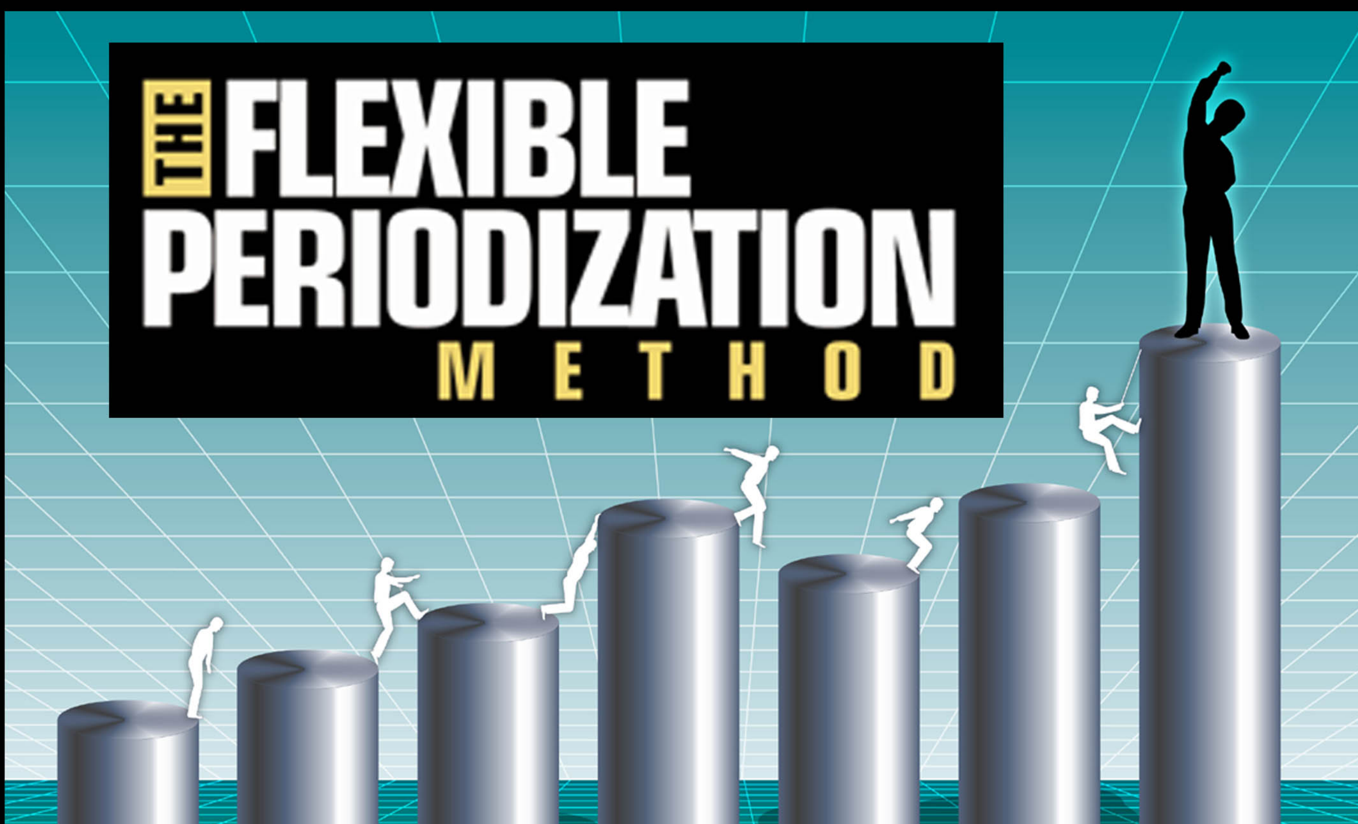
PERIODIZATION SIMPLIFIED

How to Use



on the "Fly"

YES TO STRENGTH

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PREFACE

The Flexible Periodization Method (FPM) is the first holistic method of periodization dedicated to highly individualized training programs for the fitness client, the world class athlete and everyone in between.

Karsten’s research, contemplation and application of periodization principles started in the early 90s. It was during his work in the Danish sports system (Team Denmark) where he was hired (in 1999) to create individualized training programs for the Danish world class and Olympic athletes that his focus on individualized training programs was intensified.

One characteristic of a good periodization method is that the method provides answers to all the questions a strength coach or personal trainer has during the process of creating training programs. Studying all available literature on periodization Karsten learned a lot, but always felt that “something” was missing.

Around 2004, Karsten realized that a separate system – The Flexible Periodization Method - was taking shape. The FPM is characterized by:

- The allowance for all known loading patterns. Thus, the FPM is a system of systems.
- Providing guidance on the periodization of all program variables.
- Identifying individual weak links to avoid a “great program with the wrong goals.”
- Not being associated with any specific program – the only way a program made with the FPM can be recognized is by the results produced by the athlete/fitness client who is following the program.

Olympic medalists in Athens 2004 were some of the first athletes to use the FPM. Since then, many world class and Olympic athletes have benefitted from the highly individualized programs created with this unique method.

The Flexible Periodization Method (the book) was released in 2010. Part 1 of the book focuses on the principles of the FPM. Karsten has taught these principles in a two-day workshop format together with the rest of the FPM but gradually realized – through feedback from workshop participants – that the amount of information was so overwhelming that the learning outcome would improve by dedicating a full day to the principles of the FPM.

Additionally, he has received ample feedback that many strength coaches/personal trainers are interested in periodization, but they do not necessarily have the time required to create written training programs in a long-term format.

Periodization Simplified – How to Use the Flexible Periodization Method on the Fly provides an updated and expanded version of the principles behind the FPM (part 1 of the book) and practical guidelines for using these principles without a written training plan.

What is a principle? A "principle" is a basic truth, law or assumption (thefreedictionary.com). A "principle" can also mean a "pre-determined or fixed policy or mode of action". The principles of the FPM take either the shape of a basic truth or a mode of action.

INTRODUCTION

How to Use this Manual

Periodization Simplified – How to Use The Flexible Periodization Method "on the Fly" forms the foundation for working with the FPM both if your intent is to create programs *on the fly*, and/or if you intend to use the FPM to the fullest extent.

Using the FPM *on the fly*

Become overall familiar with each principle. Then:

1. Consider any principle that you think would be useful to apply to the program of a current athlete or client.
2. Read the section about that principle.
3. Follow the guidelines for applying the principle that are suggested at the end of each section.

Repeat the above process with any other principle should you chose to do so.

Using the FPM to the fullest extent:

1. Study all the principles carefully.
2. When you feel that you understand all the principles consider moving forward with one or more of the eight Yes To Strength workshops/manuals that focus on the descriptions of various types of training with the 7 blocks of the Flexible Periodization Method.
    - ***Periodization of Flexibility Training*** – Why Flexibility is Developed Before Strength, Speed, Power or Endurance
    - ***Beyond "Functional Training"*** - Periodization of Exercise Selection
    - ***Tempo Matrix*** - Why Repetition Tempo is Important and How to Periodize it Using The Flexible Periodization Method
    - ***Maximal Strength*** - How to Manifest Untapped Potential For Strength Using The Flexible Periodization Method
    - ***Power*** - How to Manifest Untapped Potential for Power Using The Flexible Periodization Method
    - ***Speed and Endurance*** - Manifest Untapped Potential for Speed and Endurance with The Flexible Periodization Method
    - ***Needs Analysis for Sports*** - The Foundation of Success with The Flexible Periodization Method.
    - ***Are Your Programs H.I.P.*** – How to Create Holistic, Individualized, Periodized Training Programs Using The Flexible Periodization Method.

PRINCIPLE #1

Scientific Studies and Fundamental Physiological Models Form the Rationale for Periodization

What is periodization? Is there a benefit to creating training programs based on principles of periodization? If so, what are the reasons why periodization is effective?

1a. What is periodization?

Appendix 3 provides a review of various definitions of periodization. These definitions are characterized by variations in the exact wording but similarity in meaning and content.

The non-technical definition, according to the dictionary, is that ***periodization** is a division into periods.* [21]

With the FPM, the technical definition of **Periodization** is a division of a longer training cycle into periods with different goals, structures and content of the training program.

These periods, with different goals, different structures and different content are **sequenced** in such a way that **selected physical abilities** are maximized at the goal attainment date.

1b. Is there a benefit to creating training programs based on the principles of periodization?

Training literature contains many studies that claim to research periodization. Most of these studies focus on resistance training. A much smaller number focus on speed-endurance-cardiovascular training (S.E.C. training). There is some disagreement in the training literature about the conclusions of these studies.

Today, 12 periodization systems exist. [41] Major periodization systems include:

- linear periodization
- reverse linear periodization
- daily undulating periodization
- conjugate periodization
- block periodization
- The Flexible Periodization Method

Research has been conducted on linear, reverse linear, daily undulating and block periodization.[42] Some researchers conclude that “comparative studies of non-varied programs and periodized programs in which serial testing was performed demonstrate that non-varied programs can result in training plateaus, whereas, periodized programs result in more consistent fitness gains.” [1]

Other researchers are of the opinion that despite the large number of controlled studies on periodization, the scientific evidence for periodization is lacking and that the studies that are conducted mainly serve to prove that variation is important. (38)

A real-life training scenario, particularly in the long-term (years) range, is affected by so many factors that it makes scientific studies challenging. Within the FPM, the body of scientific studies is seen as very important and useful pieces of a larger puzzle that must be assembled by the coaches and athletes together to create optimal long-term results.

Within the FPM, the following two physiological models are seen as very strong support for periodization as it is defined above.

1c. The Principle of Accommodation

Have you ever experienced athletes or fitness clients making initial gains on a new program only to reach a plateau after a few weeks?

The Principle of Accommodation, often considered a general law in biology, states that the response of a biological object to a constant stimulus decreases over time. (2) In the case of strength and conditioning or fitness training, the "biological object" is the human mind-body and the stimulus is the training load.

The "training load" is not a well-defined term. (3) The word "load" may be understood as the total external force applied TO or BY the human body. (4) The load also has a qualitative component (which structures and systems in the body experience or create the external force).

A training load is created through the use of certain exercises, performed with certain intensities, volumes, rest periods and frequencies.

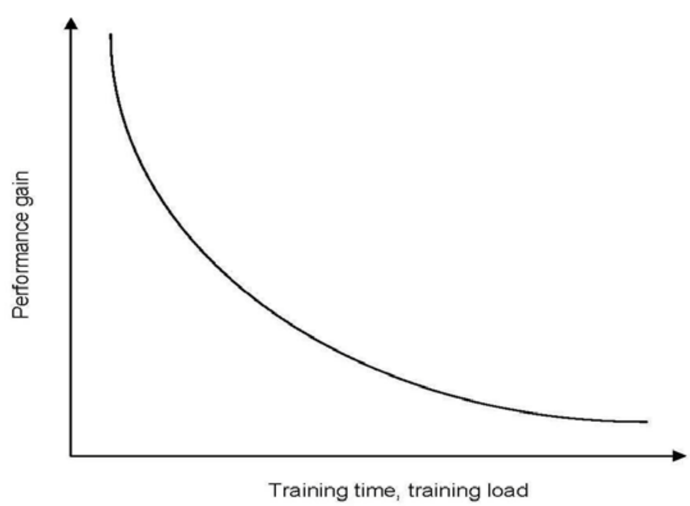

Figure 1c-1: The Principle of Accommodation.

Figure 1.c-1 shows that as a certain training load is repeated over time, the performance gain decreases and the body's response to the training program diminishes. (2)

It is the Principle of Accommodation that is the physiology behind the saying that ***"the best program is the program that you are not using right now."*** The saying points to the fact that any program gets gradually more ineffective (the performance gains drop) every time it is used.

Einstein was quoted for stating that "the definition of insanity is to do the same thing, yet expecting a different result." When the athlete/client has adapted to a program and performance gains are low or non-existent, it is necessary to change one or more program variables in order to stimulate new progress.

If changes are not made to the athlete's/client's training program despite reduced performance gains, the result is monotonous training. [39] Monotonous training is:

- not characterized by high levels of fatigue or any other symptom associated with overtraining (see below).
- an over-adaptation of the central nervous system (CNS) to the same mechanics being repeated over and over.

In conclusion, with the FPM, the Principle of Accommodation is viewed to be mainly about the QUALITY of the training stimulus. When the athlete/client has adapted to the program, one or more program variables must be adjusted for the athlete/client to continue making progress towards the stated objective.

1d. The General Adaptation Syndrome

Have you ever experienced the situation whereby an athlete/client has great energy in some weeks and then a few weeks later becomes exhausted and maybe even acquires an overuse injury?

Canadian biologist, Hans Selye, coined the term General Adaptation Syndrome (GAS) to describe how the adrenal glands respond with an initial alarm reaction followed by a reduction of an organism's function in reaction to a noxious stimulus. The key to the continued adaptation to the stress is the timely removal of the stimulus so that the organism's function can recover. [5]

Former Eastern Block scientists and physicians found similarities between the pattern of the training response in athletes and the stress patterns observed by Selye.

According to the General Adaptation Syndrome, there is a three stage response to the stress. [6]

Stage 1: Alarm Phase – When a new and more intense stress or stimulus (type, volume, intensity) is applied, the first response is the shock or alarm phase that may be characterized by excessive soreness, stiffness and a drop in performance. This phase may last days or weeks.

In some cases, the alarm phase is associated with **depletion** of biochemical substances; for example, glycogen. However, certain texts assert that it has never been proven which substances need to be looked at to understand this process. These texts also deem the GAS as too simple to explain progress. [7]

Stage 2: The Resistance Phase – At any instant the body has a definite ability to respond and adapt to the training stimulus, termed the Current Adaptation Reserves (CAR).[8] The body adapts to the stimulus through various neurological, bio-chemical, structural and mechanical adjustments leading to increased performance. Examples of such adjustments include increased cardiac output and enzyme concentrations (adaptations to aerobic training) and increased neural drive/neural activation (adaptations to resistance training). [9, 10]

In some texts, the resistance phase is referred to as super compensation and is associated with enhanced levels of biochemical substances.

> **Example:** One theory of muscle hypertrophy is called the Energetic Theory of Muscle Hypertrophy. According to this theory, muscle catabolism (breakdown) is stimulated by lack of energy for protein synthesis during resistance training sessions. Thus, DURING sessions, muscle protein can actually DECREASE. Then, during the recovery phase, also known as the resistance or super compensation phase, the balance is reversed and protein synthesis exceeds protein breakdown. The results are a net increase in muscle, also known as myo-fibrillar hypertrophy. [11]

Stage 3: The Exhaustion Phase – If the stress persists for an extended period of time, the body loses the ability to adapt to the stress and soreness, stiffness, staleness and maladaptation may occur.

The exhaustion phase might be seen as the consequence of overwork/overstress that:

- results from the summation of all stressors from training and daily life reaching a total level that becomes too great and the recovery-adaptive processes begin to fail.
- can be divided into **short-term overtraining** - also referred to as overreaching, (acute excessive training or "exhaustion") and **chronic** overtraining (chronic excessive training). [40]
- can be divided into general overwork/overstress that affects the whole body and local overwork/overstress that affects one muscle group. [40]
- is also divided into "sympathetic overstress" and "parasympathetic overstress."

While the General Adaption Syndrome may have its shortcomings in completely explaining the body's response to the training stimulus, it is still a useful model for understanding training progress. The curve on Figure 1d-1 (see following page) can be understood on two different levels. The first level is the neurological, bio-chemical, structural and mechanical changes that underlie a second level that consists of easily observable performance changes.

In relation to periodization, the General Adaptation Syndrome supports the strategy of **alternating** periods with an increased, developmental, stressing training stimulus (training load) with periods consisting of a reduced training stimulus that allows the body to recover and super compensate.

In simpler terms, we can say that the training stimulus must be strong enough and new enough to stimulate the alarm phase. The training stimulus must be applied repeatedly as long as the athlete/client is in the resistance phase. Lastly, the training stimulus must be removed at the beginning of, or early into, the exhaustion phase.

For practical purposes these three phases can be understood in the context of a single workout or to a period of two to three weeks of training.

	Single Workout	2-3 week cycle
Alarm Phase	Soreness stiffness during initial warm up exercises	Post workout soreness lasting for 1-2 days
Resistance Phase	Performance increases during specific warm up and during several work sets (pyramid training)	Performance increases from one workout to the next (reps, load, time etc)
Exhaustion Phase	Performance drops, feelings of exhaustion, potential aches/pains	Smaller increases in performance leading to no increase or drop in performance and potential injury.

Table 1d-1: The Alarm Phase, Resistance Phase and Exhaustion Phase in the context of a single workout or a 2 to 3 week training cycle.

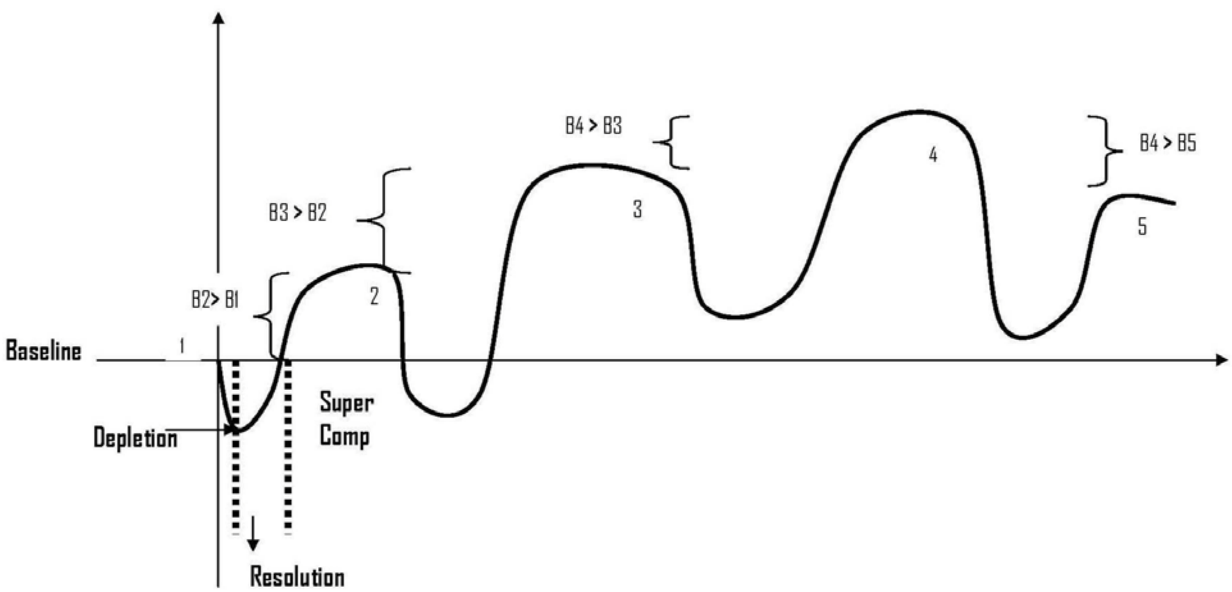

Figure 1.d-1: The General Adaptation Syndrome is a model for showing initial performance improvements that gradually taper off and can continue into performance decrements.

Within the FPM, the General Adaptation Syndrome is seen to be mainly about the QUANTITY of the training stimulus. When the athlete/client reaches the exhaustion stage, it is not enough to do something different, the athlete/client needs rest or active rest to recover and super compensate.

Using Principle #1 of the FPM *on the Fly*

1. If the athlete/client stops making progress, but is not exhausted then adjust one or more program variables to something that is DIFFERENT yet still supportive of the overall objective.
2. If the athlete/client stops making progress AND is exhausted, then reduce the training load until the athlete/client reports good energy. Adjust one or more program variables to resume developmental training with a slightly different program that is still supportive of the overall objective.

PRINCIPLE #2

A Macrocycle is like an 8-Layer Box

Layered boxes are a set of boxes of graduated size, each fitting inside the subsequent larger box. A Layered box is an excellent metaphor for the relationship between the quality of the single repetition and the outcome of the macrocycle.

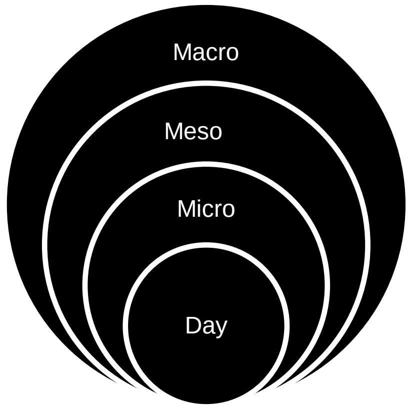

Figure 2-1: Each larger cycle is made up of the smaller cycles.
Each smaller cycle is contained within the larger cycle.

The 8 layers of a macrocycle are the macrocycle itself, the mesocycle, the microcycle, the training day, the individual session, the exercise, the set and the individual repetition. The main focus of Section 2 is to define each layer of the macrocycle and provide an understanding of the relationship between them.

2a. What is the macrocycle?

The **macrocycle** (macro = large) is considered the outermost layer of the 8-layered box.

A typical macrocycle is composed of a preparation period, a tapering period, a competition period and terminated with an active rest period.

Macrocycle			
Preparation	Tapering	Competition	Active Rest

Table 2a-1. A macrocycle consists of a preparation period, tapering period, competition period and active rest period. (Adapted from 22)

In sports, the macrocycle is structured around the most important competitions that occur during the year. Depending on the nature of the sport, some authors see a year as one macrocycle with one to three peaks. [23] However, other experts regard a year as one to three macrocycles with each cycle having one peak.

In sports, the end goal of the physical preparation is to raise the levels of sport-specific strength, power, speed, endurance or a combination of the four qualities. Optimal improvement of these sport-specific qualities involves FIRST improving other goals like structural strength and stabilizer (tonic) endurance as explained in other sections of this manual.

Since the number of physical abilities that can be improved at any one time is limited, the macrocycle is structured as a **sequence of training periods** with a defined purpose of improving different physical abilities (bio-motor abilities - See Appendix 2). [24] (See Table 2a-2)

Preparation Period			
Mesocycle 1	Mesocycle 2	Mesocycle 3	Mesocycle 4
Stabilizer Endurance	Structural Strength	Maximal Strength	Sport Specific Power

Table 2a-2. A macrocycle is a sequence of training periods. (Adapted from 24)

As indicated in the Table 2a-2 above, these training periods are called mesocycles. They form the second layer of the 8-layered box.

The improvements in physical capacity (bio-motor abilities) at the end of the macrocycle are the accumulated improvements of each of the mesocyles.

2b. What is a mesocycle?

The ultimate characteristic of a mesocycle is the targeted training adaptations - the specific physical adaptations that are sought in a particular training cycle.

In the FPM, a **mesocycle is defined as the number of weeks within which the training deals with similar combinations of type2 goals.** (See Appendix 2 for a description of type 2 goals.)

The mesocycle definition above differs somewhat from those in the training literature, which suggest that the length of the mesocycle be two to six weeks. [25]

The duration of the mesocycle is an absolute key to the design of the macrocycle. Each mesocycle must be long enough to allow for stable training adaptations to occur.

> **Stable training adaptations** are training adaptations of the required physical abilities that allow for positive improvements that can be maintained throughout the competitive period.

The duration of the mesocycles are both science-based and empirically based. They are, in general, 3-12 weeks long depending on the:

- athlete's/fitness client's training age.
- athlete's/fitness client's responsiveness.
- the targeted physical adaptations.
- the quality and design of the training program.

The improvements in physical capacity (bio-motor abilities) at the end of each mesocycle are the accumulated improvements of each of the microcycles.

2c. What are microcycles?

The concept of the speed of accommodation is essential in the relationship between the microcycles and the mesocycle.

The speed of accommodation is the number of training sessions it takes for the athlete or fitness client to adapt to a particular program. In order words, the speed of accommodation is the number of workouts it takes for the athlete/fitness client to reach the bottom of the accommodation curve (See Principle #1). It is obviously important that the athlete/fitness client has experienced practically significant adaptations before the bottom of the accommodation curve is reached.

There is no clear science on the speed of accommodation, but the factors listed in Table 2c-1 are important:

Lower	Speed of Accommodation	Higher
Lower	Training Age	Higher
Higher	Complexity of Exercise	Lower
Lower	Initial RPE	Higher
Lower	Skill learning	Higher
Lower	Retention	Higher
Lower	training frequency	Higher

Table 2c-1: A variety of factors affect the speed of accommodation

More specific guidelines for the speed of adaptation are presented in the Table 2c-2:

	Training age (year)	**Flexibility**	**Strength**	**Jump/throw**	**S.E.C.**
Beginner	1	12-16	12-16	12-16	12-16
Beginner-intermediate	2	8-12	8-12	8-12	8-12
Intermediate-advanced	3+	4-8	4-8	4-8	4-8
Extreme		1-4	1-4	1-4	1-4

Table 2c-2: Speed of accommodation based on training age.[26,27,28]

The above values are guidelines. To maximize accuracy in the training programs it is essential to observe the athlete's/client's progress to get the best possible understanding of the individual speed of adaptation. Additional considerations to take into account regarding the optimal length of microcycles include:

- Choosing the right number of sessions is a component of the "art" of program design.
- A good program challenges (new stimulus) the athlete/client to adapt and gives him/her time (sessions) to adapt (maintaining stimulus long enough) - the right length of the microcycle is a "sweet spot" (zone), neither too few, nor too many workouts is ideal.
- **Strategy 1:** Change the program while the adaptation per workout is still high.

- **Strategy 2:** Change the program when the athlete/client has fully adapted and there is little or no adaptation from the individual workout.
- The speed of accommodation also has a mental component. Quick adaptation = athlete/client gets bored quickly. Slow adaptation = athlete client likes to keep things the same.

When the athlete/fitness client has adapted to the program (for example, after 12 workouts) there should be a change to one or more program variables as previously discussed. Thus, with a change to one or more program variables there is a new period (not with new goals because it is still the same mesocycle) with new content and structure of the training.

The number of training sessions it takes for the client to adapt to a specific program is thus a natural unit in the macrocycle. This "number of training sessions it takes for an athlete/fitness client to adapt to a program" is the definition of the microcycle, which corresponds to the definition found in training literature: "a number of training sessions that form a recurrent unit with a period of several days [or weeks]." [23]

A "program" typically includes variation within the theme. Thus, a microcycle is also characterized as described in the box below:

> **A Microcycle is** a number of training sessions built around a given combination of acute program variables, which include progression as well as alternating effort (heavy vs. light days).

When you plan the actual program based on the number of training sessions for a microcycle, the following general guidelines apply:

- Exercise variations that are part of the same method-variation are counted separately.
- Different repetition tempos or contraction types that are part of the same method variation are counted separately.
- Different intensity zones that are part of the same method-variation are counted separately.
- Variations of intensity – within the same zone – are counted together.

When exercise variations, repetition tempos and intensity zone are counted separately, the result is overlapping microcycles that work synergistically.

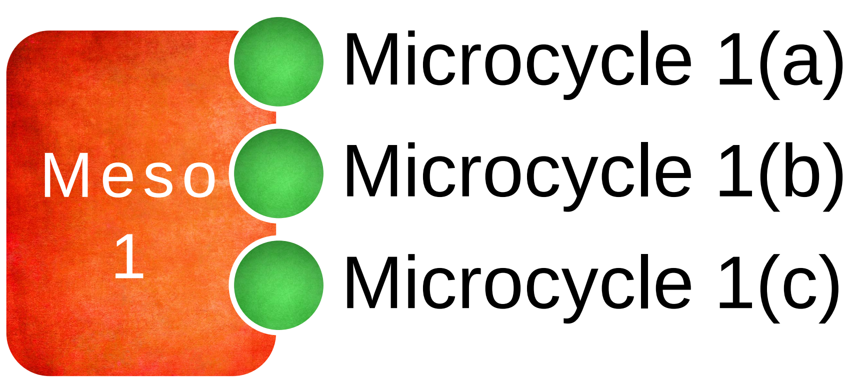

Figure 2c-1: Illustration of one mesocycle that consists of three overlapping microcycles.

If the total number of training sessions in a mesocycle exceeds the speed of accommodation, the mesocycle then consists of more than one microcycle, each with the same target training adaptation (for example, peak power), but with slight differences in structure and content of the training program.

The improvements in physical capacity (bio-motor abilities) at the end of each microcycle are the accumulated improvements of each of the training days.

2d. What is a training day?

A training day is one or more training sessions, with one or multiple purposes, that are performed on the same day.

The improvements in physical capacity (bio-motor abilities) at the end of each training day are the accumulated improvements of each of the training sessions.

2e. What is a training session?

A training session is multiple exercises that are performed with a well-defined purpose and prescribed rest periods.

The improvements in physical capacity (bio-motor abilities) at the end of each training session are the accumulated improvements of each of the exercises.

2f. What is a set, or interval repetition?

A set or an interval repetition is a series of individual movements (for example bench press or rowing strokes) performed with no or – in the case of cluster sets in strength training or jumping/throwing – with prescribed, short rest periods.

The improvements in physical capacity (bio-motor abilities) at the end of each set or interval repetition are the accumulated improvements of each of the individual movements.

In conclusion, there is a direct correlation between the quality of each repetition and the improvements at the end of the macrocycle.

Using Principle #2 of the FPM *on the Fly*

1. Define the length and objectives of the macrocycle.
2. Choose the appropriate content and length of the mesocycles.
3. Initially, use the listed guidelines. Subsequently, observe the athlete's/client's progress to determine the optimal length of the microcycles.
4. Emphasize to the athlete/client the importance of the quality of the individual repetition.

PRINCIPLE #3

Optimal Results are Achieved by Working with, Rather Than Against, Natural Cycles

Dates for peaking as well as the goals, structures and content of training programs may typically be dictated by competition schedules, work schedules, availability of training facilities and other external factors. However, there is ample information to indicate that timing in both longer (year) and shorter (day) natural cycles may affect an athlete's/client's ability to train and respond to training.

The first basic assumption is that better results are achieved if the program design allows the athlete/client to work with, rather than against, these cycles.

The second basic assumption is that the athlete/client can work with these cycles by training MORE when s/he has MORE energy and training LESS, when s/he has LESS energy, thereby "riding the wave" of each cycle.

This section discusses:

- What are some of the natural cycles that may exist?
- How may these cycles affect the athlete's/client's ability to train, adapt to training or compete?
- How is program design affected by taking into account various natural cycles?

3a. Annual cycle

Have you ever analysed whether or not there are certain periods in the year when your clients make most of their gains in physical capacity?

The lowest trainability may be seen during winter months with increases in the spring and a peak during the summer before the trainability drops again in the fall. This variation in trainability might be due to variations in ultra-violet radiation. Treatments with ultra-violet radiation may increase trainability during winter months to the levels of summer months. [29] In support of this information, other research shows that exercise combined with exposure to the sun has a greater effect on stamina, fitness and muscular development than exercise alone. [43]

The positive effects of sunlight have been recognized for a long time:

> "If at all possible, expose the naked body to the sun. Man is a creature of light and air and I should therefore recommend little or no clothing when training."

The quote above can be found in a highly recommended book, *The Way to Live,* by George Hackenschmidt, published in 1935. Hackenschmidt was a famous wrestler and strongman. Among his accomplishments are a one arm barbell snatch with 90kg and somersaults with 50 pound dumbbells.

While ultra-violet radiation appears as a way to maintain a high trainability, it might be prudent to consider the overall training load during fall-winter months to stay within the athlete's/client's current adaptation reserves.

	Spring-Summer	Fall-Winter
# of training session per week	4-5	2-3
Duration of training sessions	60-75 min	30-45

Table 3a-1: Variation in training frequency and duration of training sessions by season.

3b. Bio-rhythms and lunar cycle

Have you ever experienced sessions where your athletes/clients were surprisingly strong? Have you ever experienced sessions where your athletes/clients were surprisingly weak?

Bio-rhythms are cycles of approximately three weeks (23 days) in length. Beginning at the birth date biorhythms claim predictable highs and lows of physical capacity, including the ability to handle various amounts of training within a three week time span. (30)

According to current science, the theory of bio-rhythms is not valid. (31) However, the importance of organizing training in cycles of approximately three weeks is recognized elsewhere in the literature. Based on numerous recordings of training diaries completed by athletes, it's noted that both "injuries and strong performances occur in cycles of three and five weeks." (32)

Empirically, three-week cycles are supported by three "greats of the iron game": Vasily Alexejev, Louie Simmons and Mel Siff. Louie Simmons has stated: (33)

> *Mel Siff asked how I arrived at our 3-week pendulum system. It was quite similar to that used by the great Soviet Union SHW champion Vasily Alexejev. I stated that after 3 weeks we could not become faster or stronger, so we waved back down and started over. Mel said that Alexejev found the same to be true.*

It is worth noting that in the famous Tabata study the students improved VO_2max from 48-55 mlO_2/kg/min significantly over the first three weeks then they experienced a tendency to plateau. (36)

In the holistic, individualized program design the 3-week cycles are followed by increasing the training load (intensity, volume or intensity + volume) in two to three week waves.

Another natural cycle is **the lunar cycle**, or the female menstrual cycle. Practical experience has shown significant decreases in performance and increased incidence of injury can occur in the days leading up to and during menses. An increase in injury around the days of the menstrual cycle is supported by investigations on Australian elite athletes. (34) There are, however, individual differences. Some women don't experience any problems. (35)

The lunar cycle is followed by planning a light week of training to correspond to the days before and during menses.

3c. Circadian rhythms

Various physiological functions are observed to fluctuate on an approximate 24-hour basis. These fluctuations are called Circadian ("about a day") rhythms. Circadian rhythms are controlled from the suprachiasmatic nucleus as well as genes, but are also entrained by external geophysical stimuli.

Motor accuracy tends to be highest in the morning. Most physiological factors like flexibility, strength, peak power, anaerobic power and maximal speed, tend to demonstrate a peak in the early afternoon and late evening, possibly linked to the pattern of core temperature. There is less, if any diurnal variations in aerobic power. Some studies indicate better trainability in the early afternoon and evening. (37, 50) Hypertrophy gains appear to be similar regardless of the time-of day (morning or evening). (47)

However, there are also indications that the greatest strength increases occur when testing is performed at the same time of day as the training. (44, 45) Therefore, it can be recommended to train at the same time of day as an upcoming competition if the time of competition is known. (46)

The mechanism behind time-of-day effects are not clear, but might be associated with changes in resting levels of hormones: (45)

- **Testosterone,** which is important for nervous system excitation and recovery, is higher in the morning, making training-induced increases easier to accomplish during that time period. On the other hand, training later in the day can increase total testosterone production over the entire day. (48) It can be speculated that if there is an excellent endocrine capacity, attempting to peak testosterone levels twice a day may lead to good results. Also, the opposite can be true. If the testosterone level is lower, it might be advisable to train with only one peak, the “natural” (morning) testosterone peak.

- **Cortisol** needs to be low during recovery phases. Cortisol rises in the morning and should naturally diminish throughout the afternoon/evening (when the sun sets). All training stimulates a release in cortisol. Training too late in the day stimulates cortisol at a time when this hormone tends to leave the body. Late day training might be counterproductive to recovery and potentially lead to overtraining. In addition, heightened levels of catecholamines due to training may contribute to sleep disturbances, further impeding recovery. (49)

Overall, because of the combination of internal and external influences it is difficult to draw clear scientific conclusions regarding scheduling of training based on circadian rhythms. (37) If you are in a position to make choices regarding time-of-day training, the above studies point to the following guidelines:

- Train at the same time of day as the competition if the time of competition is known.
- Since studies overall demonstrate good trainability both earlier and later in the day, there is freedom to schedule the training at times when the individual athlete/client performs best. External factors like work, school or sport specific training sessions clearly affect the available mental and physical energy at various times during the day.
- If overtraining and sleep disturbances are issues for individual athletes then carefully monitor training responses if training is scheduled after sunset.

Using Principle #3 of the FPM *on the Fly*

1. Reduce the training load during winter months and/or safely expose the athlete/client to ultraviolet radiation. (See reference 44 for details on safe sun exposure.)
2. Within each mesocycle plan two to three week waves of increasing training load and then "start over" with a lower developmental training load or an actual active rest week.
3. On a given training day, schedule the training session(s) according to the guidelines in section 3c.

PRINCIPLE #4

Optimal Results are Achieved by Planning to Create Synergy Between Concurrently Performed Training Elements

Have you ever created a training program that included developmental training of more than one bio-motor ability within the same week? For example:

- Flexibility and strength
- Strength and power
- Strength and endurance

If you answered yes, then you have created programs with concurrently performed training elements.

Section 4 provides a look at the dynamics of concurrent training, a brief review of current research on concurrent training as well as main guidelines for actively planning to create synergy between concurrently performed elements.

4a. What are the dynamics of concurrent training?

When the training program contains more than one component performed "at the same time" there are three overall scenarios.

1. Synergy - 1 + 1 = 11
2. Negative interference - 1 + 1 = 0
3. Neither interference nor synergy - 1 + 1 = 2

Physiologically, the concept of "a week" is not important for understanding the three scenarios.

The important thing is (assuming that component A occurs before component B): **When you engage in a session to develop component B (for example, endurance training), do you still have the acute adaptations (changes stemming from a single workout or even a single set) from the session to develop component A (for example, the strength training) present in the body**?

```
---------------------------------- Timeline ----------------------------------------------------------------------→

Component A
|---------------------------|
         ~~~~~~~~~~~~~~~~~~~~~~ (component A adaptations)
Component B
                      |------------------------------------|
                                       ~~~~~~~~~~~~~~~~~~~~ (Component B adaptations)
```

When the athlete or fitness client engages in a session to develop component B while the acute adaptations from the session to develop component A are still present in the body at least six scenarios are possible.

1. The acute adaptation from the session to develop component A is negatively affected (which presumably limits the chronic adaptations to component A).
2. The acute adaptation from the session to develop component A is positively affected (which presumably enhances the chronic adaptations to component A).
3. There is neither interference nor synergy on the adaptations from session A.
4. The performance in the session to develop component B is negatively affected (which presumably limits the chronic adaptations to B).
5. The performance in session B is improved (which presumably enhances the chronic adaptations to component B).
6. There is neither interference nor synergy in session B.

Because these acute adaptations range in duration from minutes to hours to days, it becomes important not only to know what bio-motor abilities (physical capacities) are trained within the same week but also how the sessions are distributed within the week and within individual days.

4b. What information is provided from research on concurrent training?

Concurrent strength and flexibility training

- Concurrent strength and flexibility training performed on alternate days can enhance strength gains in beginners compared to strength training only. (51)
- High volume stretching of the agonists can reduce strength and power of the same muscle groups when stretching is performed immediately prior to the strength and power movement. (52)
- Shortened antagonist muscles can inhibit strength of the agonist muscle. Stretching the hip flexors prior to a vertical jump and the hamstrings prior to knee extensions may enhance jump height, power output and strength. (53) The study did not report if the stretched muscles were tight or had normal length.

Strength and Power Training

- Under the right conditions a heavier set can have a potentiating effect on a lighter set for up to 10 seconds in the form of increased mean power, increased force, and increased jump height. (54, 55, 56) This potentiating phenomenon is called post-tetanic potentiation, or the “after-effect of the nervous system”. (58)

- Within the same workout a lighter load may enhance power output with subsequent heavier loads. (57)

Strength and endurance training

The majority of research on the topic of concurrent training investigated concurrent strength and endurance training. A recent meta-analysis of studies of concurrent training (2012) offer the following guidelines: [60]

Overall effects

Power is more susceptible to decrements than strength or hypertrophy – the researchers suspect that the effect is through an attenuation of contraction velocity or rate of force development. [60]

VO_2max is not negatively affected by concurrent training and endurance performance could even be augmented by an increase in the area of type 2a fibres, gain in maximal muscle strength and rate of force development. [60]

Potential sources of interference

The studies indicate that "the unique physiological and chemical interactions that exist when varied and multiple exercise stressors are placed on a subject can be highly complex and interrelated. There may need to be a particular alignment of training variables and a very small window of opportunity within which a … program is effective."[59]

Unique and distinct adaptations to the different forms of training coupled with the potential for overtraining is believed to explain any potential interference. Overreaching and overtraining appear to play a smaller part of the negative effects seen in the reviewed studies. The competing adaptations are related to differences in duration and force levels between endurance training and strength training. [60]

Some studies have shown that concurrent training increases muscle size only in the type II A fibres, while the strength training group increased size of type I, type II A and type II C fibres. This difference appears to represent a cellular adaptation that shows the antagonism of simultaneous strength and aerobic endurance stimuli, since strength training alone produced results in both the type I and type II fibres. [61] Specifically, increases in muscle hypertrophy appear to be strongly dependent on the activation of a protein complex called MTORC1. High intensity endurance exercise above 70-80% of max HR – even with VERY little volume, for example 10 x 6 seconds sprint – before OR after lifting in the same session- appears to acutely block the activation of MTOR through various molecular mechanisms. [62]

Relating to competing adaptations at the cellular level as the source of negative interference is the effect of training modality

- The endurance training modality is a primary factor in determining interference – running but not cycling results in negative effects on both strength and hypertrophy in the concurrent training group. The difference could be caused by cycling being more specific to the applied tests as well as less muscle damage caused by cycling compared to running.[60]
- Interference effects are body part specific and not systemic – decrements in strength are seen in lower body, but not upper body exercise after lower body oriented endurance exercise. [60]

Regarding the role of overwork/overstress in negative interference

- When an endurance component is added to the training, strength and muscular growth is blunted in proportion to the frequency of endurance training. (66)
- If endurance training is performed only two to three times per week and the intensity does not exceed 70% of max HR the risk of negative interference is reduced. (67)
- Volume accounts for a relatively small portion of any interference effect seen on strength, power and hypertrophy. (60)
- The risk of negative interference from overtraining is higher for advanced bodybuilders/lifters because higher volume and intensity is needed to stimulate further improvement. (66)
- One advantage of interval training is that an anabolic response and a cardio respiratory training effect can be created through lower volumes of training. (68)
- The risk of negative interference from overtraining increases with the duration of the training period (beyond six to seven weeks). (66)

Potential sources of synergistic effects

- Shorter duration-higher intensity interval training does not result in decrements in strength and power and can result in significant improvements in VO_2max.(60)
- High Intensity Endurance (>70% of the maximal heart rate) should be performed first in the day and at least 3 hours before strength training when the goal is hypertrophy. This selected molecular factors as AMPK and SIRT1 to return to baseline. MTOR can be elevated for 18 hours after a session. (62)
- When 45 min legged cycle ergometry is performed six hours before 4 x 7 maximal knee extensions, the subjects saw significantly greater increases in hypertrophy compared to the group that performed strength training only. (63)
- Perform a strength session immediately after a low-intensity, non-depleting, endurance exercise. This improves endurance adaptations and does not interfere with the pathways regulating strength gains. (62) Heavy Resistance Training (70-80% 1RM) performed immediately after endurance training (consisting of one hour at 65% of VO_2max) results in enhanced expression of the genes involved in mitochondrial biogenesis/oxidative metabolism in recreationally active subjects. (64)
- There are somewhat contradictory findings on this issue, but it appears that to maximize the anabolic environment after one concurrent training session, endurance training should come before strength training. (64)

4c. What are the practical guidelines for achieving synergy and avoiding negative interference for concurrently performed training elements?

Based on the research in the previous section (and more) the FPM applies the following practical programming guidelines to achieve synergy and/or avoid negative interference between various concurrently performed training elements.

Currently, we have seen no research on concurrent training that involves more than one mesocycle. Therefore, at this point in time, the available research mainly supports how to train WITHIN a mesocycle, specifically within a week and within the same day.

Concurrent strength and flexibility training

- Particularly in the first six months of training: Perform strength and flexibility training (for muscle groups that are tested as tight) within the same week, on alternate days.
- If a muscle is not tight by basic standards then long duration (more than 30 seconds) stretching exercise for agonist muscle groups immediately prior to strength/power should be avoided. The opposite is true if the muscle is tight by basic standards.
- Stretch selected antagonistic muscle groups immediately prior to strength power exercises.

Concurrent strength and endurance training

- If possible, based on the athlete/client objectives, choose strength and endurance exercises that involve non-overlapping muscle groups. Place exercises that involve the same muscle groups on different training days within a week.
- If hypertrophy is the objective then strength and endurance training in the same workout should be avoided unless the intensity of endurance training is below 70% of the maximal heart rate.
- If – for scheduling reasons – strength and endurance is performed in the same workout and hypertrophy/strength is the goal, then the endurance exercise should be performed first (to maximize the anabolic environment).
- If strength and endurance training is performed on the same day and hypertrophy is the explicit objective, then endurance training should be performed three to six hours before the strength training.
- Short-duration, high-intensity, interval training can be performed in the same week as training for maximal strength and/or power.
- If hypertrophy, strength and power are the main goals of strength and conditioning, then perform as little endurance training as possible, no more than two to three workouts. In some athletic environments the sport training provides sufficient conditioning effect and no additional endurance training is needed.
- If endurance is the main objective, then perform strength training immediately after low intensity endurance exercise.

Plan increases and decreases in the training load in waves of two to three weeks of length.

Concurrent strength and power training

- Strength and power training can be performed within the same week.
- If power is the main goal, then perform strength exercises “first” to facilitate power performance.
- If power output with a heavier load is the goal, then use a lighter load “first.”

There is one additional guideline that is used with the FPM for concurrent strength and endurance and concurrent strength and power training. The guideline relates to two statements that we discussed above

> “There may be a **particular alignment of training variables** and a very small window of opportunity (within which an SEC program is effective).”[59]
>
> **“**The competing adaptations are related to **differences in duration and force levels between endurance training and strength training.**”[60]

If competing adaptations (between strength and endurance training) are related to DIFFERENCES in force levels and duration, it is possible that synergistic adaptations would come about with SIMILAR force levels and duration.

More similar force levels and duration when comparing endurance and strength training might be achieved by **aligning the length of the set in resistance training with the length of the interval in endurance training**.

By aligning the length of the set with the length of the interval we ensure that the duration of work is the same, but we cannot ensure that the force levels – and thus the mechanical stress – are exactly the same. For example, let’s say that a set of five reps with a 5RM load takes 20 seconds - five contractions in 20 seconds. Compare that to a 20-second all out sprint on a row ergometer that could involve 20 or more contractions in the same timeframe.

It cannot be said that the force levels will be the same in the set of barbell back squats compared to the row ergometer, but it can be said, with great certainty, that they will be more similar than if the set of barbell squats was compared to 20 minutes (or more) of continuous rowing.

The guideline of aligning the length of the set in resistance training with the length of the interval in endurance training is the predominant guideline used to combine resistance and power training methods with energy systems training methods in the same meso and microcycles.

As a primary pattern, the FPM combines: (please see Appendix 4 for a closer explanation and definition of the different methods)

- The Repeated Effort Method (long duration) and the Aerobic Method
- The Repeated Effort Method (short duration) and the Anaerobic Lactic Method
- The Maximal Effort Method, the Dynamic Effort Method (short and long duration) and the Anaerobic Alactic Method

The principle of aligning the length of the resistance training set with the length of the interval is applied in situations where it is the goal to optimally (possibly maximally) develop both the strength component and the speed/energy systems component of training.

The principle is not necessarily applied in situations where the goal is to use resistance training to improve endurance performance.

Additionally, endurance athletes will need continuous work beyond the length of the resistance training sets. Also, other athletes from interval based sports might, in some rare situations, benefit from continuous endurance training.

Using Principle #4 of the FPM *on the Fly*

1. Do you have concurrently performed elements in your training program? If so, which ones?
2. Consider if there are any components that are not necessary for the athlete’s/client’s program?
3. Review the practical guidelines provided in the previous section and apply any guideline that is relevant to an athlete/client.

PRINCIPLE #5

First Develop Flexibility, then Develop Strength, Power, Speed and Endurance

Have you ever given your athletes/clients flexibility training programs?

If you answered “yes” to the question above, what was the purpose of the flexibility training program? How did you plan the flexibility training in relation to other training elements?

Section 5 discusses the definition of flexibility, the types of flexibility that exist, the various purposes of flexibility training, the principles that support periodization of flexibility and lastly key principles of periodization of flexibility within the FPM.

5a. What is flexibility?

Flexibility is the available range of motion within a specific movement, in a specific joint, under specific conditions: [78]

- Active or passive movement
- Velocity of movement
- Duration of movements (as in a race)

In many cases the available range of motion is greater during passive compared to active conditions. With increasing velocity (and frequency) of movement, maintaining range of motion requires increasing degrees of strength to accelerate and decelerate the limbs. Also, increasing levels of coordination is required to accurately turn on and turn off the agonists and antagonist. Similarly, strength endurance and coordination are required to maintain range of motion as the duration of movement in a race increases.

With respect to flexibility, more is not necessarily better:

- It is possible that there is an optimum level of flexibility required for injury prevention. [78]
- The need for flexibility differs between different sports: “Many athletes run or lift skilfully employing their springs (read passive tissues). If this is the case, never stretch these athletes beyond the range of motion required in their event.” [79]

There is no conclusive evidence to support two common claims about flexibility training; that flexibility training will prevent DOMS or prevent musculo-tendinous injury. [78]

5b. What types of flexibility exists?

Relating to the definition above, flexibility, under various conditions, is defined in the literature as “types” of flexibility. See also Appendix 2 (which includes the individual references).

Static passive flexibility

Static flexibility is the range of possible movement around a joint and its surrounding muscles and tissues during a passive movement" (a partner, gravity or other muscles than the ones crossing the joint provide the force needed to create the movement). Static flexibility is occasionally referred to as passive flexibility.

Static active flexibility

Static active flexibility is the ability to assume and maintain extended positions using only the tension of the agonists while the antagonists are being stretched.

Dynamic mobility/flexibility

Dynamic flexibility refers to the available range of motion during active movements. Therefore, it requires voluntary muscular actions from muscles crossing that joint.

Dynamic flexibility is occasionally referred to as active flexibility, flexibility-speed (achieving ROM during fast movements) or ballistic flexibility. [(78)]

Strength flexibility

Strength flexibility is the ability to exert force with the antagonists at the end range of motion of a movement, in order to control the movement and return to the start position.

5c. What are the purposes of flexibility training?

In order to fully understand flexibility it is important to answer the question, "What is the purpose of flexibility training?" with a response that goes deeper than "to become flexible." The following section highlights some of these *deeper* responses.

1. Muscular relaxation and increasing parasympathetic activity

Muscular relaxation - indicated by a reduction in EMG – can be the result of flexibility training (emphasizing the static methods). Muscular relaxation can result in increased sensory awareness, reduced blood pressure, more energy efficient movement (to a certain degree), improved blood circulation (facilitates recovery) and maintaining shock absorption capabilities. [(78)]

It is through increasing muscular relaxation and parasympathetic activity that flexibility can act as a recovery tool. [(87)]

Muscular relaxation as an effect of flexibility training is less about gaining range of motion and more about the neurological and mechanical effects of the flexibility training.

2. Normalize length tension relationships of muscles throughout the body to achieve an optimal posture

The posture of an athlete is affected by numerous factors including mood/emotions, held tension as well as short and/or weak muscles that theoretically will "pull" the individual out of optimal alignment.

Normal length-tension relationships may be understood as the length tension relationships (flexibility) of an individual with an optimal, balanced posture. Many textbooks and training programs offer specific guidelines for optimal length-tension relationships. (80)

What is optimal posture and why is optimal posture important?

Posture is usually defined as the relative arrangement of body parts. Good posture is that state of muscular and skeletal balance which protects the supporting structures of the body of injury and progressive deformity irrespective of the attitude (lying, standing, etc) in which these structures are working or resting. Under such conditions the muscles will function most efficiently and the optimum positions are afforded for the thoracic and abdominal organs. (81)

The term "most efficiently" in the above paragraph is synonymous with "least energy expenditure." In the context of standing and sitting postures, "least energy expenditure" is achieved by maintaining minimal lever arms in relation to a plumb line. Thus, optimal posture involves that the person has half their body in front of and behind (side view) and to the left and to the right of (front view) a plumb line. In sub-optimal posture, one or more body parts has deviated from the plumb line, which results in

- increased pressure on joint surfaces
- increased tension in passive structures like joint capsules and ligaments
- Increased low level isometric contractions (to maintain upright posture in the field of gravity), reduced blood flow as well as trigger points
- reduced blood flow negatively affecting the removal of waste products and the delivery of nutrients to that muscle, with diminished recovery/super-compensation in that muscle as a result
- reduced inspiratory volume (with increased thoracic kyphosis)

Normalized length-tension relationships as an effect of flexibility training is less about gaining range of motion and more about the neurological and mechanical effects of the flexibility training. Specifically, normalized length-tension relationships are about the question: If the athlete/client just relaxes, what position does the body gravitate towards?

3. Improving postural stability

Static stretching of the leg muscles can improve postural stability in non-balance trained individuals by desensitizing the stretch reflex. This study demonstrated improved posture stability after stretching, however, the effect was not present in balance trained individuals. (83)

Improving postural stability as an effect of flexibility training is less about gaining range of motion and more about the neurological and mechanical effects of the flexibility training.

4. Stimulating hypertrophy

Placing high tension on a muscle in the stretched position results in high levels of active (from a voluntary contraction) and passive (from a passive stretch) myo-fibrillar tension and is thought to be a strong stimulus for the laying down of sarcomeres in series and in parallel. An increased number of sarcomeres in series supports a maximal shortening velocity and power. An increased number of sarcomeres in parallel supports an increased cross-sectional area of the muscle. (85, 86)

While the active muscle tension in the stretched position appears to be the strongest stimulus for hypertrophy, animal studies have demonstrated that passive tension (mechanical stimulation) in the form of stretch can stimulate muscle growth through: (86)

- Increases in IGF-1 messenger RNA
- Increases in IGF-1 gene expression
- Increased percentage of fibres expressing slow myosin
- Stimulation of Akt

The duration of the stretch was days/weeks and these results have not been reproduced in humans. (84) However, when increased constant tension is applied to animal experimental muscle, many of the same processes of hypertrophy are stimulated. (86)

It is hypothesized that blood flow restriction is one of the mechanisms through which passive stretch could result in hypertrophy in humans. Blood flow restriction has been demonstrated during stretches and that blood flow restriction can lead to increases in GH and IGF-1. (86)

5. Acute removal of reciprocal inhibition to achieve maximal force and power output

Shortened antagonist muscles can inhibit strength of the agonist muscle. Stretching the hip flexors prior to a vertical jump and the hamstrings prior to knee extensions may enhance jump height, power output and strength. (53)

Increased force and power outputs as an effect of flexibility training is less about gaining range of motion and more about the neurological and mechanical effects of the flexibility training.

6. Acute and chronic relief of muscular cramps and dysmenorrhea (78)

7. Ability to perform desired strength and conditioning movements or sport specific movements with optimal form

This purpose of flexibility training most directly relates to the definition of flexibility: If the athlete/fitness client does not have the range of motion to perform an exercise then they can’t perform the exercise.

Over 4 years of teaching beginners Olympic lifting, I saw over and over again that lack of flexibility is the number one limiting factor for learning Olympic lifts.

In 2012, I worked with a young badminton player who had problems making contact with the shuttle at a sufficiently high point above the head. A flexibility assessment showed a reduction of passive shoulder flexion of about 15-20 degrees. As the flexibility improved, so did his ability to make contact with the shuttle at the right point.

Optimal technique (form) is defined as a way of moving that allows the athlete/client to use his/her physical abilities to the fullest without injury. [82] Optimal technique requires that each of the involved joints contribute to the movement and the torque generation in an optimal way that is specific to the movement. In the badminton example above, lack of range of motion in the shoulder joint can exacerbate movements in the spine as an attempt to make contact with the shuttle at the optimal point. Such compensation is referred to as compensatory relative flexibility. [78]

The ability to perform desired movements as a purpose of flexibility training is directly about static active or dynamic flexibility as the result of flexibility training.

5d. What supports the principle of periodization of flexibility training?

Based on section 5c the different purposes of flexibility training are now clear. The next step is to review what periodization of flexibility training really means. Also, since there is no real literature on periodization of flexibility training it is important to look at what factors support the principle of periodization of flexibility training.

With the FPM, the principle of periodization of flexibility training means that the **type and priority of flexibility training varies from mesocycle to mesocycle (short term periodization) and from macrocycle to macrocycle (long term periodization).**

By utilizing the definition of periodization as “different periods with different goals, structures and content of the training program” the principle of periodization of flexibility is supported if a look at the nature of the flexibility training points to an ideal of different periods with different goals, structures and content of the training program. For example:

- The development of some forms of flexibility may happen safer and more effectively when other forms of flexibility are developed first.
- The development of strength, speed, power and endurance may take place more safely and effectively in the presence of adequate levels of flexibility.
- Acute adaptations to flexibility training support or contradict the acute adaptations to other forms of training.

In conclusion, within the FPM the viewpoint is that there is sufficient support for the principle of periodization of flexibility training and that periodization of flexibility is a key component of optimal results with periodized training.

5e. How is flexibility training periodized?

Based on the different purposes of flexibility training and an understanding of the factors that support periodization of flexibility training, section 5e looks at how flexibility training is periodized with an emphasis on similarities and differences to the periodization of other components of the training program.

1. Long-term periodization (across macrocycles)

Except for sports like gymnastics that require exceptional degrees of flexibility, the optimal levels of flexibility for a particular sport might be achieved within the first year of training. Thus, in contrast to several other bio-motor abilities that are relevant to the sport, actual developmental flexibility training may take up a very limited portion of long-term training.

The long-term periodization of flexibility training may be described in three major stages.

Stage 1: The purpose of flexibility training is to achieve a balanced length tension relationship around all joints. See also section 5c, the second purpose of flexibility training. This stage should take up no more than a few weeks of training and is never repeated unless flexibility is lost.

Stage 2: The purpose of flexibility is to develop sport-specific range of motion, dynamically and or statically. See also section 5c, the seventh purpose of flexibility training. In some sports with limited flexibility requirements, an athlete may clear this stage within the first year of training. In sports with more extensive flexibility requirements, this stage can be repeated in subsequent macrocycles until the required levels of flexibility are achieved.

Stage 3: The purpose of flexibility training in Stage 3 is to maintain range of motion and release residual muscle tension after workouts. See also section 5c, the first purpose of flexibility training. Since both sports and every day activities, particularly sitting, can result in residual muscle tension, Stage 3 is essentially a lifelong stage.

2. Short-term periodization (within macrocycle)

It is the strength, power, speed and endurance exercises that support sport performance. Adequate flexibility supports the strength, power, speed and endurance exercises. Therefore – when increased range of motion is needed, the development of flexibility should happen as early and as quickly in the macrocycle as possible in order to allow for as many weeks of training as possible with the new and increased range of motion.

It is worth nothing that strength and coordination supports the development of high amplitude, high velocity, dynamic flexibility because of the strength required to stabilize, accelerate and decelerate involved body parts.

3. Micro-periodization (within a week)

The acute adaptations from a bout of flexibility training can both enhance or reduce performance in strength, power or endurance exercises. Therefore the timing of flexibility training is of high importance. (For details of timing of flexibility training see Principle #4.)

4. Flexibility should be developed in the order of passive static, active static and then dynamic flexibility

Looking at the various qualities of flexibility there is good reason to develop those qualities in a specific order:

1. Emphasize the development of passive static flexibility before active static flexibility. Passive static flexibility increases the speed of acquisition of active static and dynamic flexibility as passive resistance from antagonists is reduced.

   Example: Athletes or fitness clients who might perform cervical retractions (for joint mobility or postural optimization) with tight upper trapezius muscles and sub-occipital muscles are "fighting" the tension in their own muscles to perform the movement.

2. Emphasize the development of passive static flexibility before dynamic flexibility particularly in multi-joint movements. Without adequate passive static flexibility in all joints dynamic flexibility movements may result in compensatory patterns leading to hyper-mobility and injury.

   Example: Athletes or fitness clients perform front-to-back leg swings with tight hip-flexors (or poor coordination, in this case poor hip-spine dissociation) typically display compensatory movement in the low back.

3. Emphasize the development of active static flexibility before dynamic flexibility. By first controlling the end range during a static movement the athlete client learns the dynamic movements faster and safer.

Using Principle #5 of the FPM *on the Fly*

1. Perform a needs analysis for flexibility for a certain athlete’s/client’s specific goal.
2. Assess athlete’s/client’s flexibility.
3. Determine which stage of long-term development the athlete/client is in.
4. Choose the type and amount of flexibility training to focus on.

PRINCIPLE #6

First improve the weak link, AND THEN improve the function of the entire kinetic chain

Have you ever worked with an athlete or fitness client whose goal involved some form of multi joint movement? For example, a bench press, a jump or swimming.

If you answered “yes” to the above question, maybe you considered the question of “how many different ways can bench press, jumping or swimming be improved?”

Consider this quote from Olympic weightlifting great, Vasili Alexejev [88]

> *What upsets me is that the method of training used by an overwhelming number of weightlifters, in spite of the amazing growth in records, is still at the same point it was in the fifties. For example, you want to improve your technique on the snatch - you practice the snatch; the jerk -- you practice the jerk. I tell them to correct their mistakes differently -- to strengthen separate groups of muscles. A simple example: an athlete is having trouble with the snatch. They advise him to start differently, to change his grip on the barbell -- wider or narrower. But it turns out that it's enough to build up a group of muscles which 'do the trick' with the maximum effort and he gets better results.*

Alexejev discusses two ways of improving the snatch and the jerk. The first method is practicing the snatch and the jerk, which – as will be evident – is training the entire kinetic chain. The second method is to strengthen separate groups of muscles, which – as will also be evident- corresponds to strengthening weak links.

6a. What is a weak link and what is the kinetic chain?

The saying that “no chain is stronger than the weakest link” is applicable with respect to the human body. A “weak link” can be defined as the ONE muscle (or joint) where a given improvement of strength (or torque) leads to the largest improvement in strength power in the targeted whole body movement. For example, lifting, throwing or running.

A weak link can be:

- A “smaller” tonic stabilizer muscle, potentially with an antagonistic function (See Principle #7)
  Primary need: proprioceptive function, eccentric or isometric strength
  Examples: deep core, deep shoulder, deep knee and deep ankle muscles

- A larger muscle group with a stabilizing function
  Primary need: eccentric or isometric strength
  Example: grip

- A larger muscle group with an antagonist function
  Primary need: eccentric strength
  Example : hamstrings

- A larger muscle group with an agonist/synergist
  Primary need: eccentric-concentric strength
  Example: shoulder extensors, hip extensors, plantar flexors

The weak link has a muscular aspect and a joint related aspect. Weakness of a given muscle negatively affects torque production in the joint that is moved by that muscle.

The following points do not directly meet the definition of a weak link. However, these points can clarify what the weak link is:

- A position in a lift where the bar/body slows down or stops (the sticking point)
- A painful muscle or area of the body that causes pain and limits training
- A muscle/area that received little or no direct training
- A muscle group that has to counteract the strongest external levers

A weak link is determined through assessment. Occasionally, the choice of test as well as bench marks is clear. In other situations the choice of assessment is more challenging. (For a closer look at assessments see "Are Your Training Programs H.I.P?" (www.yestostrength.com)

What is the kinetic chain?

Kinetics means "relating to the motion of material bodies and the forces and energy associated therewith" [89] Chain is "a series of usually metal links or rings that are connected to each other." [90] The "material body" is the human body, the "links" are the bones and the connections are the joints.

The concept of the body acting as a chain is most clear in certain fluid sporting movements. For example, a baseball pitch.

6b. How is the strength of a weak link and the entire kinetic chain improved?

Power-lifting coach Louie Simmons has stated the following: [91]

> *When lifters repeatedly use the same simple method of training to raise their strength level, they will eventually stall. Like the scholar who must utilize many sources of information to achieve a higher level of knowledge, the lifter must incorporate new and more difficult exercises to raise their standards. Many have the theory that to squat, bench, or dead lift more, you simply have to do the three lifts. If it were that simple no one would need special exercises, machines, or systems of training. But we know this is not true.*

Conversely, the following statement can be found in Pavel Tsatsouline's book *Power to the People*:

> *In spite of your apparent "imbalances" chances are that you do not need a specialization program. Build up to respectable poundage in your basic lifts and the lazy muscles will be forced to do their part.* (92)

There are two reasons why just doing the basic lifts generally is not the best approach:

1. Basic neurophysiology states that the nervous system will avoid positions of weakness and seek positions of strength. Thus, the nervous system will do anything to COMPENSATE for, rather than challenge, the weak links whenever the target movement is performed.

   Real world gym experience shows this principle over and over again:

   - Squatting with one leg being weaker. The athlete/client will invariably lean away from the weak leg and emphasize the strong one. The same issue is evident when a client attempts to bench press when one arm is weaker than the other.
   - Lunges with weak hamstrings. The client will invariably let the knee move forward to utilize the quads more.
   - Planks with weak transversus abdominis muscles. The client/athlete will be unable to hold the neutral spine. Instead, s/he will engage the rectus abdominis and flex the spine (bringing the ribcage and the pelvis closer together) in order to reduce the extension torque created by gravity.

2. In most cases, just performing the **basic lifts is not the most efficient way to stimulate/improve the weak link**. To challenge a weak link, look for an exercise that works the weak link HARDER than the goal movement.

   - If grip is the weakness in a deadlift, do heavy one or two finger curls or rolling thunder lifts.
   - If your sticking point is in the mid-range of a bench press, do floor presses.

Two types of exercises can satisfy the criteria of working the weak link harder than the goal movement.

1. Modified versions of the basic lifts
2. Isolation exercises

The first strategy is eloquently describes in this way, "Tweak the basic drill to shift a lion's share of the load to the problem area." (92)

On the neuromuscular level, the term INTRA-muscular coordination describes what is happening when the training focuses on one muscle: (93)

> *Another possibility for improved power results from improved **intra**-muscular coordination. The term "intramuscular coordination", describes in the author's opinion the relation between excitatory and inhibitory mechanisms for **one muscle** for a specific movement.*

During almost any possible exercise more than one muscle is active, but the main training effect can be targeted to result in, for example, improved strength in elbow extension.

To understand how to strengthen the entire kinetic chain it is helpful to begin with the definition of INTER-muscular coordination: (93)

"A further way to improve power results from improved ***inter-****muscular coordination. Inter muscular coordination describes the ability of* ***all muscles*** *involved in a movement, agonists, antagonists and synergists to corporate wholly with respect to the aim of the movement."*

Clearly, it is during multi-joint movements that the various muscles are challenged to cooperate wholly with respect to the aim of the movement.

In conclusion, the main strategy with the FPM is:

- To develop intra-muscular coordination of the identified weak links with one isolation exercise and one modified version of the basic lift.
- To develop inter-muscular coordination in the target movement through the use of multi-joint exercises and movements.

6c. Why should the weak link be developed before the entire kinetic chain?

The weak link should be developed before the entire kinetic chain because the weak link, by definition, inhibits performance in the multi-joint exercises that are used to develop the entire kinetic chain.

One controlled study also supports this common sense notion and concludes that "a strengthening program should start with isolated movements for better stimulation of the weaker muscles and continue with complex exercises for more impressive strengthening." (94)

Some authorities recommend to "train the movement, not the muscle." (95) Using similar terminology it can be said that the philosophy of the FPM is to **"train the muscle, then the movement."**

Principle #6 is a key principle behind the need for and the specific structure of periodization of exercise selection (See Beyond Functional Training: Periodization of Exercise Selection).

Using Principle #6 of the FPM *on the Fly*

1. Consider the athlete's/client's overall goal.
2. Define the weak link(s).
3. Determine isolation exercises as well as multi-joint exercises to strengthen the weak link.
4. Determine the best exercises to strengthen the entire kinetic chain.

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