THE MUSCLE AND STRENGTH PYRAMID TRAINING

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PREFACE

While I was creating The Muscle and Strength Nutritional Pyramid a few years ago, I knew that I would eventually need to create a similar construct for training. The problematic issues that are prevalent in the fitness industry are not isolated to the topic of nutrition. Whether the topic is nutrition or training, we are bombarded by sound bites rather than content, generalizations rather than context, and an endless stream of information overload without any sense of priorities. To give some credit to the industry, resistance training is a broad topic in the sense that there are countless ways to provide a stimulus and achieve success, so the confusing landscape of information is understandable. The fact that this topic is so broad is why it took me two years after the completion of the Nutritional Pyramid to figure out an effective way to deliver the same framework for training.

For this reason it's no wonder that people, even highly intelligent people, are so often confused when it comes to the topic of setting up a sound training program. In most cases there is a deep rooted confusion that is apparent in the questions that are asked. Very commonly in the fitness field, you will be asked questions like "Is 531 better than Sheiko?" or "What's the best chest workout?" Well, that's kind of missing the whole point. What level of volume are you currently adapted to? How does your current training load compare to the approach you are planning on starting? Do you understand what stimulates muscle to grow? These queries sound perfectly reasonable, but in fact they imply a fundamental lack of awareness of what is important in the realm of resistance training.

As some of you may already know, I am one of the 5 coaches on a team called 3D Muscle Journey. We are a group of professional coaches who help people pursue their goals with drug-free bodybuilding, powerlifting, Olympic lifting, strongman, and anyone else who may be interested in strength or muscle mass gains. We do this in a couple of formats. We have our weekly coaching service which is primarily for people actually competing who need consistent ongoing guidance, and we also have our one-off consultations which can either be done as a standalone programming service or in sporadic sessions for off-season and general population coaching. Without fail, something that I have learned from consulting with people in these one-on-one discussions is that typically, the reason they aren't getting to where they want to be is because they don't have a system. They don't have an understanding of prioritization, and they can't differentiate between big rocks and pebbles.

I think that honestly, the fitness industry as a whole needs to take responsibility for this lack of awareness. I can't tell you how many articles I run into with titles like "The best leg routine for a massive squat!" or "10 exercises that every bodybuilder must do". These articles give the impression that programs are distinct "things" rather than just the manipulation of volume, intensity and frequency over time. Articles focus on the merits of certain rep ranges, exercises, and weekly routines in isolation. The problem is that we don't perform just one rep range, exercise, or training split; these concepts don't exist in a vacuum. These concepts exist as a part of your training as a whole. To continue to progress into the later stages of development and to reach your full

potential, you need a deeper understanding than these articles provide. You have to comprehend the fundamental reasons of why and how we get bigger and stronger, and then how to manipulate your training to stimulate progress before you start focusing on minutiae in isolation.

As you can see, we've got this fancy little cart here, it's got its lead, but it's hooked up to nothing and it's just hanging out here in front of the horse. Now the horse is sitting here going "Hey, I want to pull this cart, but I can't do it while I'm behind it." This expression of 'putting the cart before the horse' means that you are focusing on the details before you know the context of those details and the big picture.

For example, let's say you're an aspiring race car driver, and you've spent months researching race courses, strategies for competition, mechanical engineering as it relates to improving handling and top speed, and how to select a good pit crew. But you haven't yet learned to drive and don't have your driver's license. This may sound like a ridiculous error to make, but believe me, people do the equivalent of this every single day when it comes to training.

So, I decided to design what I call "The Muscle and Strength Training Pyramid". It is a six step pyramid with Level 1 as the foundation, the most important level. Then, as you move up into Levels 2 through 6 the level of importance gets progressively lower. I also acknowledge the overarching theme of periodization that is linked to all levels of the pyramid. While all elements of the pyramid are important, it's critical that we discuss the most important things before we discuss the least important things.

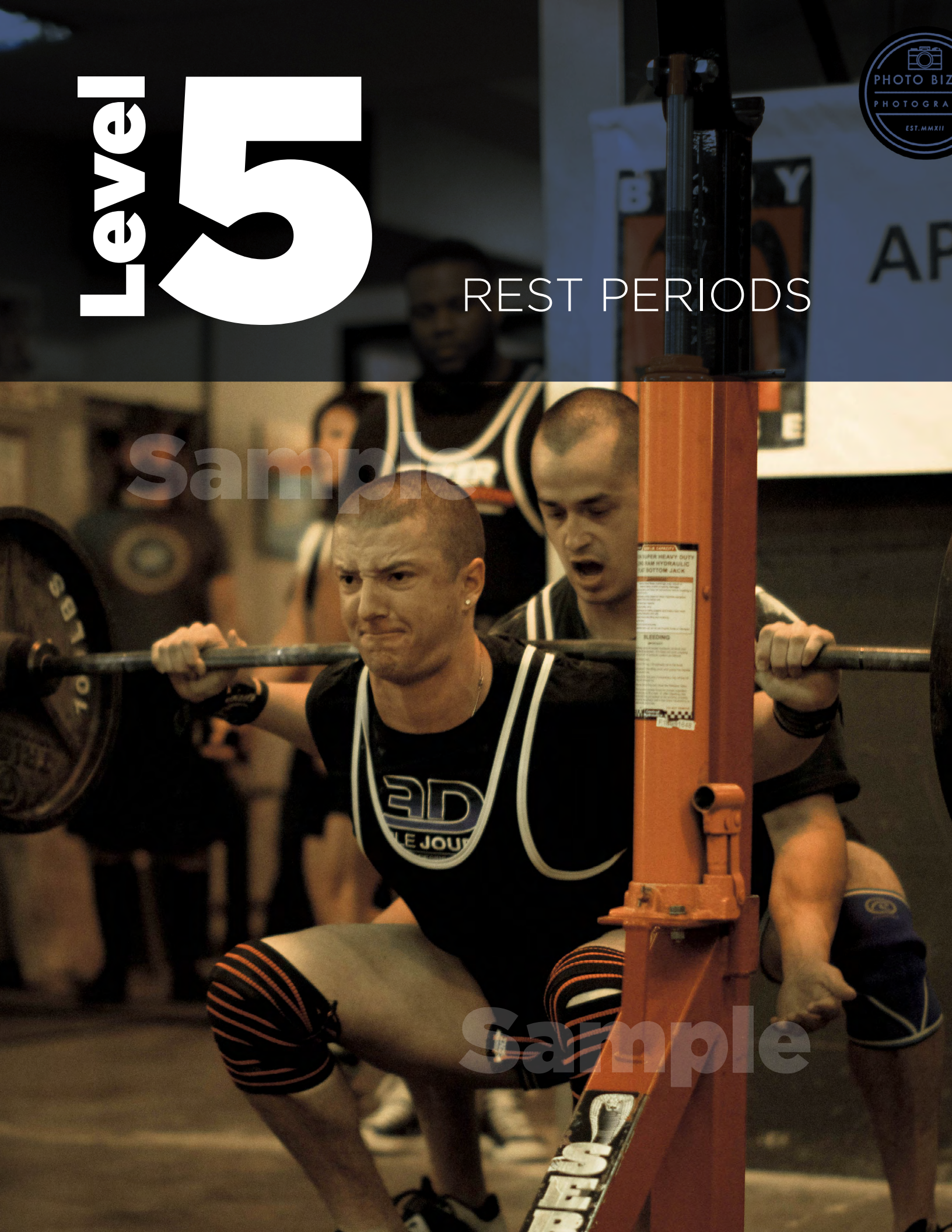
This is the whole reason I've made this pyramid. To help create some context and general guidelines for you to follow in an order that makes sense scientifically for reaching your goals.

Lastly, I also want to let you know what this guide is not. In this book I take the position of focusing on what to do, not what not to do. Frankly, I get extremely tired of the constant stream of myth busting that goes on in our industry. The reactionary approach of "evidence based" professionals is just as maddening to me as the gurus who promote nonsense. Waiting around for a moron to say something stupid just to point out why it's stupid is a waste of time in my mind, and I'd much rather spend time helping you learn what to do, why and how to do it. Got it? Good.

Let's dive in.

Level 5

REST PERIODS



How long one rests between sets has been theorized to be an important variable for resistance training, specifically when the goal is hypertrophy. However, in recent years the mechanisms by which short rest intervals are thought to augment hypertrophy have been questioned and a solid body of research now challenges this convention. In this chapter we discuss the ins and outs of rest periods and give practical recommendations to help you avoid potentially degrading your training quality and also to potentially allow you to complete your training in a more time-efficient manner.

The Hormone Hypothesis

In Chapter 2 we stated that the traditionally recommended repetition range of 8-12 is not superior to other rep ranges for the purposes of inducing hypertrophy for any *mechanistic* reason. Rather, this repetition range is *practically* useful in that it allows you to accumulate volume in a time-efficient manner with a heavy enough load to produce hypertrophy. The distinction between this being the *practical* versus *mechanistic* rep range for hypertrophy stems from the history of the research in this area.

In the late 80s, 90s and through the early 2000's, a large body of evidence was accumulated that seemed to suggest that the hormonal "spikes" that occurred for short periods after resistance training were associated with hypertrophy. These associations were consistently found, and eventually it became nearly a forgone conclusion that if you wanted to optimize hypertrophy, you had to design your training in a way that created the largest hormone (typically growth hormone) spike possible post-training [1]. This body of evidence is what led to the hypertrophy-training recommendations of using compound movements, moderately high repetitions and short rest intervals, because all of these methods caused a large post-exercise hormone response.

This viewpoint went largely unchallenged until the late 2000's when a number of research groups began testing and then subsequently questioning this conventional thinking [2-7]. As was previously discussed, it is now known that to a point there is a linear relationship with volume of resistance training, and hypertrophy. However, higher volumes of training also carry a greater metabolic demand as more fuel is needed to perform more work. Importantly, one of the many functions of growth hormone is to mobilize fuel. Thus, it has been speculated that at least in part, the hormone responses associated with hypertrophy were not necessarily causing the muscle growth, but were in fact caused by the training, which was causing the growth. Meaning, that rather than the hormone response being the *mechanism* causing hypertrophy, it was simply correlated with muscle growth because high-volume training produced a large growth hormone response [4].

This is not to say that hormones have no impact on muscle growth. Certainly we know that anabolic steroids (testosterone) taken exogenously as performance enhancing drugs in supra-physiological amounts can have large impacts on muscle growth and strength [8]. However, continuously injecting anabolic steroids in much larger amounts than are present naturally is completely different than temporary elevations that

occur post-exercise in the much smaller (natural) physiological range. Additionally, growth hormone which was primarily emphasized in the hormone hypothesis, unlike testosterone, doesn't appear to have a significant impact on hypertrophy even when taken at supra-physiological levels comparable to doping programs for a full month [9]. For these reasons, recommendations for hypertrophy training based around post-exercise hormone manipulation have been seriously questioned.

Understandably, this questioning also carried into the research on rest periods. In one study, a group of researchers found that the acute anabolic hormone response was higher in a group resting one minute between sets compared to a group resting two and a half minutes. However, interestingly enough muscle growth in the arm favored the longer rest period group [10]. Most likely, this was because the loads selected in this study were chosen so that the final sets on exercises were taken to failure. Thus, the longer rest period group most likely was able to use heavier loads in training. To conclude, at this stage we can confidently state that the hormonal response to exercise is not the cause of subsequent muscle growth, and therefore the recommendation to restrict rest intervals to enhance hormonal response is unfounded. But, are there other ways that restricted rest periods could aid hypertrophy?

Metabolic Fatigue

Besides progressive tension overload, which is the primary driver of natural skeletal muscle growth in adults [11], muscle damage and metabolic fatigue have also been proposed to play roles in resistance training induced hypertrophy [12]. As was discussed in Chapter 2, the result of effective hypertrophy training is the combination of increased strength and muscular work capacity. As the muscle cell increases in size and its fuel capacity increases concomitantly, the result is an optimized increase in muscle size. Both low and high load training can be used in hypertrophy training. Low-load high repetition training can produce appreciable muscle growth [13, 14] as it forces the muscle to adapt to a high work load and if taken to failure stresses the fiber's ability to keep contracting. For this reason, an argument can be made that by restricting rest periods, one could enhance metabolic fatigue to cause hypertrophy [15]. However, training that primarily emphasizes metabolic fatigue would prove suboptimal if it subverted the primary driver of hypertrophy, progressively increasing tension and volume over time [16].

For example, it is well established that using very short rest intervals can reduce the number of repetitions that can be performed on subsequent sets [17]. Thus, if you restrict rest periods for the purpose of increasing metabolic fatigue to the point where you perform less total repetitions, or have to use lighter loads on subsequent sets, you are essentially "throwing the baby out with the bathwater". Meaning, you have sacrificed total volume for metabolic fatigue.

In fact, the only study that has ever shown the superiority of shorter (1 min) compared to longer (4 min) rest intervals for hypertrophy, was designed so that the participants trained sub-maximally (not to failure) and therefore didn't risk "losing reps" [18]. While

this is a smart way to train in real life (see Chapter 2), as it allows you to perform more volume with subsequent sets and in subsequent days and weeks of training, for research intended to determine the mechanistic effect of rest intervals, this is a confounding variable. If both groups are not training to failure but using similar loads, this would mean that the group resting one minute would be less recovered between sets. Thus, due to cumulative fatigue, they would be providing more stress per set even if the sets and reps are the same. While you could argue that this is the appropriate way to train; restricting rest intervals but not restricting them so much as to detract from subsequent set performance, you also have to remember that in the real world we don't just manipulate rest periods, but also volume and load. Yes, a restricted rest period can be used to induce overload, but if you had the option of doing more repetitions with a heavier load or restricting rest intervals, the option of doing more volume with a heavier load would be the better choice.

Muscle Damage

But what about the role of decreased rest intervals and their effect on muscle damage? First of all, the muscle damage response to decreased rest intervals is inconsistent, and variable between individuals [19]. But even more importantly, we have to unpack the role of muscle damage in hypertrophy.

Like the growth hormone response to high volumes of moderate-load training, muscle damage has to occur to some degree when performing progressive resistance training. Muscle fibers are damaged and must regenerate during the process of completing muscular work. If you complete a large volume of work, there will logically be a larger amount of muscle damage. For this reason, it is difficult to discern whether muscle damage is causative, additive, or simply an unavoidable intrinsic process that occurs alongside resistance training induced hypertrophy.

While this is an evolving field, certainly it is known that in a practical sense, noticeable muscle damage is not required for muscle growth. Meaning, that you don't have to purposely design a training program to elicit damage and cause yourself soreness to ensure growth [20]. In fact, muscle damage can reduce force production capacity which can result in lowered volume and intensity in subsequent training bouts [21, 22]. Indeed, excessive muscle damage can actually interfere with hypertrophy [23]. This is not to say that damage should be avoided, rather that it simply does not need to be sought out. An appropriate amount of damage will occur naturally as you try to ensure progressive overload in your training by following the principles in Chapter 2 and 3.

To conclude, if the rationale for reducing your rest periods is to augment hormonal response, metabolic fatigue, or exercise induced muscle damage, that rationale needs to be reconsidered. The potential detrimental effect of short rest periods on your ability to perform outweighs any potential benefit of short rest periods.

The Final Word On Short Rest Periods For Hypertrophy

If the above explanation of why the proposed arguments are flawed for using short rest periods to augment muscle growth didn't sway you, I have a feeling that the sheer weight of the evidence might:

- De Souza [24] found no significant difference in muscle cross sectional area when comparing rest intervals of 2 min to rest intervals as short as 30 secs.
- In a 6 month study by Ahtiainen [25] 2 minute rest periods were compared to 5 minute rest periods with matched volume programs of differing intensities, and no significant differences in muscle size were found.
- In Schoenfeld's 2014 study [26] using matched volumes in a powerlifting style split compared to a bodybuilding style split, muscle thickness changes were not significantly different in the powerlifting style group using 3 minute rest periods and the bodybuilding style group using 90 second rest periods.
- In our recent review on bodybuilding training, we stated: "no investigation to date has yet found variations in rest periods between 1 to 5 minutes to alter the hypertrophic response" [16].
- In a recent review in Sports Medicine by Henselmens and Schoenfeld on rest intervals for hypertrophy [19] the authors stated: "To date, no study has demonstrated greater muscle hypertrophy using shorter compared with longer rest intervals. Longitudinal studies that directly measured hypertrophy in groups with various rest intervals found either no differences between groups or, in the study by Buresh et al. [10], a higher increase in muscle girth in the group using 2.5-min rest intervals than in the group using 1-min rest intervals."
- In a paper recently accepted by the Journal of Strength and Conditioning Research, Schoenfeld and colleagues found that resistance trained males gained more muscle mass and strength after training using 3 minute rest periods compared to 1 minute (Schoenfeld et al., in review).

As we previously stated, only one study [18] has ever shown the superiority of shorter rest periods for hypertrophy, and this is more than likely due to what I would argue is a study design issue. While on the other hand, the majority of studies show either no difference [24, 25] or the superiority of longer rest periods [10] for muscle growth, which was recently confirmed in a study by Schoenfeld and colleagues (Schoenfeld et al., in review).

A Place For Reduced Rest Periods In Training

From what we've discussed so far in this section, it may sound like the only reasonable recommendation would be to rest as long as you want, auto-regulate your rest periods and then train when you are ready.

In fact, this is a logical conclusion to make. But is there a place for reduced rest periods in training? I would argue that there is, in a way, using a form of training called "antagonist paired sets".

Antagonist Paired Sets

Simply put, an antagonist paired set (APS), is performing one set on an exercise, and then instead of performing a second set on that exercise after resting, you perform a set on an exercise that is the "antagonist" of the muscle group trained on the first set. An example would be performing a set of leg extensions, and then performing a set of leg curls. The joint action of extending the knee, is "antagonistic" to the joint action of flexing the knee, hence the name.

Now honestly, this is something we in the bro community would just call "supersets"; where during the rest interval of one exercise, instead of just purely resting, another exercise is performed. But there is an important distinction. Supersets are often performed with an exercise that trains the same muscle group, while with APS the *opposite* muscle groups are used in the second exercise. For example, a set of shoulder presses immediately followed by a set of lat pulldowns, rather than a shoulder press followed by a front raise. Other examples are a leg extension paired with leg curls, bench press paired with rows, or bicep curls paired with tricep extensions.

Using supersets to train the same muscle group is essentially an approach that emphasizes metabolic fatigue. Often, these supersets are performed in such a way that can actually hamper total volume. For example, if you are supersetting shoulder press with front raises, and using minimal rest periods, not only will you run into the potential issue of "losing reps" like we discussed above, but also the fatigue generated from performing one shoulder exercise will decrease the load you will be able to lift on the other. While you might stimulate a lot of muscle fibers via fatigue and training the shoulders to failure, the total training volume and the mechanical tension will likely be substantially less than had you rested between sets.

Interestingly enough, APS, unlike supersets, can potentially allow you to *increase* performance.

Imagine that you do the bench press paired with a bench pull (commonly referred to as a "seal row" by the cool kids these days). When doing the bench press you're training your pushing musculature, then you go over and you do your seal row. While you're doing your seal row you're essentially resting all of the pushing musculature while you're training your pulling musculature. However, because the antagonists are being moved through an active range of motion but not actively contracting against load, it has been proposed that this might produce some sort of active recovery or potentiation effect that could actually improve performance when returning to the antagonist exercise. In fact, one study on APS for bench pulls and bench press found exactly that to occur; an increase in the volume load performed in the APS group compared to the traditional

group [27].

A review on APS in 2010 concluded that overall this improved performance effect is not always necessarily shown in research, but at the very least structuring training in this manner could be a time efficient way to train that would not harm performance [28]. However, since the publication of that review, more studies have been conducted which found a performance enhancing effect [29] and others have clarified when it might be a bad idea to implement this strategy [30].

So How Does One Implement APS In An Effective Manner?

Well, first you have to remember that despite the practical similarity, the underlying philosophy of APS is fundamentally different from supersets. Instead of ramping up fatigue, you are trying to improve muscular performance to enhance volume. So, when performing APS with compound upper body push and pull movements, you want to ensure the cumulative fatigue doesn't detract from performance, so resting between sets is still important. Basically, you would pair a push and a pull, and complete a set of each in roughly a 3-4 minute period. This allows the completion of one set on the pushing exercise, a rest period of two minutes or so, and then the completion of one set on the pulling exercise [27]. Because these are compound exercises that can produce significant total body fatigue, I would advise auto-regulating your rest periods and simply performing the next set on the antagonist exercise when you feel ready if you don't quite feel ready after a two minute rest period.

When you are performing isolation exercises with APS, such as tricep extensions and bicep curls, or leg curls with leg extensions, there is less total body fatigue to worry about. In the research examining APS for isolation exercises, more repetitions are performed when the rest period is approximately one minute between sets on opposing muscle groups [29]. Thus, you might perform a set of leg extensions, rest one minute or so, then perform a set of leg curls, as an example.

Finally, we do need to talk about when this strategy can go wrong. One study found that performing squats with a 3 minute rest interval, but doing a set of bench press and seal rows during this rest interval, reduced total repetitions performed on squats [30]. Truly, a squat is a full body movement. Even though the legs are the primary movers, the load is supported on the back. Thus, all of the muscles that support the spine and posture have to be aggressively activated in order to perform each rep. Meaning, squats and other movements that require full body effort generate local fatigue in many muscle groups at once, and also generate a lot of cardiovascular stress that can leave you winded. Therefore, for "full body exercises" such as the deadlift, deadlift variants, back squats, squat variants, and lunges it's a good idea to simply rest between sets without doing anything else. I would even argue that powerlifters should be cautious when considering using APS with bench press. Many consider a properly performed powerlifting bench press as a full body movement due to the intended "leg drive" that is used.

Example Programming With APS

Imagine you have an upper body day pairing a horizontal push with a horizontal pull, a vertical push with a vertical pull, and a tricep exercise with a bicep exercise.

Programming this day with APS might look like the following:

Incline Bench	Overhead Press	Tricep Press-downs
~2 minutes rest	~2 minutes rest	~1 minute rest
Seal Row	Chins	Bicep Curls
~2 minutes rest	~ 2 minutes rest	~1 minute rest
Incline Bench	Overhead Press	Tricep Press-downs
~2 minutes rest	~2 minutes rest	~1 minute rest
Seal Row	Chins	Bicep Curls
~ 2 minutes rest	~2 minutes rest	~1 minute rest
Incline Bench	Overhead Press	Tricep Press-downs
~2 minutes rest	~2 minutes rest	~1 minute rest
Seal Row	Chins	Bicep Curls
~2 minutes rest	~2 minutes rest	

Not only will this not negatively affect your performance, it may positively affect your performance. Plus, much of the time you would usually spend sitting on your butt listening to music or getting distracted by Facebook posts will be spent training. You can finish your workout earlier, and accomplish the same amount of (if not more) total volume, while maintaining your loads.

However, make sure you remember when you would probably not want to do this. If you are a bodybuilder and you have a leg day that includes the squat, or a back day that includes the deadlift or if you're doing a deadlift variant, a squat variant, a lunge, or some other movement that requires a lot of full body effort and stabilization, APS would not be advised as it could potentially harm the performance of the main movement. - Rest as much as you need so you can give it all you've got.

Rest Period Recommendations

After all of that information and all of the theory we discussed, in the end, the recommendations are quite simple. Rest until you feel ready to perform at your best on the next set [19]. However, if you happen to be hyperactive when training, or have a history of feeling like you need to sweat, or that you habitually under-rest, it would be a good idea to actually clock your rest periods to ensure you rest at least 1.5 minutes

between smaller muscle groups and at least 2.5 minutes between compound lifts when training in a straight-set fashion. If you are performing APS for upper body push and pull exercises, rest for roughly 2 minutes between sets on exercises, and if you are performing APS for isolation exercises rest for roughly 1 minute.

References

1. Schoenfeld, B.J., *Postexercise hypertrophic adaptations: a reexamination of the hormone hypothesis and its applicability to resistance training program design.* J Strength Cond Res, 2013. **27**(6): p. 1720-30.

2. Loenneke, J.P., et al., *Blood flow restriction: the metabolite/volume threshold theory.* Med Hypotheses, 2011. **77**(5): p. 748-52.

3. Phillips, S.M., *Physiologic and molecular bases of muscle hypertrophy and atrophy: impact of resistance exercise on human skeletal muscle (protein and exercise dose effects).* Appl Physiol Nutr Metab, 2009. **34**(3): p. 403-10.

4. West, D.W. and S.M. Phillips, *Anabolic processes in human skeletal muscle: restoring the identities of growth hormone and testosterone.* Phys Sportsmed, 2010. **38**(3): p. 97-104.

5. West, D.W., et al., *Elevations in ostensibly anabolic hormones with resistance exercise enhance neither training-induced muscle hypertrophy nor strength of the elbow flexors.* J Appl Physiol (1985), 2010. **108**(1): p. 60-7.

6. West, D.W., et al., *Resistance exercise-induced increases in putative anabolic hormones do not enhance muscle protein synthesis or intracellular signalling in young men.* J Physiol, 2009. **587**(Pt 21): p. 5239-47.

7. West, D.W. and S.M. Phillips, *Associations of exercise-induced hormone profiles and gains in strength and hypertrophy in a large cohort after weight training.* Eur J Appl Physiol, 2012. **112**(7): p. 2693-702.

8. Hartgens, F. and H. Kuipers, *Effects of androgenic-anabolic steroids in athletes.* Sports Medicine, 2004. **34**(8): p. 513-54.

9. Ehrnborg, C., et al., *Supraphysiological growth hormone: less fat, more extracellular fluid but uncertain effects on muscles in healthy, active young adults.* Clinical Endocrinology, 2005. **62**(4): p. 449-57.

10. Buresh, R., K. Berg, and J. French, *The effect of resistive exercise rest interval on hormonal response, strength, and hypertrophy with training.* Journal of Strength and Conditioning Research, 2009. **23**(1): p. 62-71

11. Goldberg, A.L., et al., *Mechanism of work-induced hypertrophy of skeletal muscle.* Medicine and Science in Sports, 1975. **7**(3): p. 185-98.

12. Schoenfeld, B.J., *The mechanisms of muscle hypertrophy and their application to resistance training.* J Strength Cond Res, 2010. **24**(10): p. 2857-72.

13. Schoenfeld, B.J., et al., *Effects of Low- Versus High-Load Resistance Training on Muscle Strength and Hypertrophy in Well-Trained Men.* J Strength Cond Res, 2015.

14. Schoenfeld, B.J., et al., *Muscular adaptations in low- versus high-load resistance training: A meta-analysis.* Eur J Sport Sci, 2014: p. 1-10.

15. Schoenfeld, B.J., *Potential mechanisms for a role of metabolic stress in hypertrophic adaptations to resistance training.* Sports Medicine, 2013. **43**(3): p. 179-94.

16. Helms, E.R., et al., *Recommendations for natural bodybuilding contest preparation: resistance and cardiovascular training.* Journal of Sports Medicine and Physical Fitness, 2014.

17. de Salles, B.F., et al., *Rest interval between sets in strength training.* Sports Med, 2009. **39**(9): p. 765-77.

18. Villanueva, M.G., C.J. Lane, and E.T. Schroeder, *Short rest interval lengths between sets optimally enhance body composition and performance with 8 weeks of strength resistance training in older men.* Eur J Appl Physiol, 2015. **115**(2): p. 295-308.

19. Henselmans, M. and B.J. Schoenfeld, *The effect of inter-set rest intervals on resistance exercise-induced muscle hypertrophy.* Sports Med, 2014. **44**(12): p. 1635-43.

20. Flann, K.L., et al., *Muscle damage and muscle remodeling: no pain, no gain?* Journal of Experimental Biology, 2011. **214**(Pt 4): p. 674-9.

21. Zourdos, M.C., et al., *The repeated bout effect in muscle-specific exercise variations.* J Strength Cond Res, 2015.

22. Clarkson, P.M., K. Nosaka, and B. Braun, *Muscle function after exercise-induced muscle damage and rapid adaptation.* Med Sci Sports Exerc, 1992. **24**(5): p. 512-20.

23. Paulsen, G., et al., *Leucocytes, cytokines and satellite cells: what role do they play in muscle damage and regeneration following eccentric exercise?* Exerc Immunol Rev, 2012. **18**: p. 42-97.

24. de Souza, T.P.J., et al., *Comparison Between constant and decreasing rest intervals: influence on maximal strength and hypertrophy.* Journal of Strength and Conditioning Research, 2010. **24**(7): p. 1843-1850

25. Ahtiainen, J.P., et al., *Short vs. long rest period between the sets in hypertrophic resistance training: Influence on muscle strength, size, and hormonal adaptations in trained men.* Journal of Strength and Conditioning Research, 2005. **19**(3): p. 572-582.

26. Schoenfeld, B.J., et al., *Effects of different volume-equated resistance training loading strategies on muscular adaptations in well-trained men.* Journal of Strength and Conditioning Research, 2014.

27. Robbins, D.W., W.B. Young, and D.G. Behm, *The effect of an upper-body agonist-antagonist resistance training protocol on volume load and efficiency.* J Strength Cond Res, 2010. **24**(10): p. 2632-40.

28. Robbins, D.W., et al., *Agonist-antagonist paired set resistance training: a brief review*. J Strength Cond Res, 2010. **24**(10): p. 2873-82.

29. Maia, M.F., et al., *Effects of different rest intervals between antagonist paired sets on repetition performance and muscle activation.* J Strength Cond Res, 2014. **28**(9): p. 2529-35.

30. Ciccone, A.B., et al., *Effects of traditional vs. alternating whole-body strength training on squat performance.* J Strength Cond Res, 2014. **28**(9): p. 2569-77.

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