
<td></td>
</tr>
</tbody>
</table>

*BPm = multifactor block periodization; BPs = single factor block periodization.

Figure 9. Example of a multifactor/semi-unidirectional block periodization (BP) paradigm for collegiate (division 1) basketball. SE = strength endurance, PE = power endurance, OR = planned overreaching (POR).
Problems With Single Factor Block Periodization

As previously noted for traditional periodization, single factor BP is not always suitable for team sports requiring multiple fitness and technical factors to be improved simultaneously (23,107,138). This simultaneous improvement of various technical and fitness aspects is particularly important for high-school and collegiate team sports in the United States (and some other countries with similar systems). This is related to the limited time periods from the end of an active rest or holiday (such as summer break) and the first game of the season. Often this period of time is only 2–3 weeks. In any case, it became quite obvious that some aspects of training did not always carryover or some important factor did not develop at the appropriate time. Multiple factor periodization concepts were developed to help obviate these problems (89,90). Multiple factor (target) BP can present challenges:

- Several factors—sometimes not completely compatible, must be trained early in process (win every game)—however, some types of multiple factor concentration must take place to take advantage of residual effects—thus this training paradigm is semiuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniuniu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Although various factors are being trained simultaneously, the degree of de-emphasis of noncompatible factors is not as substantial as in single factor paradigms. In this example (Figure 9), note that in the accumulation phase, although basketball practice is minimized, the other fitness variables increase and strength training predominates. However, by the early transmutation phase, basketball practice becomes dominate and the exercise selection during strength training and sprint agility exercise become considerably more task specific. Strength training again briefly predominates during planned overreaching (POR) at the beginning of realization. Exercises become more task specific and power oriented as volume decreases during the taper portion of realization.

### Evidence of Block Periodization Efficacy

This section will deal with evidence that BP produces superior performance alterations compared with other methods of training. It should be noted that the programming of these comparisons would affect the outcome—a factor discussed later in this article. We are also limiting the evidence presented to studies using athletes or very well-trained subjects using sport training paradigms in which training was performed in addition to resistance training. The studies range from a few weeks to years. Although there have been a few comparisons which do not favor BP, we note that none of the studies we have been able to locate indicated that BP was not at least equal in effecting performance (67,97). Tables 5–8 illustrate results of comparisons. These studies indicate that BP can be a very efficacious and typically superior method of training.

**Programming Considerations: Details, Subtleties, and Nuances**

As noted previously, programming drives periodization. This means that to "cause" a periodization block to produce desired effects, sets, repetitions, exercise selection, etc., must be chosen so that the desired result has a strong potential for success (32,206). Although this section is not meant to be all inclusive of programming details and nuances, there are several important considerations:

- Generally large multijoint (MJ) exercises typically affect greater physiological adaptations or more efficiently

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**Table 7**

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multifactor BP for strength-power sports.*</td>
<td>3 blocks: strength-power, speed and intensity, game practice; 2 cycles (6 EM basketball)—no comparison group (23 and 19 wks)</td>
<td>Significant gains in jump performance; game activities not reported</td>
</tr>
<tr>
<td>Porta and Sanz (165)</td>
<td>Annual plan based on 3 block types, single case study elite M tennis player (3 y)</td>
<td>Outstanding performances of Carlos Moya in 2002–2004</td>
</tr>
<tr>
<td>de Souza et al. (39)</td>
<td>BP program (4 blocks: strength, power, speed, and practice; 11 EM team handball) comparison group (16 wks)</td>
<td>Significant gains in jump performances, agility, anaerobic, and games activities not reported</td>
</tr>
<tr>
<td>Campeiz and de Oliveira (23)</td>
<td>Seasonal program including blocks of highly concentrated strength/power training (16 EM soccer) (1 y)</td>
<td>Significant gains of anaerobic power, decreased body fat, and games activities not reported</td>
</tr>
<tr>
<td>Marques et al. (118)</td>
<td>BP: 5-wk accumulation phase, 5-wk transmutation, 3-wk realization phase (21 EM and 11 NatM judo players (13 wk)</td>
<td>Statistical increase in SJFT</td>
</tr>
<tr>
<td>Comparisons vs traditional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bartxömei et al. (6)</td>
<td>BP vs. trad: 3 blocks (SE, S, and P) 25 strength and power athletes competing in track and field throwing events or in rugby and American football in the Italian leagues (15 wk)</td>
<td>BP &gt; trad: 1 RM bench and bench power</td>
</tr>
<tr>
<td>Piñuela et al. (163)</td>
<td>BP vs trad (6 EM soccer) (10 d)</td>
<td>BP &gt; trad: CMJ, no sprint differences</td>
</tr>
<tr>
<td>Rannestad et al. (172)</td>
<td>BP (wks 1, 3,4,5, and 6 strength training; wks 2 and 5 HIT aerobic vs. trad mixed methods (Hockey) (6 wk)</td>
<td>BP &gt; trad: peak torque knee extension knee at 60° × s⁻¹, mean power output during a 30-s cycling sprint</td>
</tr>
</tbody>
</table>

*1 RM = 1 repetition maximum; CMJ = countermovement vertical jump; EM = elite male; HIT = high intensity training; SJFT = static jump flight time.

**Table 8**

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multifactor BP—team sports with strong endurance component.*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparison with different methods</td>
<td>Aerobic block versus dribbling drills (20 EM soccer) (10 d)</td>
<td>BP &gt; DD: ( \dot{V}O_2)max—favorable game activity?</td>
</tr>
<tr>
<td>Stolen et al. (185)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Characterization/compare with previous training</td>
<td>BP annual plan based on 3 block types, 4 seasons, 77 elite soccer players (4 y)</td>
<td>Significantly better performances after realization block and mesocycle</td>
</tr>
<tr>
<td>Mallo et al. (115)</td>
<td>Annual plan divided into 5 stages with 3 block types; (22 EM soccer players (1 y)</td>
<td>Significant gains in jumping performance, sprint, and Yo-Yo test</td>
</tr>
<tr>
<td>Mallo (116)</td>
<td>Single block of aerobic HIT program; (12 SE soccer players (13 d)</td>
<td>Significant gains in RSA (46%) and Yo-Yo endurance (24%)</td>
</tr>
<tr>
<td>Wahl et al. (232)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*HIT = high intensity training; DD = dribbling drills; RSA = repeated sprint ability. These studies were conducted in a variety of activities and sports requiring different physiological and performance characteristics.
produced performance alterations and typically provide greater transfer to sport-related variables and sport performance (92,113,160,198,206).

Exercise order during a session makes a difference—the most important exercises should be programmed first. Typically, this requires large muscle mass, MJ exercises to be performed first. There are 2 major reasons to use this order: first, the intensity falls off as a session moves forward which can affect the level of adaptation in more important exercises, and second, it is possible that small muscle mass exercises first may fatigue stabilizers increasing injury potential during large MJ exercises (3,4,42,77,177–179,190).

The session order likely makes a difference, simultaneous endurance activities can interfere with strength-power adaptations, particularly explosive strength (RFD) and high velocity movements (62). Especially for athletes using multiple sessions per day, placing the strength training session first (or in some cases on a different day) may reduce or eliminate the interference effects (43,45,146).

Although it is not clear, some evidence suggests that combining high intensities of training with low aerobic intensities or very low volumes creates less interference during typical long slow distance training (127,183). Importantly, very short bouts of high intensity interval activity such as sprints also seem to minimize the effects of concurrent training interference from typically associated with endurance training and likely offer superior benefits for strength-power athletes (128).

Within the microcycle, programming wave-like loading from day to day or week to week seems to enhance training outcomes (40,41,163,190,197). These findings encompass a variety of sports and resistance training (19,20,25,55,156,158).

For resistance training, and likely other forms of training (55), combination training (heavy plus light loading) creates a wave-like variation throughout a microcycle and makes a positive difference in performance adaptation, particularly RFD and power output. This training method can be combined into the same training session (208–210) or take the form of unload weeks and heavy and light days.

### Table 9

**Example of exercises used to create a strength emphasis, power emphasis, and power and explosive emphasis.**

<table>
<thead>
<tr>
<th>Strength emphasis (Figure 10A)</th>
<th>Wednesday</th>
<th>Saturday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday and Thursday Squats</td>
<td>Power snatch (very light)</td>
<td>Power snatch (very light)</td>
</tr>
<tr>
<td></td>
<td>Push press</td>
<td>Snatch grip shrugs*</td>
</tr>
<tr>
<td></td>
<td>Bench press</td>
<td>Snatch pulls (floor)</td>
</tr>
<tr>
<td>Dips†</td>
<td></td>
<td>Bent over rows†</td>
</tr>
<tr>
<td>Tuesday and Friday</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short (15–20 m) sprint build-ups</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy med ball (backward overhead throw)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sit-ups (3 × 10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lying windshield wipers (3 × 10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stretching</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power emphasis (Figure 10B)</th>
<th>Wednesday</th>
<th>Saturday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday and Thursday 1/3 squats (power rack)</td>
<td>Power snatch (very light)</td>
<td>Power snatch (very light)</td>
</tr>
<tr>
<td>Push jerk</td>
<td>Snatch grip shrugs*</td>
<td></td>
</tr>
<tr>
<td>Incline press</td>
<td>Snatch pulls (mid-thigh pulls from blocks)</td>
<td></td>
</tr>
<tr>
<td>Dips†</td>
<td>Pull-ups</td>
<td></td>
</tr>
<tr>
<td>Tuesday and Friday</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short (15–20 m) sprint build-ups</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incremental med ball (backward overhead throw)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sit-ups (3 × 10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lying windshield wipers (3 × 10)</td>
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<tr>
<td>Stretching</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power and explosive emphasis (Figure 10C)</th>
<th>Wednesday</th>
<th>Saturday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday and Thursday 1/4 squats (power rack)‡</td>
<td>Power snatch (very light)</td>
<td>Power snatch (very light)</td>
</tr>
<tr>
<td>Box jumps‡</td>
<td>Snatch grip shrugs*</td>
<td></td>
</tr>
<tr>
<td>10° incline press (dumbbells)</td>
<td>Power snatch</td>
<td></td>
</tr>
<tr>
<td>Tuesday and Friday</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short (15–20 m) sprint build-ups</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incremental med ball (forward and side from 1/4 squat)</td>
<td></td>
<td></td>
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<tr>
<td>Sit-ups (3 × 10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lying windshield wipers (3 × 10)</td>
<td></td>
<td></td>
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<tr>
<td>Stretching</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Pull first repetition from floor.
†Assistance exercises (volume not included).
‡Complex with 1/4 squats (vest: loaded up to 5% of 1 RM squat).
§Strength emphasis and power emphasis that the exercises do not always have to change substantially to change the programming emphasis (Figures 6A, B). Typically, major exercise alterations should be made during the realization block to better ensure task-specificity is being addressed. These task-specific alterations are not only movement pattern based but should also include an emphasis on explosive strength (RFD) and power output. It should also be noted that combination training heavy and light days cannot be effectively accomplished when training to failure. Training to failure entails a consistent relative maximum effort, resulting in poor fatigue management and inability to achieve a true loading spectrum (25,136).
Heavy and light resistance training days (24, 158, 159) typically consist of reduced loading (10–20%) and volume load on the light day and not training to failure as this would obviate the contrasting effects (failure always produces a relative maximum). This method (Table 9, Figure 10A–C) can also be integrated such that combination training can take place both within a training day and also across the microcycle (heavy and light days) and is commonly used in resistance training (25, 40, 41, 78, 158).

There seems to be 2 important aspects to this method of training that may enhance performance adaptations. First is fatigue management (40, 41, 188, 189). Indeed, programming paradigms using unload weeks and heavy and light days can reduce training strain and monotony compared with programs using less variation (25, 158). The second aspect deals with providing a diverse loading scheme which results in a spectrum of force, RFD, velocity, and power outputs across a training session and through each microcycle (heavy and light days) and is commonly used in resistance training (25, 40, 41, 78, 158).

There seems to be 2 important aspects to this method of training that may enhance performance adaptations. First is fatigue management (40, 41, 188, 189). Indeed, programming paradigms using unload weeks and heavy and light days can reduce training strain and monotony compared with programs using less variation (25, 158). The second aspect deals with providing a diverse loading scheme which results in a spectrum of force, RFD, velocity, and power outputs across a training session and through each microcycle (heavy and light days) and is commonly used in resistance training (25, 40, 41, 78, 158).

It should be noted that this concept of combined training does not mean that one factor cannot be emphasized at specific times. Figures 10A–C provides examples of different emphases for advanced athletes (Table 9).

- Concentrated load: normally associated with single factor BP and individual sports but is often incorporated into team sport programs in the “off” season. Typically, one summed microcycle (4–6 weeks) that takes advantage of unidirectional stimuli (concentration) and volume alterations. The final effect is due to the interplay of a concentrated stimulus and volume manipulations. The concentration can be one of any fitness characteristics (e.g., strength endurance, strength, power etc.). Primary performance may decrease during the CL. After returning to more normal training, there can be a DTE causing an increased performance (222).

A type of CL referred to as POR is a short-term period of very high volume or intensity (1–2 weeks). Performance often shows a decrease during the POR phase. After returning to normal volume training, as with a CL, there can be a DTE causing a more stable or often an increased performance. The POR likely causes additional adaptations beyond normal training (8, 188, 203). The POR should be applied suddenly, represent a substantial increase in loading, and result in a considerable perturbation in homeostasis. Some data indicate that well-trained and advanced athletes respond to the POR better than lesser trained athletes (58, 82). Often a primary vehicle for the POR is an increase in basic strength training (8, 82). When the POR precedes a taper, this may increase the performance enhancement effects of the taper (8, 82, 200). Figure 11 shows the expected theoretical effects of a POR coupled with a taper.
This section has summarized many of the most important aspects of programming that affect the outcome of periodization blocks, the stage and the final outcome of a periodization process. We have not discussed several programming methods such as polarized training for endurance, cluster sets, complex sets, etc. because this is beyond the scope of this review. For strength-power training, and a more detailed discussion of exercise selection, sets, and repetitions, etc., the reader is referred to Carroll et al. (25); DeWeese et al. (40,41), Haff et al. (74) and Haff and Nimphius (73). For endurance training and accompanying strength training, the reader is referred to Shumann et al. (74) and Haff and Ronnestad (175).

**Criticisms of Periodization and Block Periodization and Factors Effecting the Mechanistic Paradigm**

The following are criticisms of “periodization” often noted in the literature (and unfortunately social media). We briefly address these criticisms:

*Periodization was Created for the Management of Resistance Training Along With Other Stressors.* One common misconception often encountered in the literature is the implication that periodization was developed to incorporate resistance training into an overall training management structure (16). Although there is no doubt that resistance training should be an essential component of human performance development, there is no evidence that we are aware of that indicates that periodization was created or developed to specifically incorporate resistance training into a periodized program, integrated, or stand alone. As noted in the introduction of this article, periodization did not come into being with Matveyev as it was developed and historically evolved as a concept for the integration and management of all aspects of training, not specifically resistance training (32,89,90). Furthermore, there have been several studies that examine “periodization” (programming) simultaneously with other “stressors” (24,25,78,105,158,159).

*Periodization and Programming are Often Confused.* From a conceptual paradigm, it is apparent that many authors are still confusing periodization with programming (32,86,186). In brief, periodization is a conceptual athlete management system dealing with periodic timelines and fitness phases; depending on the goal of the training process, it creates time direction of training volume, intensity, and task specificity factors. For example, a goal for most sports is to increase strength, power, and velocity of movement, generally the conceptual paradigm moves from higher to lower volume, lower to higher intensity, and less task specific to more task specific (32,40,164). Programming “drives” the periodization phases as properly applied programming creates the appropriate physiological and psychological environment in order for the appropriate adaptations during a specific phase to take place. Thus, programming includes exercise selections, loading parameters, rest periods, etc. (32). For example, Buckner et al. (16) indicate that the periodization conceptual paradigm is flawed and does not work, particularly for resistance training. Part of this criticism stems from the idea that periodization is not “flexible” enough to meet athlete needs. Much of this type of criticism usually stems from the often erroneously stated and very typical confusion of periodization with programming (32,86). As a result of this misunderstanding, several forms of programming such as “autoregulatory periodization” “flexible periodization,” “tactical/technical periodization,” “agile periodization,” etc. have been created that are purported to offer increased flexibility and address the individual characteristics and attributes of athletes (86,100). However, none of these programming models adequately address the basic tenants of periodization (86), particularly for long-term development. It should be noted that substantial flexibility for

![Figure 11. Planned overreaching: volume load (usually accompanied by intensity) is substantially increased above that of “normal training” loads. Combination heavy-light loading still occurs through the planned overreaching (POR) phase (Figures 10A–C). Evidence indicates that in many cases, as with a typical concentrated load, performance and the T:C ratio may decrease during this phase. Evidence further indicates that there can be a performance “supercompensation” that occurs with a return of the T:C ratio to normal or higher, especially if the POR is accompanied by a taper.](image-url)
individualization, and thus a substantial degree of “autoreregulation” can be built into appropriate programming schemes (e.g., ranges of intensity and work within set-rep schemes), individualized warm-up protocols, individualized relative intensities, individualized rest periods, monitoring induced alterations, etc. (32,40,41). Furthermore, a substantial degree of flexibility can be built into the periodization paradigm itself. Typically for most sports, the periodization paradigm proceeds from high to low volume. However, these phases can be reversed for some sports to produce somewhat different effects often enhancing specific endurance factors (69). In addition, the length of time that a phase lasts can be altered based on a number of factors, including the competition calendar, the trained state, or the level of accumulated fatigue carried over from the previous stage. Using BP as an example, if the time from the last active rest stage until the next important competition is 8 weeks then several variations of the block time periods could occur, for example,

In underdeveloped athlete (based on monitoring):
Accumulation (3 weeks), transmutation (3 weeks), and realization (2 weeks).
In an elite athlete in good condition (based on monitoring):
Accumulation (1 week), transmutation (4 weeks), and realization (3 weeks).
In addition, if, based on monitoring, illness, injury etc., expected development is not occurring during a specific periodization block (or a CL), a different block can be substituted such that appropriate development resumes. Thus, there can be considerable individualization and flexibility within both the paradigm of periodization and the programming constructs.

For resistance training, there are 2 primary reasons underlying this criticism: first, it is indicated (16) that increases in muscle cross-sectional area (CSA [hypertrophy]) from resistance training do not contribute to strength gains and thus an initial high-volume phase is unnecessary. Indeed, an initial alteration in body composition (including myofibrillar hypertrophy) is conceptually (along with the more important increased work capacity) a tenet of resistance training periodization aimed at increased strength, RFD, power, etc. From a periodization and programming standpoint, the initial hypertrophic gains are not only related to strength gains but also likely potentiate later gains in strength and related characteristics across subsequent training phases. From a logical conceptual aspect, the paradigm of first increasing muscle CSA to potentiate strength (and power) gains have been around for a considerable length of time (137) and have substantial theoretical support (114,119,133,213,239). In brief, we believe that there is sufficient evidence indicating that resistance trained hypertrophy, along with other factors, does in fact enhance maximum strength and related characteristics. CSA enhancement magnitude depends on several factors including training methods and trained state. Compared wi other factors such as neurological adaptations, selective motor unit hypertrophy, tissue stiffness etc., it is likely that the whole muscle hypertrophy impact on maximum strength and related factors is relatively small, particularly in early phases of training. However, total hypertrophy (myofibrillar) resulting from long-term resistance training does substantially contribute to strength development (114). We also note that there is evidence from both early muscle activation and CSA studies (75,139) and later studies (33,37) indicating that the initial gains (up to 6–8 weeks) in hypertrophy (myofibrillar) are negligible to small and likely do not contribute markedly to increased maximum strength because these hypertrophic gains are largely edema or sarcoplasmic (169). However, this evidence also suggests that later alterations (after ~8 weeks) in CSA (myofibrillar) can begin to contribute to alterations in strength and related characteristics (114,219). This idea is in concert with most studies with which we are familiar. Thus, there is (and has been) ample evidence to understand why initial resistance-trained increases in CSA do not always associate with gains in strength and related characteristics, particularly among untrained and minimally trained subjects.

Second, it has also been indicated that variation in training is largely unnecessary and that there is little or no evidence to support the need for variation in resistance training or in periodization programming or for that matter periodization in general (16). However, consider simple observation, subjects including athletes cannot typically tolerate constant high volume or heavy MJ exercise loading for extended periods without experiencing nonfunctional overreaching or perhaps overtraining and certainly increased injury potential. Indeed, in pilot studies in our laboratory results (Auburn, Edith Cowen University, East Tennessee State University, and West Virginia University), we noted that subjects, from a spectrum of training backgrounds, performing MJ, heavy loading (95–100% of 1 RM), constant heavy loading for the required set and repetition scheme (for example: 3 × 5 at 95–100%), or high-volume training could at best

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**Figure 12.** Block periodization as part of the traditional paradigm (Matveyev’s terminology).
only increase or maintain performance (1 RM, sprints, and jumps) for about 4–5 weeks—longer periods resulted in performance declines. This agrees with the observations of Fry et al. (60,61). In addition, if Buckner et al. (16) are correct then rearranging the phases of periodization would make no difference in the outcome; however, this does not seem to be the case. For example, in several studies, researchers have reversed the order of fitness phases (and therefore programming) from typical and found different outcomes, sometimes subtle, nevertheless different (2,26–28,69). This evidence also includes resistance training (166,168). It should be noted that in many of the early resistance training studies, researchers examined programming using variation versus various constant repetition programming schemes with high and low volumes, to failure and not to failure (124,155,191,192,204,234,235). In each case, the variation group produced superior results. A recent systematic review indicates that providing essentially the same training stimulus for “greater than 6 weeks could result in a plateau in maximal strength development, necessitating training variation to elicit further improvement” (207). In addition, there is evidence indicating that how the programming variation is structured in a periodization and programming context can also make a difference in maximum strength, power, motor unit (MU) type selective hypertrophy, and fatigue management (24,25,134,158,159). Indeed, most reviews and meta-analyses have concluded that periodization and appropriate programming offer advantages over other methodologies (47,164,167) (Table 1).

Resistance Training Gains in Performance are the Result of Specificity and Neural Adaptation. It has also been suggested that gains in resistance-induced gains in strength are simply because of “specificity” of training and is largely a nervous system phenomenon (16). At best, this is an oversimplification of training adaptation. Clearly the nervous system, muscle CSA and architecture, tissue stiffness, training with the “intent” to maximally activate muscle(s) impact physiological and cognitive characteristics (54,63,103,119,184,186,214,215). However, adaptations in each underlying mechanism are potentially affected by “specificity.” As “specificity” and the physiological (and likely psychological) adaptation aspects also impact the “transfer of training effect”; specificity becomes an extremely important factor for appropriately training variables. For example, from the standpoint of mechanical specificity, appropriate manipulation of exercises and other training variables (e.g., load, volume, etc.) become paramount in optimizing transfer from training to performance (138,140,198,206). Although attempting to measure (only) nonspecific alterations in strength may be interesting, it does not provide adequate insights into potential transfer. Additional insight into possible transferability can be examined by using exercise measurement specificity along with concurrent calculation of alterations in appropriate performance variables.

Resistance Training to Failure is Necessary for Optimum Gains. From a programming standpoint, it has been suggested that training to or near failure using a load (≈30–85% of IRM) largely determined by preference is sufficient for optimum hypertrophy (16,70) or for maximal strength (50,51).

As a training concept, this suggestion is rather remarkable considering most well-conducted studies, and reviews have indicated that training to failure is unnecessary, can be counterproductive, and loading does make a difference for maximum strength and power outcomes, particularly with MJ movements (24,25,33,70,95,96,109,117,153,207). Although the degree of hypertrophy may be unclear, the type of hypertrophy produced as a result of low load and high repetitions versus high load/low repetitions and ballistic movements may be different. Type II fibers produce somewhat greater specific tension, substantially higher rates of force development, velocities, and power outputs (13,127,129). Although training to failure, as a result of fatigue, can recruit high threshold MU’s, recruitment seems to be incomplete and selective (110,132). Training to failure, particularly with higher repetitions, tends to select Type I MU and heavier loading and ballistic movements targeting type II MU (24,37,152,153,229). In addition, evidence indicates that endurance training can interfere with strength training adaptations (62,236). Many athletes who depend on an endurance factor as well as strength and speed-related factors (e.g., soccer) use training that relies heavily on both aspects of training. Of interests would be the possibility that typical endurance training, increases the fiber type selectivity of strength training to failure, particularly using higher repetitions, thus substantially altering the fiber type mix-up of muscle, especially the IId ratio.

There is evidence from reviews of the literature (213) and both cross-sectional (59,127,129) and longitudinal studies (24,134,153) indicating that selective hypertrophy can result from different resistance training programs with different loading schemes without training to failure. These observations likely play an important role in the training outcomes and performance capabilities of athletes, particularly strength-power athletes (127,129). There are No Long-Term Studies Dealing With Periodization. One criticism that we do agree with (partially) is that few long-term experimental studies have been performed, particularly for resistance training. Although this is certainly true for typical experimental studies for a number of reasons (e.g., time constraints, subject availability, athlete availability, adequate funding, ecological validity versus internal validity, etc.), it has not been true for observational and descriptive studies. These observational studies, many of which lasted several years, included many of the original studies of Matveyev (120), Nadori (149,150), Verkoshansky (220), etc. More recent long-term observational and descriptive studies have dealt with a number of periodization related factors including performance-related variables, sport performance, and injuries and have included a variety of sports such as swimming (82), volleyball (181), orienteering (211), cross-country skiing and biathlon (147,176,182,212), and weightlifting (21). These types of studies and observations are especially important because they were performing observing athletes in their normal environment, thus maintaining ecological validity.

A Final Thought

Classical periodization has been shown to produce superior results for many sports. One important criticism of BP is that by breaking up the training process over a macrocycle into many small blocks, attaining high levels of fitness and development of the athlete may not be possible (107,111,112). Indeed, appropriate sequencing and programming BP stages over a macrocycle often follow a more traditional pattern of periodization. Note in the example presented in Figure 12, representing a process for an advanced athlete, there are 3 stages in a 34 weeks macrocycle. In keeping with traditional tenants, the greatest emphasis on developing “general” fitness occurs in the first stage. Thus, the first accumulation and transmutation blocks contain the greatest volume of training relative to the same blocks later in the macrocycle. After each active rest phase, there is a return to the accumulation block, and high levels of general fitness are re-established. Note that after the initial block each accumulation and transmutation block is smaller in extent as are the transmutation

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blocks. This is based on (a) there is sufficient loading during active rest that “fitness” does not decline to baseline and (b) residual effects and retaining a reasonable level of “general” and “specialized” fitness; thus, extensive accumulation and transmutation phases are not needed, and more time can be spent on realization. Programming additional “waves and oscillations” such as heavy and light days, unload weeks, etc. are still intact. Thus, in this context, BP can be viewed as an integral part of traditional periodization. Indeed, both single factor and multiple factor BP would be compatible with this concept (Figure 12) as the programming for each phase could be appropriately adjusted to accommodate team or individual sports.

Summary

Periodization is a logical phasic method of managing fitness phases and timelines for athletes. Through appropriate programming, alterations in training variables can be made such that, qualitatively, predictions can be made as to when peak preparedness and performance are likely to occur. As a concept periodization has a long and rich history of evolution into the 2 current paradigms of Traditional Periodization and BP. Block periodization has evolved and developed into 2 sub-types, single-factor (one primary performance goal) and multi-factor (several primary goals). Block periodization is a process of micromanagement and consists of factors (e.g., exercise selection, sets, repetitions, etc.) that drive the periodization blocks toward completion. Considerable evidence indicates that periodization and proper programming can produce superior results compared with other methods of training.

No conceptual paradigm with which we are familiar is without problems. However, many of the criticisms leveled at periodization are without merit. These criticisms have been addressed to ensure the reader and practitioner are not misled.

Practical Applications

This narrative review has presented evidence for the efficacy and efficiency of Periodization and appropriate programming. Periodization and programming has considerable means for variation and flexibility when properly integrated into the training process. There are two different types of Periodization: Traditional and Block. Block has 2 subtypes, Single and multiple goal. Coaches should carefully, and critically examine the sports with which they are involved and integrate a periodization and programming model appropriate for these sports.

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