JUNE 2018

STRENGTH

Muscle Strength vs. Muscle Size

WRITTEN BY: DR. MATT GASTON VILLANUEVA, PH.D.

Goal-specific resistance training is one of the most challenging modes of training to program correctly. It requires a deep understanding of acute resistance training variables and how those variables change over time. These include, but aren't limited to: exercise selection and sequencing, sets, reps, rest interval length in-between sets, and individualization.

Often, I hear the term "strength training" used interchangeably with the term "muscle-building," when, in fact, we need to characterize resistance training in a precise and goal-specific manner. For starters, I want to dive into the differences between 1) resistance training for strength; and 2) resistance training for muscle growth (a.k.a. hypertrophy).

Overall, to optimize your gains in muscle strength or muscle size, it's imperative that you understand how to efficiently and effectively train to achieve each goal.

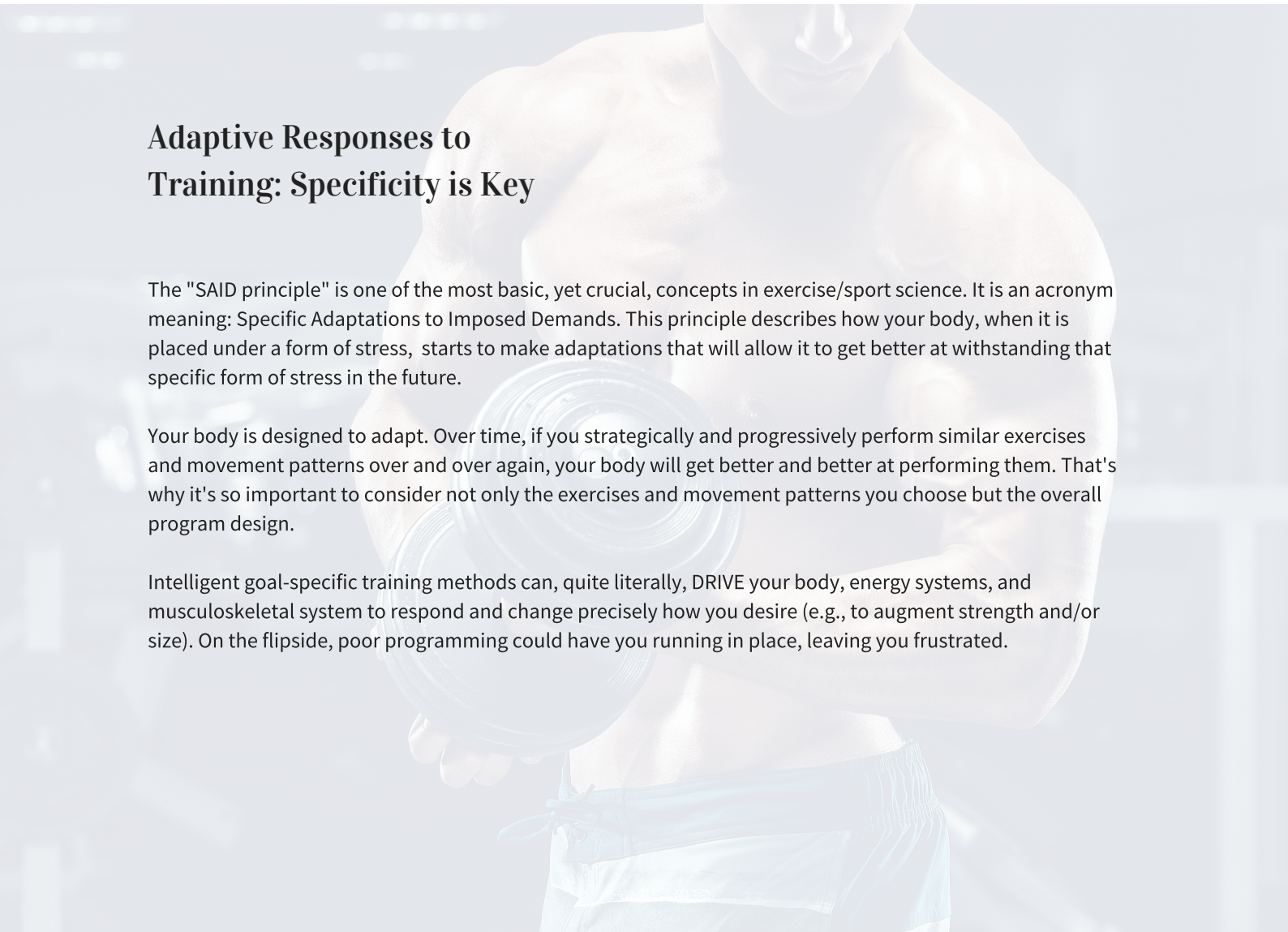
Strength vs. Hypertrophy

As a beginner-level lifter, it's very realistic to achieve a simultaneous increase in both muscle strength AND muscle size at a relatively rapid rate. Physiologically, "newbie gains" are typically categorized by one's ability to steadily enhance strength and size at the same time. However, this phenomenon will not persist forever. As you become more experienced as a lifter, you will need to cycle your training to support either muscle strength or muscle size. This goal-specific approach will be essential for you to experience continued and significant progress long-term.

In terms of training methodology, there are several important distinctions between resistance training for strength (strength training) and resistance training for muscle growth (hypertrophic training). While they often do require the same equipment, movements/exercises, and muscles groups, the key to unlocking either strength or size is how you decide to package all of the acute resistance training program variables together (i.e., the training methodology).

So, what are the main differences between resistance training for strength vs. size, and why and when would you train for one over the other? Moreover, how do you optimize your training methods?

I've mapped out a comprehensive guide, which discusses the basic principles that make each foundational training objective highly distinct. Let's take a closer look.



Adaptive Responses to Training: Specificity is Key

The "SAID principle" is one of the most basic, yet crucial, concepts in exercise/sport science. It is an acronym meaning: Specific Adaptations to Imposed Demands. This principle describes how your body, when it is placed under a form of stress, starts to make adaptations that will allow it to get better at withstanding that specific form of stress in the future.

Your body is designed to adapt. Over time, if you strategically and progressively perform similar exercises and movement patterns over and over again, your body will get better and better at performing them. That's why it's so important to consider not only the exercises and movement patterns you choose but the overall program design.

Intelligent goal-specific training methods can, quite literally, DRIVE your body, energy systems, and musculoskeletal system to respond and change precisely how you desire (e.g., to augment strength and/or size). On the flipside, poor programming could have you running in place, leaving you frustrated.

Dose-Response

Simply put, here's a cycle we should consider when programming for any training target:

Training stress: how are we challenging the body?

Recovery: how are we recovering during and after a workout?

Acute adaptive responses: how are our bodies adjusting to each workout?

Consistent optimized training stress and recovery across time: how are we sticking to our workouts and recovery periods week after week?

Long-term and progressive adaptations in muscular and functional performance: how is our body adapting to the workouts week over week?

However, every single person adapts differently. In terms of individualization, training stress in the appropriate dose simply means not too much and not too little. If there isn't sufficient and consistent stress, then there will be no short (acute) or long-term adaptation or progress.

Conversely, if there is too much stress, you are more likely to experience injury and/or burnout. So, the name of the game is, ultimately, to increase the level of difficulty of your training program - by properly manipulating certain acute resistance training program variables over time - without getting injured or allowing fatigue effects to eclipse fitness effects.

In theory, this seems to be a very simple concept, but to apply it practically and "in the trenches" is truly a science and an art.

The last thing we want from our training methods are performance plateaus, which will occur when the difference between too much stress and too little stress isn't addressed.

From my Olympic-level athletes, to my Division-1 collegiate-level athletes, to my lifestyle clients and fitness fanatics, the greatest and most successful ones are those who are able to endure the highest amount of stress while recovering fully from session to session without injuring themselves.

So, when it comes to resistance training for any goal, keep this in mind:

1) execution, technique, and form are the number one priorities

2) physical change, positive adaptive responses to training, and results take time and, thus, patience

3) your body is hard-wired to survive, and it does this by adapting specifically to the demands placed on it repeatedly

4) resistance training is a well-planned and well-executed interplay between stress and your body

You are fully capable of applying the right type of stress that will transform your body and/or augment your performance capacity beyond its present limits.

Regardless of your experience as a lifter, your age, and your training goal(s), there is an appropriate starting point for you. If you have the right program with inputs and stressors personalized to your goals, you'll see results. So, let's be sure those inputs and stressors are strategic, science-backed, and results-proven.

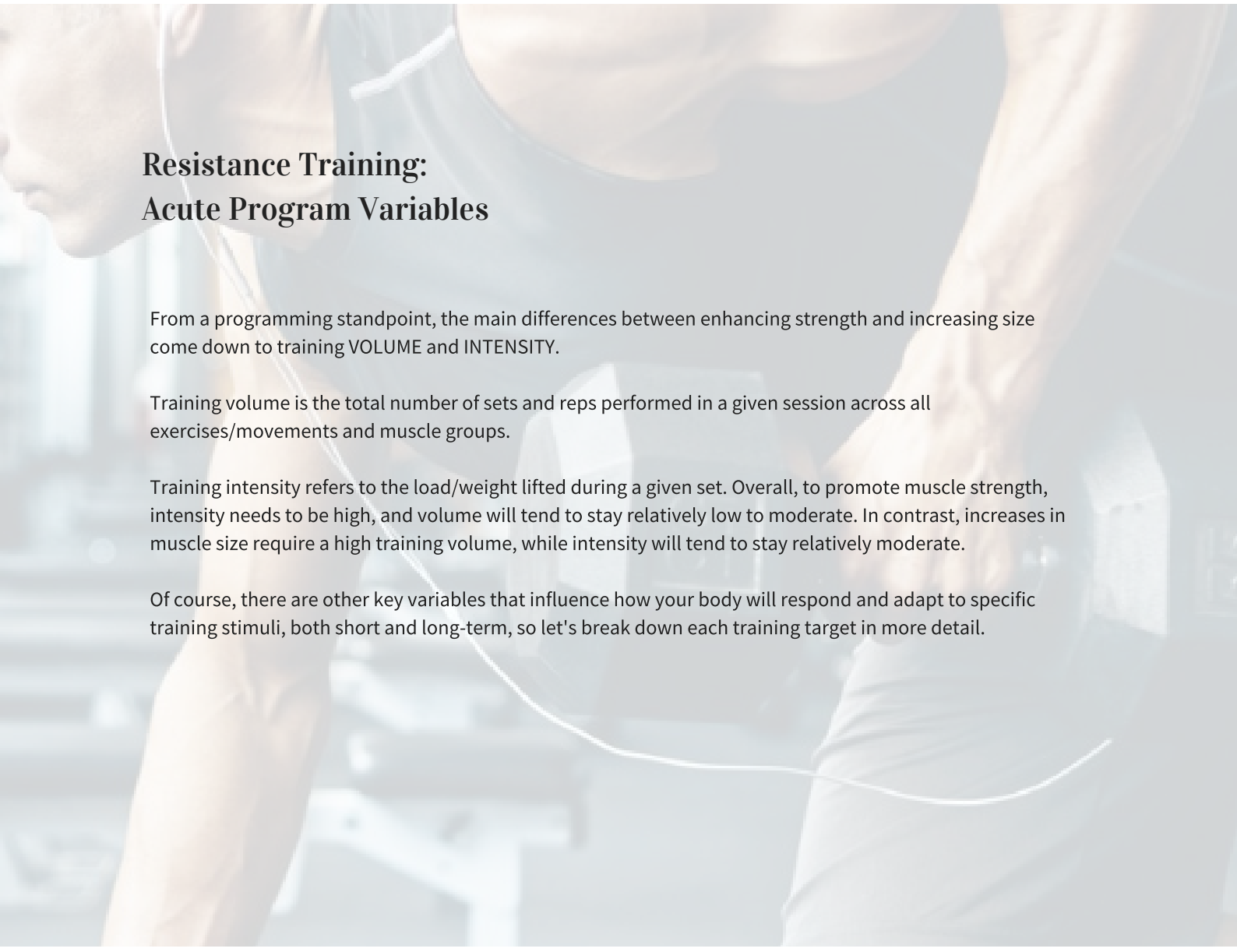
Separating Strength + Size

Muscular strength is defined as the maximum amount of force that a muscle can exert against some form of resistance in a single effort. The primary adaptations that lead to increases in strength are associated with the nervous system and motor unit recruitment patterns.

Muscular hypertrophy is defined as an increase in muscle mass and muscle cross-sectional area. The increase in dimension is due to an increase in the size (not length) of individual muscle fibers. Skeletal muscle adapts to consistent and progressive workloads that challenge the capacity of a muscle fiber. As a result, skeletal muscle can become bigger and more efficient at generating force.

Strength increases and hypertrophy both require progressive overload by applying varying and intermittent levels of stress to skeletal muscle and "forcing" it to adapt. The muscle is able to adapt by increasing motor unit recruitment and/or increasing the size and amount of contractile proteins, which comprise the myofibrils within each muscle fiber, leading to an increase in the size of the individual muscle fibers (i.e., myofibrillar hypertrophy). The latter, defined as a hypertrophic adaptation, in turn, can enhance muscle strength.

A bigger muscle (achieved via myofibrillar hypertrophy) will also be a stronger muscle. However, a stronger muscle will not necessarily equate to a bigger muscle.



Resistance Training: Acute Program Variables

From a programming standpoint, the main differences between enhancing strength and increasing size come down to training VOLUME and INTENSITY.

Training volume is the total number of sets and reps performed in a given session across all exercises/movements and muscle groups.

Training intensity refers to the load/weight lifted during a given set. Overall, to promote muscle strength, intensity needs to be high, and volume will tend to stay relatively low to moderate. In contrast, increases in muscle size require a high training volume, while intensity will tend to stay relatively moderate.

Of course, there are other key variables that influence how your body will respond and adapt to specific training stimuli, both short and long-term, so let's break down each training target in more detail.

Resistance Training for Strength

Sets per Exercise
o Beginner: 2-3 working sets
o Intermediate/Experienced: 3-5 working sets
o Advanced: 3-10 working sets

Reps per Set
o Beginner: 3-6 max effort reps
o Intermediate/Experienced: 1-6 max effort reps
o Advanced: 1-6 max effort reps

Intensity
o Beginner: 1-2 reps short of an **RM
o Intermediate/Experienced: RM efforts
o Advanced: **RM efforts; occasionally employing intensity boosters like training past failure (i.e., with the help of an experienced spotter)*

**RM: repetition maximum, referring to the use of a load/weight that yields a maximum effort for any given repetition assignment

Rest Interval Length in Between Sets
o Beginner: 60s to 2 minutes
o*Intermediate/Experienced: 60s to 2 minutes
o*Advanced: 60s to 2 minutes

*These lifters should consider strategically utilizing supersets/complex work and keeping passive rest intervals in-between sets to an absolute minimum

Resistance Training for Hypertrophy

Sets per Exercise
o Beginner: 2-3 working sets
o Intermediate/Experienced: 3-5 working sets
o Advanced: 3-10 working sets

Reps per Set
o Beginner: 8-15 max effort reps (i.e., not to absolute muscle failure)
o Intermediate/Experienced: 8-15 max effort reps
o Advanced: 8-15 max effort reps; occasionally employing very high volume sets ranging from 20 to 50 reps

Intensity
o Beginner: 2-3 reps short of an RM
o Intermediate/Experienced: 1-2 reps short of an RM + RM efforts
o Advanced: 1-2 reps short of an RM + RM efforts; occasionally employing intensity boosters like drop sets and training past failure (i.e., with the help of an experienced spotter)

Rest Interval Length in Between Sets
o Beginner: 60s to 90s
o *Intermediate/Experienced: 60s to 90s
o *Advanced: 60s to 90s
*These lifters should consider strategically utilizing supersets/complex work and keeping passive rest intervals in between sets to an absolute minimum

As you can see from my breakdown of these primary prescriptive, "variables" details matter when developing a results-driven training methodology, particularly from the scientific perspective.

Overall, regardless of your training goal, you're still going to use "the heaviest weight possible," while executing each repetition of every exercise with the perfect technique and the appropriate amount of volume and rest interval length in-between sets.

To summarize: when all of these acute program variables blend together, I describe training for strength as quality over quantity. The goal is to "ramp up" your nervous system and accumulate more muscle activation across repeated sets while taking an aggressive approach to executing sets/reps.

Training for hypertrophy is best categorized by high amounts of metabolic stress, which stems from hitting a "sweet spot" with training volume, load, AND rest interval length in-between sets; getting uncomfortable (i.e., pushing past "the burn") during your sets; and, preparing for much longer periods of time under tension.

Finally, my doctoral research also suggests that using relatively short passive rest intervals in-between sets is optimal for both strength and hypertrophic training protocols.

Contrary to traditional strength and conditioning programming, when it comes to training to augment strength, relatively short rest interval lengths (i.e., 60s to 120s) help to maximize the hypertrophic response to strength-focused training and can elicit simultaneous increases in both strength and size.[1] This is likely due to a combination of various mechanisms, including the effects that shortening rest interval lengths has on acute (intra-workout) metabolic stress and acute transient anabolic hormone responses.[2]

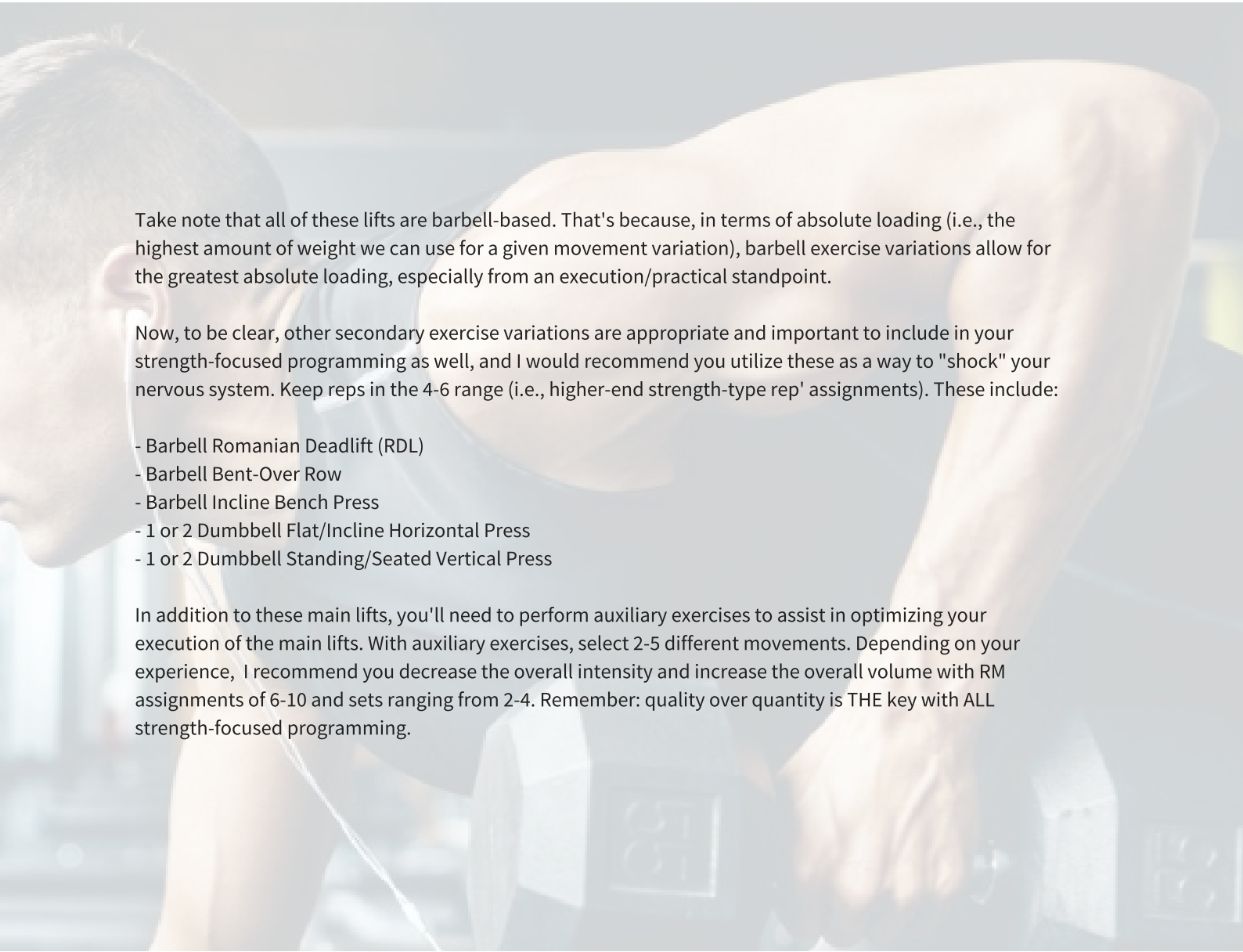
Strength Movement Focus vs. Hypertrophic Muscle Group Focus

Resistance Training for Strength Enhancement

In the realm of strength-specific resistance training, instead of simply saying "I am going to strengthen my [insert the name of any muscle group]," it's important to look at gaining total body strength and taxing your nervous system.

Overall, the main movements that you will incorporate and emphasize in strength training programs are multi-joint and involve (multiple) large muscle groups. When it comes to your highest intensity work and, thus, lifts that you'd hit for very few reps per set (1-4) and very heavy weight, these include:

- Barbell Deadlift
- Barbell Back/Front Squat
- Barbell Flat Horizontal Press
- Barbell Front Vertical Press



Take note that all of these lifts are barbell-based. That's because, in terms of absolute loading (i.e., the highest amount of weight we can use for a given movement variation), barbell exercise variations allow for the greatest absolute loading, especially from an execution/practical standpoint.

Now, to be clear, other secondary exercise variations are appropriate and important to include in your strength-focused programming as well, and I would recommend you utilize these as a way to "shock" your nervous system. Keep reps in the 4-6 range (i.e., higher-end strength-type rep' assignments). These include:

- Barbell Romanian Deadlift (RDL)
- Barbell Bent-Over Row
- Barbell Incline Bench Press
- 1 or 2 Dumbbell Flat/Incline Horizontal Press
- 1 or 2 Dumbbell Standing/Seated Vertical Press

In addition to these main lifts, you'll need to perform auxiliary exercises to assist in optimizing your execution of the main lifts. With auxiliary exercises, select 2-5 different movements. Depending on your experience, I recommend you decrease the overall intensity and increase the overall volume with RM assignments of 6-10 and sets ranging from 2-4. Remember: quality over quantity is THE key with ALL strength-focused programming.

Auxiliary exercises for upper body strength work can include (free weight, cable/machine, TRX, etc.):

For the Horizontal/Bench Press:

o Chest Fly (flat, incline, and/or decline)
o Triceps Extension Isolation (e.g., cable pushdown)
o Shoulder Flexion Isolation (e.g., front raise exercise variations)
o Rotator Cuff Isolation (e.g., band internal/external rotation at the shoulder joint)

For the Vertical Press:

o Shoulder Flexion Isolation (e.g., front raise and side lateral raise exercise variations)
o Triceps Extension Isolation (e.g., overhead triceps extension)
o Rotator Cuff Isolation (e.g., 2 dumbbell bent-over or lying Y's, T's, and W's)

For the Bent-Over Row:

o Vertical Pulling (e.g., pull-ups; cable lat pulldown exercise variations)
o Horizontal Pulling (i.e., non-barbell-based exercise variations, including: 1 or 2 dumbbell bent-over row; machine seated row w/ various grip positions/wrist alignments)
o Elbow Flexion Isolation (e.g., 2 dumbbell hammer curl)
o Rotator Cuff Isolation (e.g., band standing Y's, T's, and W's)

Auxiliary exercises for lower body strength work can include (free weight, cable/machine, TRX, etc.):

For the Deadlift:

o Rack Pulls (i.e., deadlift with a shortened range of motion)
o Deadlift from a deficit (i.e., deadlift with an increased range of motion)
o Stiff-Legged Deadlift (e.g., barbell-based)
o RDL exercise variations (e.g., using 2 dumbbells)
o Knee Flexion Isolation (e.g., machine lying hamstring curl)
o Back Extension Isolation (e.g., 45-degree hyperextension)
o ALL Unilateral Lower Body exercise variations (e.g., lunge, Bulgarian split squat, stationary split squat, etc.)

For the Squat:

o Box Squat (i.e., squat with a shortened range of motion)
o Pause/Box Squat (i.e., squat with a full range of motion using a pause technique at the bottom end of the range of motion to train explosiveness/power)
o Loaded Squat Jump exercise variations (e.g., full range of motion barbell back squat jump)
o RDL exercise variations (e.g., heavy med ball good morning)
o Knee Flexion Isolation (e.g., machine single-leg lying hamstring curl)
o Back Extension Isolation (e.g., stability ball reverse hyperextension)
o ALL Unilateral Lower Body exercise variations (e.g., lunge, Bulgarian split squat, stationary split squat, etc.

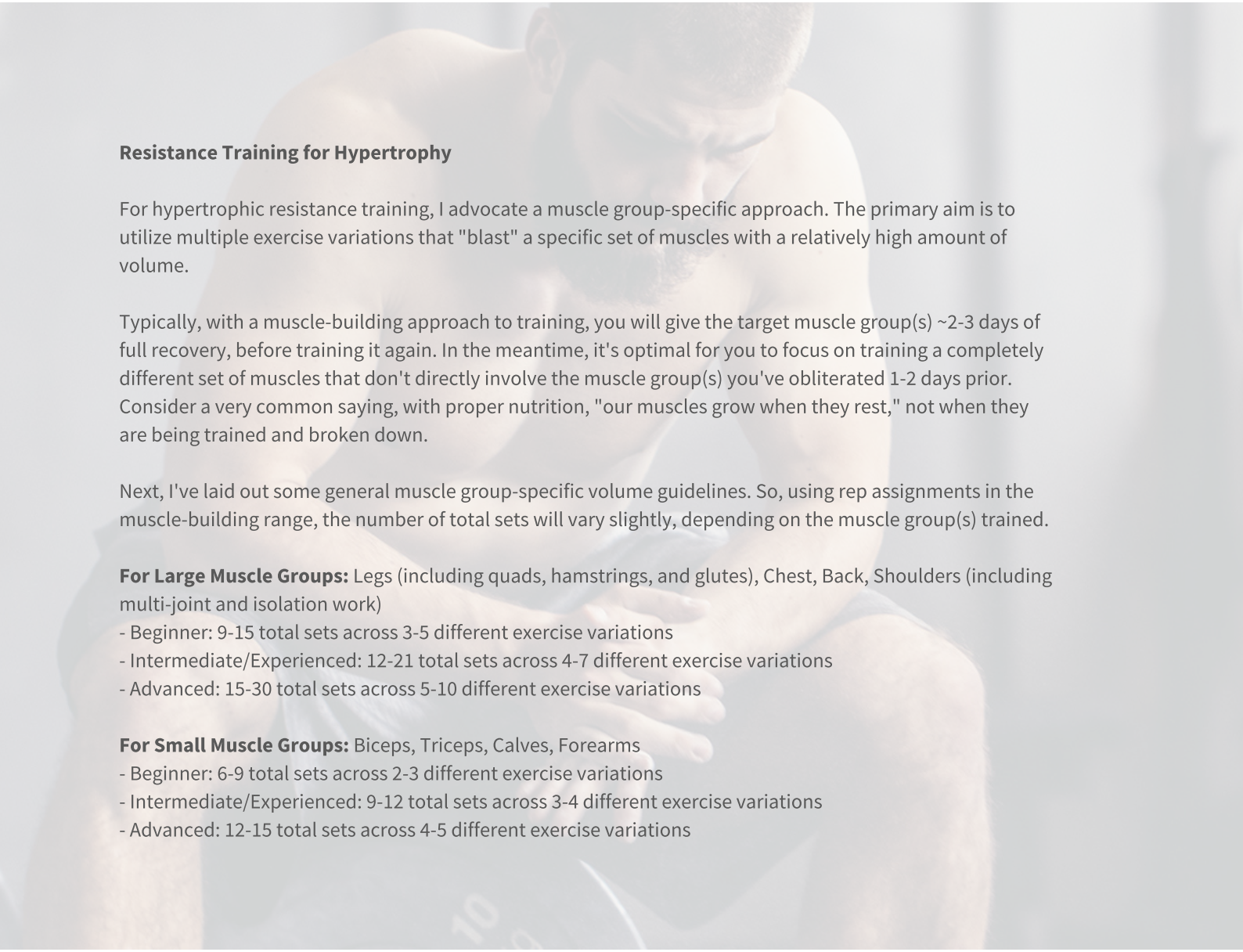
Keep in mind that form and intensity remain the number one priorities for strength training. As you move through a strength-focused workout, you'll likely experience an increase in fatigue. Since you don't want to sacrifice form or intensity, modify the volume (i.e., number of sets) of subsequent exercises following your main lifts.

Lastly, here is a sample strength training split that is appropriate for all levels/training ages and allows for solid recovery between sessions:

Day 1: Deadlift Focus
Day 2: Horizontal Push Focus
Day 3: Squat Focus
Day 4: Horizontal Pull Focus
Day 5: Vertical Push Focus

Other Considerations

Rest Days: Use as needed, typically 1 day off of lifting every 3-5 training days, depending on your training level
Movement Sequencing: Prioritize your weakest movement(s) earlier/first in your training week.
Intra-Workout Exercise Sequencing: Prioritize the main lifts earlier/first in your training session, finishing your lift with auxiliary exercises
Work Capacity: Depending on your experience/training age, goals, and overall work capacity, you can perform two movements in a single strength-focused training session. For example, deadlift + horizontal or vertical push; squat + vertical or horizontal push; horizontal pull + horizontal push or vertical push



Resistance Training for Hypertrophy

For hypertrophic resistance training, I advocate a muscle group-specific approach. The primary aim is to utilize multiple exercise variations that "blast" a specific set of muscles with a relatively high amount of volume.

Typically, with a muscle-building approach to training, you will give the target muscle group(s) ~2-3 days of full recovery, before training it again. In the meantime, it's optimal for you to focus on training a completely different set of muscles that don't directly involve the muscle group(s) you've obliterated 1-2 days prior. Consider a very common saying, with proper nutrition, "our muscles grow when they rest," not when they are being trained and broken down.

Next, I've laid out some general muscle group-specific volume guidelines. So, using rep assignments in the muscle-building range, the number of total sets will vary slightly, depending on the muscle group(s) trained.

For Large Muscle Groups: Legs (including quads, hamstrings, and glutes), Chest, Back, Shoulders (including multi-joint and isolation work)
- Beginner: 9-15 total sets across 3-5 different exercise variations
- Intermediate/Experienced: 12-21 total sets across 4-7 different exercise variations
- Advanced: 15-30 total sets across 5-10 different exercise variations

For Small Muscle Groups: Biceps, Triceps, Calves, Forearms
- Beginner: 6-9 total sets across 2-3 different exercise variations
- Intermediate/Experienced: 9-12 total sets across 3-4 different exercise variations
- Advanced: 12-15 total sets across 4-5 different exercise variations

The top priorities with hypertrophic training are form and volume. As you move through the high-volume workout, you're going to experience muscle fatigue. At this point, modify the loading/intensity of your sets, in order to ensure that your technique remains perfect and that you continue to hit your volume parameters (sets x reps). In essence, in contrast to strength-focused training, the volume must remain high, while loading/intensity is adjusted accordingly and depending on individualized fatigue.

Here are some common hypertrophic training splits that are appropriate for all levels/training ages, which can allow for sufficient muscle group-specific recovery between training sessions:

Single Muscle Group Split: aim for high-end volume parameters for each muscle group.
- Day 1: Legs
- Day 2: Chest
- Day 3: Back
- Day 4: Shoulders
- Day 5: Arms (Biceps, Triceps, Forearms)
- Rest Days: use as needed, typically 1 day off of lifting every 3-10 training days, depending on the individual

Opposing Muscle Group Split: aim for low-end volume parameters for each muscle group, so that the total training volume per session is attainable; it'd be very common to use supersets during all training sessions.
- Day 1: Chest + Back
- Day 2: Shoulders + Biceps
- Day 3: Legs + Triceps
- Rest Days: use as needed, typically 1 day off of lifting every 3-6 training days, depending on the individual

Non-Opposing Muscle Group Split: aim for low-end volume parameters for each muscle group, so that the total training volume per session is attainable; it'd be very common to use supersets during all training sessions.
- Day 1: Chest + Triceps
- Day 2: Back + Biceps
- Day 3: *Shoulders (multi-joint and isolation work)
- Day 4: *Legs
- Rest Days: use as needed, typically 1 day off lifting every 4-8 training days, depending on the individual

*Strategically use supersets on these days, emphasizing multi-joint exercise + isolation exercise supersets and/or agonist + antagonist supersets (i.e., opposing muscle groups)

Total Body Muscle Group Split: aim for 2-3 exercises per muscle group with low-end volume parameters for each exercise (i.e., number of sets/exercise), so that the total training volume per session is attainable; it'd be very common to use supersets during all training sessions.
- Day 1: Total Upper Body
- Day 2: Total Lower Body
- Day 3: Total Body (with large upper body muscle groups and isolation lower body work)
- Day 4: Total Body (with isolation upper body work and large lower body muscle groups)
- Rest Days: use as needed, typically 1 day off of lifting every 4-8 training days, depending on the individual

Putting it all together

Let's briefly discuss short-term and long-term programming for strength and hypertrophy. There is no one-size-fits-all strategy, so see what your body responds best to and, from there, apply your max effort in every single training session.

Phasic Training

A very traditional - "textbook" - approach to programming is to begin a phase of training with a hypertrophic focus and, after several weeks/months, transition into a strength focus.

For beginners and/or individuals who are untrained, in my opinion, this strategy is a must, and ample evidence suggests it's extremely effective at delivering results and predictable outcomes. Further, it will drastically help to ensure an efficient and injury-free progression of training stress.

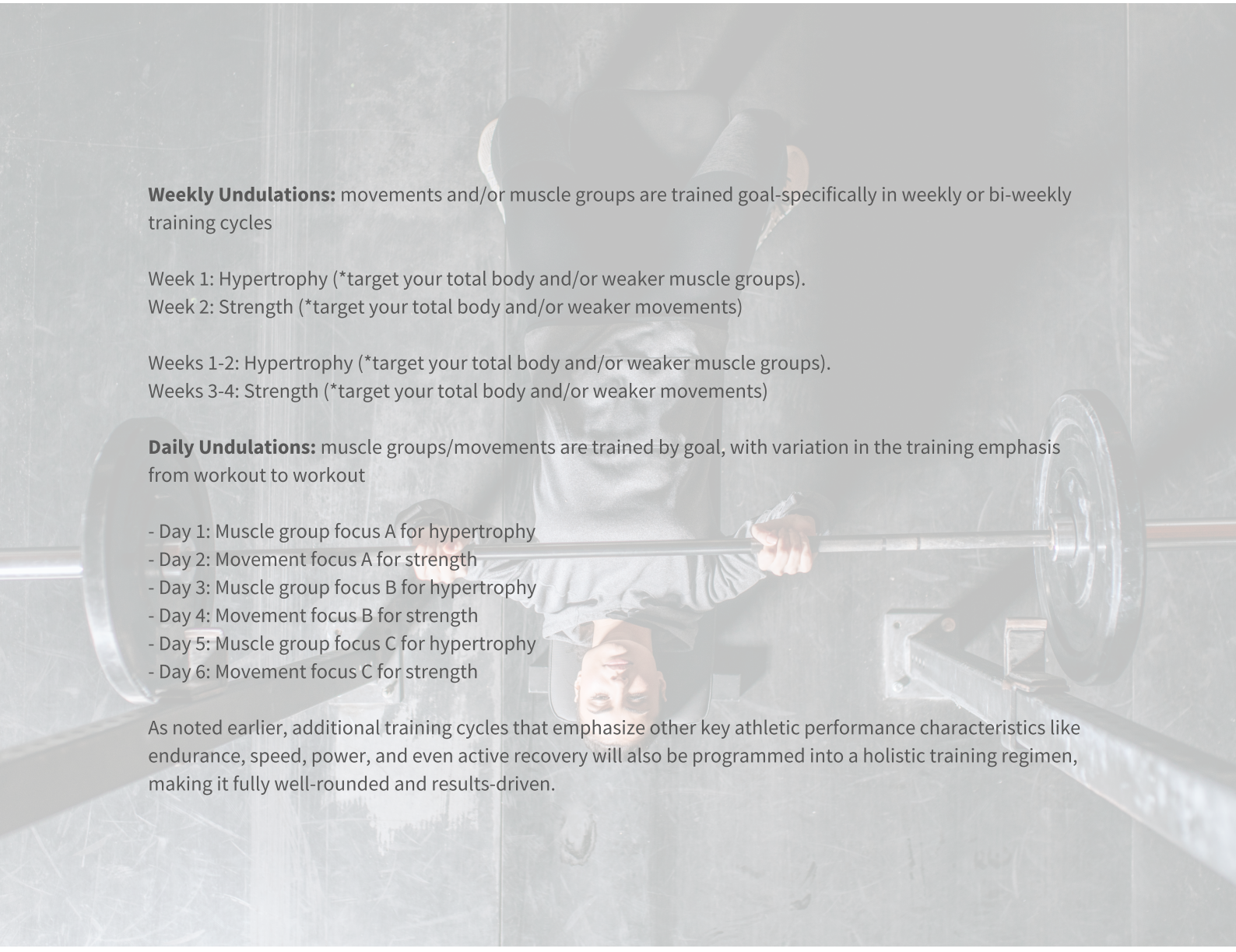
Phase 1 - Hypertrophic Training: 8-12 weeks for beginners/untrained lifters; 4-8 weeks for intermediate/experienced lifters

Phase 2 - Strength Training: 8-12 weeks for beginners/untrained lifters; 4-8 weeks for intermediate/experienced lifters

By alternating these two primary phases of training, you can form a comprehensive training cycle that you can utilize throughout the year. In this case, additional training phases that emphasize other important athletic performance characteristics like endurance, speed, power, and even active recovery will also be programmed into a holistic training regimen, making it fully well-rounded and results-driven.

Undulating Training

This approach best suits a vast majority of athletes/trainees, once they progress into a trained state. The exceptions to this norm may be certain Olympic-level athletes, competitive powerlifters, and/or bodybuilders who may "peak" best when their training is more phasic/linear in nature, particularly across a full training cycle leading up to a very important competition.



Weekly Undulations: movements and/or muscle groups are trained goal-specifically in weekly or bi-weekly training cycles

Week 1: Hypertrophy (*target your total body and/or weaker muscle groups).
Week 2: Strength (*target your total body and/or weaker movements)

Weeks 1-2: Hypertrophy (*target your total body and/or weaker muscle groups).
Weeks 3-4: Strength (*target your total body and/or weaker movements)

Daily Undulations: muscle groups/movements are trained by goal, with variation in the training emphasis from workout to workout

- Day 1: Muscle group focus A for hypertrophy
- Day 2: Movement focus A for strength
- Day 3: Muscle group focus B for hypertrophy
- Day 4: Movement focus B for strength
- Day 5: Muscle group focus C for hypertrophy
- Day 6: Movement focus C for strength

As noted earlier, additional training cycles that emphasize other key athletic performance characteristics like endurance, speed, power, and even active recovery will also be programmed into a holistic training regimen, making it fully well-rounded and results-driven.

Optimization: Bridging Science and Application

Human performance, in both the scientific community and training facilities world-wide, has become all about optimization. Any concept, method, or strategy is always on the verge of evolving into something greater, so that it can, ultimately, yield enhanced efficiency and results.

Thus, the guidelines in this article are a results-oriented combination of cutting-edge science and its hardcore evidence along with real-world effects and evidence-based practice. Because, to develop into the most elite version of yourself, it takes much more than just "good" and "good enough," when it comes to training.

The most effective training programs will be individualized and will undeniably embody a true synergy of what both scientists and practitioners tell us may be optimal. And, still, above all, the practitioners are the ones who have to make executive decisions on how to precisely blend the science and the art of augmenting human performance. Consequently, we will see all of the changes, progressions, optimizations, and paradigm shifts in real-time… a hallmark of being a part of cutting-edge science.

Publication Links:
[1]https://www.ncbi.nlm.nih.gov/pubmed/25294666

[2]https://journals.lww.com/nscajscr/Fulltext/2012/10000/Influence_of_Rest_Interval_Length_on_Acute.19.aspx

About Dr. Matt

Dr. Matt Villanueva is all about "walking his talk," by living a very fit lifestyle, leading by example, and striving to guide you on how to do so too. Dr. Matt is a graduate from the University of Southern California (Los Angeles, CA), where he earned his Ph.D. in Biokinesiology with an exercise science emphasis.

As owner and director of the V-Fit Premier Fitness and Wellness Institute in Tulare, California (vfitbydrmatt.com), Dr. Matt brings over 11 years of high-level education and over 14 years of applied, hands-on work experience with a diverse range of hundreds and hundreds of clients to V-Fit and the holistic fitness, athletic performance, health, and wellness industry, primarily in the fields/areas of: exercise science and applied exercise physiology, exercise prescription and strength and conditioning for individuals across the lifespan, athletic performance/sport-specific training, bodybuilding and physique development training, nutrition for performance and health and wellness, and healthy aging.