

## Periodization: Linear vs. Non-linear

*What is periodization* (Patel, 2004) (Siff, 2003)?

Periodization is a methodical training regime that progressively increases strength gains and conditioning over time, as well as maintains fitness with the goal of achieving peak performance at specific points in a season. With a terminal objective in mind, a coach can prioritize and manage each performance goal by strategically planning over weeks or months for these to lead to this target state. Recognizing that performance is multi-factorial, the periodization strategy is one to attain and sustain long term gains in muscle strength, power and size, meanwhile avoiding detraining once the ideal physical condition has been reached.

*Periodization trends in North America*

Up until the 1970's, classical linear periodization had been the mainstream approach to fitness programming in North America until the non-linear training approach emerged from Eastern Europe. This new spin on periodization was especially significant for coaches and sport scientists of the industry to explore as European countries were (and still are) well known for producing strong and successful athletes in Olympic competitions. This new knowledge forever altered the attitudes toward periodization in the West.

*Linear (classical) Periodization*

Linear periodization is based on the manipulation of fitness skills into manageable chunks (hypertrophy, strength, power) where training volume decreases while intensity increases in a stepwise manner. Each phase builds on the segment preceding it with the goal of peaking performance for the latter portion of an annual plan.

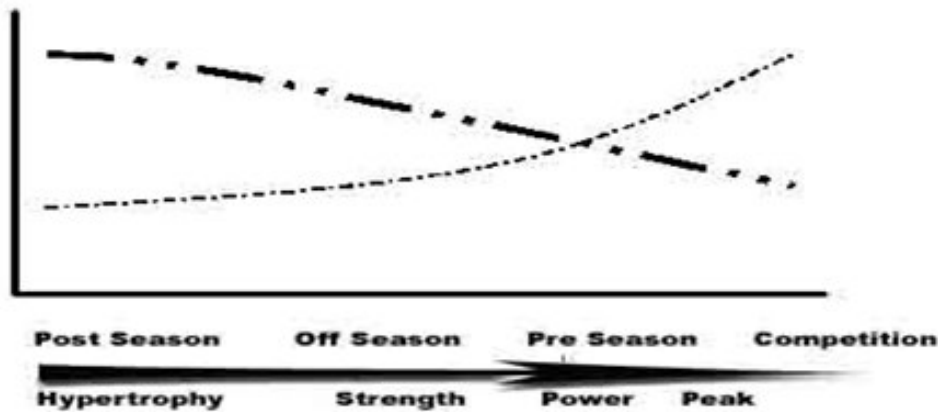


Figure 1. A typical linear model

*Which athletes would benefit from linear programming?*

Application of this method is most effective in untrained athletes as they have a greater capacity for adaptation than trained athletes. The first 6 to 12 weeks will see gains in strength through improvements in neuromuscular coordination, rate of force development, and muscle fibre recruitment patterns. The linear approach is also well suited for pre-season training, appropriate for athletes who want to peak their strength and conditioning for tryouts and fitness testing at the start of a season, as well as those who only have one to three major competitions in a competitive year.

*Non Linear (undulating) Periodization*

Non linear periodization is unlike linear in the way that it undulates; training loads are not necessarily performed in a manner where alteration of volume and intensity follow a pattern. An advantage with using non linear periodization is the flexibility. Training intensity, volume and frequency can conveniently be manipulated to fill the dynamic needs of the athlete. The key to the success of non linear is it allows for more frequent exposure to varying muscle stimuli than linear, therefore consistent fitness gains take place over longer training periods. In scientific studies that compared the results of linear and non linear programs, non linear demonstrated significantly greater gains in strength, muscular endurance, and power.

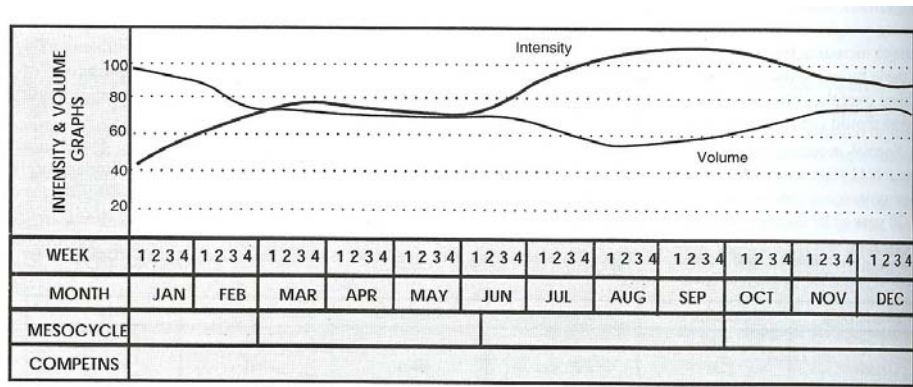


Figure 2. An example of non linear periodization.

*Which athletes would benefit from non linear programming?*

First, as mentioned, an advantage of non linear periodization is its adaptability to the competitive schedule, both in terms of time and volume. It is essential for sports like hockey, basketball or football, that have important competitions regularly throughout the competitive season and varied travel schedules, that the training program can respond to on-going needs within a weekly training plan. In these team sports, the intensity of competitions can vary greatly depending on the opposition and length of rest between games. If the intensity of a game is high, it is likely that the athlete will experience residual fatigue a day or two after competition, limiting their ability to exert maximal power. Utilizing the linear method, if this competition takes place later in the program where intensity is at its highest (Fig.1), a power based workout will limit the benefits gained by the athlete

through weight training. Whereas, at any point in an undulating program, the strength coach can reorganize the training week and postpone the power routine until the athlete has effectively recovered and reinsert the power work out later; so an intense workout can be performed at a more suitable time to ensure fatigue does not adversely affect competitive performance or cause injury or overtrain. Second, coaches using the linear approach tend not to include the fitness skills developed in the earlier stages throughout the program, which is not ideal for trained athletes who have to maintain all fitness aspects in season. Third, non linear programming diminishes the possibility of neural fatigue by varying the number of reps, sets and exercises session to session. And finally, from an athlete perspective, non linear is simply more appealing as the variation keeps sessions interesting.

### *Summary*

As discussed, there are positive aspects of both periodization models and both are helpful in the journey toward a specific trained state. Linear periodization is complementary to sports having few competitions in a competitive year, as well as younger less trained athletes. Whereas non linear periodization holds promise for elite athletes in sports that have busy weekly schedules of travel and competition as well as strength and conditioning.

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