

THE SCIENCE OF PERIODIZATION

PART I: Introduction

By

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Training: (*trey-ning*) **the education, instruction, or discipline of a person or thing that is being trained; activity leading to skilled behavior**

Organization: (*awr-guh-nuh-zey-shuhn*) **the act or process of organizing; the state or manner of being organized; Something made up of elements with varied functions that contribute to the whole and to collective functions; an organized structure for arranging or classifying**

Periodization is defined as a “programmed variation in the training stimuli with the use of planned rest periods to augment recovery and restoration of an athletes potential (1).” According to Michael Stone, Head of Sports Physiology for the USOC, “periodization can be defined as a logical phasic method of varying training volume, intensity factors, and exercises in order to optimize training progress. The primary goals of periodization are the avoidance of overtraining and performing at peak or optimum levels at the right time (2).” This model of training organization has multiple variations by name (ie: conjugate, concurrent, linear, undulating, classical, nonlinear, summated microcycles, etc..), each with the same common goal of providing a consistent increase in stimulus to overload the muscular and neuromuscular systems, resulting in adaptations which will increase overall physical performance.

There has been much debate over the years as to which model of periodization is most effective, linear or non-linear. Linear periodization holds parallels to block scheduling of practice in the field of motor learning, in that one physical capacity is trained without interruption for the length of one mesocycle (block) or an average of a four to six weeks. Upon completion of the block, a new block begins with a different physical capacity as the focus of training. The theory is that one block builds upon the results of the previous block in a step like design, until the end goal is reached. Volume and intensity are modified in a linear manner through each of these blocks of training. In motor control, block scheduling for practice requires the subject to perform practice in which “trials are performed sequentially without interruption (3).” This schedule for practice has been proven to be highly effective in the acquisition of a skill. A study on 32 college students practicing basketball skills in blocked vs. random training proved the block training group had better skill acquisition (4).” In fact many other research studies in motor learning had similar findings with regard to block schedule and skill acquisition (5,6,7,8,9,10,11).

Strength and conditioning research on block (linear) periodization has also shown positive effects on increases in strength, speed, and power. Kraemer et al demonstrated the superiority of periodization vs non-

periodization when training football players (12), while Stone et al concluded its effectiveness for increasing the 1 rep max squat when compared with other training methods (13). Various other studies, experts, and organizations agree that periodization is far superior to a non-periodized organization of training (14, 15, 16, 17, 18, 19, 20.). The National Academy of Sports Medicine (NASM) and the National Strength and Conditioning Association (NSCA) incorporate a linear model into their education curriculum for strength coaches and personal trainers. World renowned, Russian throwing coach/Sport scientist Dr. Anatoli Bondarchuk investigated athletes individually over the course of several years and charted their performance fluctuations during what he refers to as a “block training” schedule. He concluded “the more monotonously and steadily that a system of stimuli functions, the faster that both short-term and long-term adaptive restructuring take place. It is also easier for the “central nervous system to form a “passing ahead” effect (21).” Though there is substantial evidence pointing toward the superiority of this “block” method of periodization, it does have its detractors whom prefer a different approach to periodization. Below is an example of a basic 5 month linear periodization model for an intermediate level athlete.

Table I: Linear Periodization Model

Training Phase	General Physical Preparation or Corrective Exercise	Structural Adaptation	Maximal Strength Phase (pre-competition)	Peaking or Power Phase	Active rest
Phase Length	3-6 weeks	3-6 weeks	3-6 weeks	3-6 weeks	1-3 weeks
Phase Goal	Correct imbalances and dysfunctions, recover from injury	Increase cross sectional area of muscle fibers	Develop basic strength. Serves as a transition between structural and power phases.	Optimize power development	Recovery from training
Intensity	Moderate to high	Low to Moderate	Higher than structural but lower than Power Phase	High	Low
Volume	Moderate to high	High	Lower than structural	Low	Low
Sets	2-4	4-6(10 for german volume)	6-12	4-8	2-3
Reps	12-20	9-12	2-4	1-5	8-15
Tempo	2-1-2-1	4-0-2	3-0-0	X-0-X-1	2-0-3
Rest Interval	60-90s	90-120s	180-240s	240+ s	60-120s

In contrast to the linear approach, is the non-linear model of periodization. In essence there is no pure form of linear periodization, otherwise the model would not be known as periodization. “By definition, any periodization should be considered nonlinear. Although the general loading process (with respect to initial training levels) overtime may be considered linear, variations in volume and intensity that occur within a microcycle exhibit a nonlinear pattern. Therefore, all periodization is characterized by periods of high intensity or volume alternating with periods of lower intensity or volume to facilitate recovery and to maximize performance (2,22).” What may

be meant by non-linear is not the periodization schedule, but when taken from motor learning context, the variability of practice schedule, otherwise known as undulating or concurrent periodization.

Undulating periodization involves the acute variation of volume and intensity on a weekly (microcycle) or daily basis. According Poliquin, this schedule allows for minimal risk of overtraining and plateau like adaptation, while allowing for maximal training effect. This, in contrast to linear block training models, which “lose their efficacy after only two weeks” (23, 24). In his investigation, Poliquin concluded, “that if the stimulus is provided in the exact same way, results would diminish over time (23,25).” This theory holds true to Seyle’s general adaptation theory, in that there needs to be exposure to stimulus or stress for adaptation to occur (26). Utilizing the undulating periodization model with what he refers to as an “Accumulation Phase” where the main stressor is volume and an “Intensification Phase” where intensity is the main stressor, Poliquin has guided many of the world’s top athletes to success at all levels. The aforementioned Dr. Bondarchuk stated the importance of “block” periodization, but included in each block must be an undulation of load and intensity. He states “ we are convinced that loads of different intensities should be used in the workouts of highly qualified athletes in each session during the preparatory and competitive periods. Skillful alternation of these loads will help the athlete to learn and improve technique, develop the needed speed-strength, and obtain the best post workout restoration (27).” Below is an example of 1 microcycle of undulating periodization.

Undulating Periodization

Day 1

Volume Day

Core/Neuromuscular warm up activity

Exercise	Reps	Sets	Intensity	Tempo	Rest Interval
Horse stance vertical knee raise with stick	2-4 reps each side holding for 10-20 seconds	1		Static	Minimum
Horse stance with horizontal raise with stick	2 per side holding 30 seconds per side	1		static	Minimum
Lateral Band Walks					
Standing Med ball Chop sequence	10 per movement (up down/angle/angle/side)	1		Fast	Minimum
Alphabet plank on the ball	Whole alphabet			Slow	Minimum

Strength

Exercise	Set	Reps	Intensity	Tempo	Rest Interval
Snatch (technical correction/preparation sequence prior to work sets)	1 (warmup)	5 (50%1RM)			1-2 minute
	2 (warmup)	3 (60%1RM)			
	3	3			
	4	3			
	5	3			
Box Squat with bands/chains	1(warmup)	6			1-2 minute
	2 (warmup)	3			
	3	5			
	4	5			
	5	5			
	6	5			
Barbell Bench Press with bands/chains	1(warmup)	6			1-2 minute
	2 (warmup)	3			
	3	5			
	4	5			
	5	5			
Pullups (weighted if possible)	1	5			1 minute
	2	5			
	3	5			
Kneeling Shoulder Press	1	10			1 minute
	2	10			
Dumbbell Curls superset tricep pushups or dips	1	8			
	2	8			

Undulating Periodization

Day 2

Light Day

Core/Neuromuscular warm up activity

Exercise	Reps	Sets	Intensity	Tempo	Rest Interval
Side Plank Hold	2-4 reps each side holding for 10-20 seconds	1		Static	Minimum
4 Point vacuum	5 reps of 10 seconds holds	1		static	Minimum
Lateral Med Ball Throws	10 reps per side	1		Fast	Minimum
Overhead Reaching Throws with med ball	10	1		Fast	Minimum
Inchworm	10-15yards (nose to the ground)	1		Controlled	Minimum
Alphabet plank on the ball	Whole alphabet			Slow	Minimum

Strength

Exercise	Set	Reps	Intensity	Tempo	Rest Interval
Vertimax Up/Down Reactive Jumps	1 2 3	6 6 6			
Low intensity Deep Barbell Squats	1 2 3	10 (50% 1rpm) 10(55% 1rpm) 10(60% 1rpm)			
GHR (Eccentric Emphasis) 5-9 seconds down	1 2	5 5			
Dumbbell floor bench press	1 (warmup) 2 (warmup) 3 4	6 4 4 @ 80% 3 @ 85%			1 minute
Inverted Rows with weight vest with feet on ball	1 2	As many as you can do per set stopping at 10 reps.			1 minute
APECS Shoulder Circuit and Wall Shoulder Therapy	1 2 3(shoulder therapy set)	10/10/10/10 10/10/10/10 10/10/10/10			
Hammer Curls superset Overhead Tricep Extensions	1	10-12			1 minute
Heavy dumbbell crunches on ball ss standing crunches	1 2	10-12			

Undulating Periodization

Day 3

Max Day

Neuromuscular/Postural Preparation

Exercise	Reps	Sets	Intensity	Tempo	Rest Interval
Function Run	3 minutes	1		Slow	Minimum
Gravity Drop	3 minutes	1		static	Minimum
Arm circles	40/40	1		Slow and controlled	Minimum
Shoulder Curls	20			Slow and controlled	
Inchworm	10-15yards (nose to the ground)	1		Fast	Minimum
Bear Crawl	20 yards fwd/20yds bck			Slow	Minimum

Strength

Exercise	Set	Reps	Intensity	Tempo	Rest Interval
1 rep max deload drop set squats with green band accommodated assistance	1 (warmup) 2 (warmup) n n n n	6 6 once you reach one rep max, perform deload drops	65-100%		1 minute
1 rep max deload drop set Bench press with green band accommodated assistance	1 (warmup) 2 (warmup) n n n n	6 6 once you reach one rep max, perform deload drops	65-100%		1 minute
3 rep max incline bench dumbbell rows or 1 rep max pullup	N	3			
Dumbbell Curls superset with Tricep extensions	1 2 3 (wall sit curls superset tricep pressdowns)	18-10 8-10 8-10			1 minute
Plank hold or TVA work	1	variable			
Heavy Dumbbell Crunches superset standing curnches	1 2	10-12			

While intensity and volume are the main variations of training in undulating periodization, physical capacities and exercise prescription are the variables of change in a concurrent periodization scheme. As the word concurrent expresses, multiple physical capacities are trained simultaneously through the use of several different training methodologies (28). Similar to the variable (random) training schedule found in motor learning research the goal is to increase overall performance of each capacity simultaneously, while minimizing the detraining and overtraining effect proposed by Poliquin (25). Research in motor learning has shown conclusive evidence that a random practice schedule is far superior to a blocked schedule with regards to retention of the acquired skill (5,6,7,8,9,10,11). In strength and conditioning research, this practice method has also been shown to have superior results. Combining strength and power training concurrently proved better in increasing vertical leap than strength or power training alone (29). In contrast though, when strength training was combined with heavy endurance training, strength (30) and power (31) levels were lower than those whom did strength training alone. In another study, cortisol levels were found to be higher in men whom performed concurrent endurance training when compared with those whom performed strength training alone (32). Below is a single day example of a concurrent (multiple capacity workout for the lower body).

**Concurrent Bulgarian Complex (multiple capacity)
Day 1
Lower Extremity**

Core/Neuromuscular warm up activity

Exercise	Reps	Sets	Intensity	Tempo	Rest Interval
Horse stance vertical knee raise with stick	2-4 reps each side holding for 10-20 seconds	1		Static	Minimum
Horse stance with horizontal raise with stick	2 per side holding 30 seconds per side	1		static	Minimum
Lateral Band Walks					
Standing Med ball Chop sequence	10 per movement (up down/angle/angle/side)	1		Fast	Minimum
Alphabet plank on the ball	Whole alphabet			Slow	Minimum

Strength

Exercise	Set	Reps	Intensity	Tempo	Rest Interval
A1: 9s Eccentric Emphasis Squat	1 2 3 4	A1: 1 rep 9s eccentric		9-0-1	2 minutes
A2: 5s Isometric Squat (overcoming resistance)	1 2 3 4	A2: 2 reps of 5s iso		0-5-0	2 minutes
A3: Supercat Squat Jumps	1 2 3 4	A3: 4-5 reps		X-0-X	2 minutes
A4: Structural Adaptation Squats	1 2 3 4	8-10 reps at 3-0-2 count		3-0-2	2 minutes

This information can lead to much confusion pertaining to which method is superior. Each model has strong proponents and detractors as well positive and negative research findings. The answer to which periodization model is best might be found in the motor learning and control research literature. As stated previously, blocked practice led to higher skill acquisition scores (3,4,5,6,7,8,9,10,11) while a variable/random practice schedule led to higher skill retention scores (5,6,7,8,9,10,11). Perhaps the development of a non-rigid model of periodization consisting of both linear and non-linear organization, based on the trainee’s age, training experience, training

phase, physical capacity needs is the answer. At a younger or less experienced training age, the trainee may incorporate a block (linear) periodization schedule to ensure proper acquisition of technique, muscle activation/recruitment patterns, and gains in musculotendinous strength to ensure avoidance of injury. Looking at it from a motor learning theory standpoint, “acquisition periodization” may be an appropriate title. Once the athlete has matured, technical aspects are mastered, and a foundation of strength is in place, a non-linear periodization schedule may provide additional stimulus to keep the athlete from plateau or overtraining. This form of variable (random) practice schedule will be beneficial in the long-term retention of technique, strength and power gains. Again from a motor learning standpoint, “retention periodization” may be appropriate. If the athlete feels an individual capacity or technique needs attention, a fluctuation back to “block” periodization may be necessary to make the correction.

In conclusion, motor learning theory can have a tremendous impact on strength training theory in that the adaptability of the body depends on the practice schedule imposed upon it. To take from the world of finance and business, the supply (structural, neural, and physiological adaptations of the body) must meet the demands (overload, stressors) placed upon it.

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