

Avoid Fitness Plateaus, Overtraining & Mis-Timed Performance Peaks

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Dr. Andy Galpin

The science and practice of enhancing human performance for sport, play, and life. Welcome to Perform. Hello again, friends. I'm Dr. Andy Galpin, and I'm a professor of kinesiology in the Center for Sport Performance at Cal State Fullerton. What we're going to talk about today is an interesting conundrum that many of you have found yourself in, and I certainly know I have found myself in as well, and that is regarding rest, or taking a day off, or backing off of your workout. You see, we have two conflicting streams of interest here. On one side of the equation, we're either being told or our body is trying to tell us to be smart. Take a day off. Back off. Don't be overly aggressive with your training. Listen to what your body's telling you. On the other end of the equation, we're being told, "Hey, don't be mentally weak," and, "You've got to grind through things, and stick to the plan, and don't listen to your short-term, immediate emotions, and get through the training."

Dr. Andy Galpin

And the answer is both of these are true. So how do you actually balance them? How do you train smart but then also push through when you really don't want to train, but you actually probably should? How should I understand? What do I need to know about my body and my physiology based on my goals to learn what do I need to pay attention to? What should I measure? What should I monitor? What should I ignore? What is noise? What is actually signal? Now, I would love to tell you I have a complete and clear answer for all of you in all of your situations and goals, and I'll unveil to you those in our discussion today, but honestly, that's not going to happen. What we can do, though, is learn a lot about these topics. We can learn a lot more about the physiology of plateauing, peaking, and overtraining. We can learn, in fact, what these things actually are. What are some of the best in the people in the world doing to measure and monitor and intervene on these, and what are other tools and tactics that are scientifically supported that all of us can use?

Dr. Andy Galpin

So within that, I want to talk about trying to optimize for muscle strength. I also want to talk about just general exercise, fitness, and endurance, and as many different areas of human performance as we possibly can. We're going to cover in this plateauing, peaking, and

overtraining. Within each one of these categories, I will talk about what these things are scientifically, what the physiology is behind them. Along the way, I will do my best to cover our three I's. So we'll talk about how do we investigate and how do we measure. In other words, one example would be what actually is clinically officially overtraining versus maybe I'm a little bit tired and should back off a little bit. What is a deload versus what's a taper? Why do these things matter? How should I measure these things? How should I identify if these situations are actually happening? We'll, of course, cover the second I, which is then how do I interpret these, what is actionable, what is not, where these data matter, when they don't, when are they just noise?

Dr. Andy Galpin

And then finally, of course, intervene. And by that, I mean specifically two areas. One being how do I prevent these things from happening in the first place, and then second, if it's already occurred, what strategies do I have to walk myself back to recover to fix this particular issue? So we'll cover as many of these topics as we can. We'll start off getting into plateauing. So we'll talk about why that occurs, again, physiologically, and what you can do about it. We'll then roll into peaking and making sure in this particular case what we're talking about is that you perform on your best on the given day. As you'll hear me say later, there's nothing worse than feeling fantastic prior to competition, and then a couple of days later showing up and feeling flat or slow. Or the opposite. You felt terrible in your race, and two or three or four or five days later, you feel the best you've ever felt.

Dr. Andy Galpin

So not only do we want you to compete well, but we want you to do that on the exact right day. And then finally, our third major category is going to be overtraining. What is it exactly? How do we predict, prevent, and then return back to performance if at all possible? So those are our three big areas today, and I'm excited to jump in. Now, before we go too much further, I'd like to take a quick break and thank our sponsors because they make this show possible. Not only are they on this list because they offer great products and services, but because I actually personally love them and use them myself. Today's episode is brought to you by LMNT. LMNT is an electrolyte drink mix that has an ideal ratio of sodium, potassium, and magnesium, but has no sugar. Electrolytes are critical to proper hydration, which I've been harping on for years, but you can't do that by only drinking water. In fact, many of you will probably remember that I featured LMNT in my YouTube series on optimizing hydration all the way back in 2020, which is obviously long before this podcast even existed.

Dr. Andy Galpin

So I've been a fan of LMNT for a long time. In fact, astute listeners will also realize these hydration videos were the genesis of the Galpin Hydration Equation, named not by me, but by the legendary neuroscientist, Dr. Andrew Huberman. I featured LMNT in these videos because

their blend of 1,000 milligrams of sodium, 200 milligrams potassium, and 60 milligrams magnesium really is different than any other electrolyte on the market and has great scientific support. However, I want to be ultra clear, 1,000 milligrams of sodium is a lot, and not everyone needs that much. In fact, that may be way too much if you don't exercise or sweat much, already eat a lot of salt in your diet, say, from a lot of processed foods, or otherwise have sodium-related medical concerns. I personally use the citrus and watermelon flavors a ton to pre-hydrate before heading out on a full day of training or a long hike or a hunt, since I know I'll be losing a bunch of fluids and won't have many opportunities to take things with me.

Dr. Andy Galpin

LMNT has also just released a new line of canned sparkling LMNT, which I am all about. If you'd like to try LMNT, you can go to drinkLMNT.com/perform to claim a free LMNT sample pack with the purchase of any LMNT drink mix. Again, that's drinkLMNT.com/perform to claim a free sample pack. Today's episode is also brought to you by AG1. AG1 is a foundational nutrition greens supplement. And what's that mean? It means that AG1 provides a comprehensive variety of vitamins, minerals, probiotics, prebiotics, and adaptogens in an easy-to-drink greens powder. Getting your nutrition right is hard for many people. I certainly know that I have clients who really struggle, for whatever reason, to get the proper nutrients from whole food sources. Now, AG1 is not a replacement for eating high-quality whole foods, but it is a great foundational supplement for filling in the gaps where needed. I've also personally found that with many of my clients, AG1 helps move them just in the right direction for eating more high-quality foods because it helps them with cravings, digestion, and many other benefits.

Dr. Andy Galpin

I especially personally like taking AG1 when I'm on vacation or traveling because it helps me just sort of stay on track with my nutrition. I know that missing a few days of getting the proper vitamins and minerals and other micronutrients is not a big deal at all. That's not really how those things work. But for me, again, I just like knowing that I'm kind of staying somewhat on track when I'm definitely not making the best nutrition and food choices of my life. If you'd like to try AG1, you can go to drinkag1.com/perform to receive five free travel packs plus a year's supply of vitamin D3 plus K2. Again, that's drinkag1.com/perform to receive five free travel packs plus a year's supply of vitamin D3 plus K2. Okay, so let's jump right in. Now, you might be thinking to yourself, "Why is he trying to cover plateaus, peaking, and overtraining in one episode?" And the reality of it is, it's because actually I can kind of consider them to be first cousins.

Dr. Andy Galpin

They are not the exact same thing, and we do need to differentiate them, but the global physiology is actually very similar. You really can't understand one without understanding the

other one. So we felt like it was best to cover them at a bit of a high level in one continuous episode. Now, what's important to understand there is when we hear stress, we tend to think of what I call active stress, but it's really important that we understand it's any change in stress that causes adaptation. As an exercise scientist, I tend to gravitate toward, even myself, I think about stress and I think, okay, maybe you added some exercise volume. Maybe you did more physiologically challenging things, and then because of that, you got better. But stress goes the opposite direction as well. So if you remove stress from the equation, you're still getting adaptations. Now, what's actually interesting is we tend to personify this a lot.

Dr. Andy Galpin

So we make things as like a good adaptation or a bad adaptation. We call these eustress or distress, and if that's helpful for you to understand these principles, that's great. And in reality, that's not how physiology works. Not at all. It is simply responding to changes in the homeostatic balance. That's all that's happening. And so when you think about what I call inactive stress, it is things like changing activity patterns. If you want to think about it as being more active, that's great. But it also happens when you're less active. If you go to space, for example, this is a huge stressor because you've now drastically reduced the gravitational pull as one example only on your body, so this causes enormous adaptations. So one more time, and the reason I'm bringing this up is a huge part of peaking appropriately and avoiding overtraining and avoiding plateaus is also managing the active part, training more, training harder, as well as the inactive, the rest, the recovery.

Dr. Andy Galpin

We really don't think about that or should stop thinking about that part as just a null zero. It's not a nothingness. It is actually active stress. So the removal of input is still a stressor, which means it still creates adaptation. And this is the fundamental core principle behind why things like reduced training can cause increased performance and almost always do. And so hopefully that helps you understand when we hear stress, it's not just more, it can be less. And when we hear adaptation, it's not just good or bad. Everything you're doing, every choice you're making, choice to sit down, the choice to take a day off, the choice to train more, it is still a choice, it is still a stressor, which means it still contributes and causes adaptation. To be really direct here, there's a saying we have in exercise science that stress is stress, and that means any stress, a physical stress like exercise, a nutritional stress, a psychological stress, an environmental stress, a light stress, any stress is still treated as an equal stressor in the body.

Dr. Andy Galpin

In fact, your body really can't differentiate. It's not perfectly true, but it gets to a bigger point here. And for the context of this episode, let's really think about these all as equal stress. One really easy example, you might have an increase in adrenaline with acute exercise, right? Acute stress

equals stress response. However, interesting video that you watched or almost getting into an accident in your car could have an equal stress response of adrenaline, and your body doesn't inherently know where the adrenaline came from. It just had an X amount increase in adrenaline, okay? So stress is stress. Now, that all being said then, there's really three scenarios that play out here for our plateaus, peaking, and overtraining. Scenario one is when that total stress load, so all of your stressors, we call this allostatic stress or the allostatic load. So when that stress load is lower than our physiological resilience, we don't get adaptation.

Dr. Andy Galpin

Okay? What's that mean? Well, if we did something that was slightly challenging, but it didn't exceed your body's ability to recover or to handle it, it basically didn't notice. This is kind of like the little brother effect. So imagine your little brother's tugging on your shirt trying to get your attention, and you don't care because it's a tiny little tug. You're not going to change behavior or action because the stress, your little brother, wasn't enough to catch your attention. Now, if we change the scenario and now all of a sudden, instead of this being your little brother, it's your mom or your spouse or a police officer, now all of a sudden it probably caught your attention, you're going to change behavior, right? So stress load is lower than our physiological resilience or our recovery capacity, we have no adaptation. This is the most likely scenario when you're plateauing. Okay?

Dr. Andy Galpin

Now we'll get to other scenarios later that are causing it, but this could manifest itself in things like perhaps you're not having enough calories, you're not training hard enough or long enough, or doing enough volume, or frequent enough. The stress load is not enough for this system to feel like it's overloaded, so it doesn't cause a change. You didn't get its attention, okay? Not always the case with plateauing, but honestly, for most people, it's my first place I go to when they say, "I'm plateauing." We're thinking, okay, we need to push harder, do it more often, or something like that. Okay? One more time, not always the case. We'll get to that second case later. So that's scenario one. Stress is inefficient to cause a change. Scenario number two is the opposite. Now our stress load has exceeded our physiological resilience, and if we give ourselves an opportunity to recover, now we've led to adaptation.

Dr. Andy Galpin

This is exactly what peaking is. This is peaking for competition. This is a race. This is a meet. This is a game you have to play. You did some training. We caused the body to say, "Hey, we need to make some adaptations here." We gave it time to recover, and now we come back bigger, faster, stronger, leaner, more focused, more energy, or whatever adaptation we're looking for. Okay? This is the goal. This is what we're after, number two. Option number three here is a continuation of number two. So imagine that we just continued to make that stress load

even higher and higher and higher and higher, and now we have greatly exceeded the physiological resilience, or we even slightly exceeded its resilience, but we didn't give it recovery time, or it's a combination, right? So stress is way too high for our resilience. We didn't have enough recovery or some combination of both those two. In that case, now we've got a handful of things.

Dr. Andy Galpin

We'll globally call these negative adaptations or maladaptations. This could be plateauing. This is absolutely a case of plateauing, right? Where we did all the training, we're telling the body to adapt, it wants to adapt, but we don't give it the recovery capacity to actually go in and do the work. So that could be our second scenario for plateauing. This is also now when we start rolling in things like over-training or non-functional overreaching, which we'll talk about a little bit later. If you get to this case, we oftentimes will have not only a plateauing or a stalling in progress, but we could actually start having a reduction in performance. Many people, if you've been in sports or competed a lot, especially over many years or decades, you'll know a time that you can think back to right now and think, "Yeah, I trained really hard for that four weeks or eight weeks, and my times actually got worse.

Dr. Andy Galpin

I got weaker. I lost progress. So not only did I stall, I got worse." And that is a legit possibility, that is a physiological result of this scenario where excessive stress load over resilience or not enough recovery capacity. A good example of this would also be injury. So you could've gotten hurt. Just because you got hurt doesn't always mean this is exactly what happened, but you're increasing your risk or likelihood of an injury. Okay? All of those things are consequences of either that non-functional overreaching or over-training, which we will define and discuss later on in this episode. But that's our background, okay? We've talked about the three main areas. One more time, we really ideally would like to spend as much time in two as we possibly can, but the point of this episode is to not give you this, and only this background and theoretical understanding, though I do think it was hopefully very helpful.

Dr. Andy Galpin

It's to get into how do you figure out if you're in one, two, or three? What should I pay attention to? What's actually happening? And then what do I do about it if I do find myself in that scenario where I think I'm in number three, how do I walk myself back? Now, I'll try to give you as many direct examples as possible as we go through this entire episode, but as you saw from the timeframe of this show, clearly there's not one quick answer on this, and that's because of a couple of things. One, like I said a second ago, not all stress is the same thing, and also more importantly, though, not all adaptations are the same thing. I would love to tell you, "Oh, it's just because of too much cortisol," or I'd love to tell you it's because of lack of sleep, or it's all

because of calories. That's not the case. There's not one cause of plateaus. There's not one cause of over-training, and so there's not one thing to measure.

Dr. Andy Galpin

I'll give you a bunch of different options, but there's not one thing I can tell you that you need to track to avoid over-training, or there's not one actual official sign that you can measure that says you are officially over-trained. There's not one thing to tell you that there's a plateau. And then because of all that, there's not one specific tactic or change or protocol I can give you for plateauing for strength, for plateauing for muscle gain. There's not one particular supplement or technology or training program or diet that's going to fix all these problems. So rather than trying to cover every possible option for the mechanism, what to track and measure, and then what to do about it for all of these varying causes, for all of these varying goals, what I'll try to do is just give you some really good, strong examples. In an ideal world, every one of you would have a full understanding of your allostatic load at all times.

Dr. Andy Galpin

So you would constantly be tracking, measuring, and creating normative values for you and your physiology, goals, scenarios, and lifestyles. We would use that to then create what we call a physiological passport, and so as this will unfold a lot in this episode, you don't necessarily want to make judgments based on one metric or one what we'll call baseline. So not a baseline HRV, not a baseline recovery score, not a baseline testosterone level or energy or strength level. Those things meander and move. Some of them are really, really sensitive to what happened in the day. Some of them are not sensitive at all. But until we really understand what's normal for you, then we can start looking at what are called standard deviations. And so what we mostly care about in this field when we're trying to judge, are you really tired today, or are you really actually starting to get over-trained? Or are you just a little bit sleepy today, you should push through it?

Dr. Andy Galpin

A lot of that is being based on, well, we have to understand what's a normal variation for you personally. That's where this idea of a passport comes in handy. Okay? Constantly measuring every single thing in your allostatic environment, and then continually saying, "Hey, you have a normal variation of your HRV of 20%." So if you wake up today and your score is down 15%, I'm not going to care because that's a normal change for you. The next person might be more sensitive in HRV, or more resilient if you want to think about it that way, and their standard deviation is 5%. So if they wake up and they're 15% off, even though you both have the same score, for one person, that second person, maybe that is cause for paying attention, where the first person, that's totally normal. Now, you can imagine expanding that to things like, again, your strength or your mood or sleep or any number of biochemical measures.

Dr. Andy Galpin

That's really why developing a passport is ideal. But that's not always possible. Why do you want to actually go about this? Well, if you do that, you're going to know a handful of things. Number one, you're going to eventually know if you're actually under-stressed. Remember scenario one, when I said some of plateauing is caused by people not actually stressing enough? Well, how do you know? Well, number one, we need to know your baseline. If we're not seeing any markers of fatigue, any markers of reduced performance, then maybe we have a good indication that you actually haven't stressed your body enough. But until we know what that normal response is, that's hard to determine. The second thing you'll know are what we'll colloquially call your load or your readiness. If you are getting some sort of metric of your overall recovery, and we've got this passport for you, we can start predicting things like acute fatigue versus this overreaching.

Dr. Andy Galpin

And so we know in the example that I gave with HRV, don't worry if you're thinking, "What's HRV?" We will get to that later. But we will understand that normal variation versus an actual sign of fatigue. And by doing that, if we have enough data on you, we can actually predict this from happening in the future. Let me give you a couple of really easy examples. We want to know your limits ahead of time. So let's say we put you through a 10-week block of exercise. Could be eight, could be six, 12, doesn't matter. And we just collect data. We don't make any changes based on your wearable data whatsoever. We're just running the program as is, like we're not collecting everything. And then we're able to look at all that information and say, "Okay, when did we notice drops in performance? When did we notice maybe getting sick more often? Were there any injuries that popped up?" And we'll start to identify where your personal threshold is.

Dr. Andy Galpin

And so we'll start to see, hey, okay, this particular line, don't cross this many miles per week. When we cross this many miles per week, we start doing more than that, we start getting hurt more often, or we start getting less return on our investment from a performance perspective, or mood gets really worse. Soreness gets really high. Desire to train gets really, really low. Something like that. You will actually start to find pretty quickly where your own individual lines are. Got to start with data collection, though. In the world of sports, this is a classic example of things like a pitch count. So in baseball, 100 pitches is a very rough number that starting pitchers will pay attention to in the Major League level. If you go to the youth sports, they actually have very specific restrictions. So in high school, they can only pitch a certain amount of innings before they have to have a certain amount of days off.

Dr. Andy Galpin

Little leagues, same thing. And the reason they're doing that is not actually because they know

that that individual kid will get hurt at that level, but they're able to look back at enough retroactive data and say, "Hey, roughly we start seeing this sharp increase of injury once we get past 100 pitches, or a sharp reduction in performance past 100 pitches, or effectiveness." Or whatever the metric is that you care about. And so that's what I'm talking about here. Imagine having some sort of information like that about yourself, and so you can start understanding, hey, in my next program, we don't want to cross this many repetitions of squats, over 85%, because when I do, that's when we've seen problems in the past. Or I don't want to cross this many miles, or whatever the metric is for you. So tracking some data to get a better understanding of your overall load or readiness can be really helpful for predicting future negative outcomes.

Dr. Andy Galpin

The third major advantage to this stuff is you will actually now be able to understand if you've truly crossed the threshold into over-training, and whether or not this thing is actually a chronic issue or you're a little bit fatigued or tired. As I mentioned, there's no official scientific definition of over-training. But what you actually care about is, are you over-trained relative to you? Well, if you don't know what relative to you means, because you don't have this information in your back catalog, then you don't actually know, which means you actually don't know when it's been resolved or recovered or fixed. So having a baseline understanding of what's normal for you allows you to say, "Okay, I'm lower than normal. I've been lower than normal for this long, and now we start trying to climb out of that hole. When am I back to baseline?" Well, without baseline information, you're not going to know.

Dr. Andy Galpin

So even returning from negative consequences becomes suboptimal. We will cover a lot of options for tracking throughout this show, but I actually want to give you something right now, and that is what I call my MVP or minimal viable solution, something I think most people could do for free or basically no cost. So start off, measure something every day or most days in three different areas. Area one is pick something that is objective. This could be a scale, your body weight. It could be a HRV marker, or a resting heart rate, or a respiratory rate, or CO2. Something that is about your body that is not your perception. So that's your objective marker. Number two, pick a subjective marker. This could be your mood, your desire to train, your energy, how well you think you slept last night, anything that is up to your perception of how you're feeling in the world. Then number three is what I call your most severe performance anchor.

Dr. Andy Galpin

This is different for everyone, but what is the one thing that is holding you back the most that you are aware of? What is the thing you are struggling the most with? What is the one thing you're focusing the most on? Maybe you're focusing a lot on your training, and you track your running

volume. It could be whatever. But what is that one major thing that you're working on that is the biggest hole in your game, the thing that is the most key component to you getting to the next level or achieving some sort of progress block, whatever it is you're going after. So to summarize all that again, pick one thing that is objective, one that is subjective, and one that is measuring something in your most severe performance anchor or focus area. Once you've decided on your list, the next thing you're going to do is track each of those for about 30 days. Could be a little bit longer, could be a little bit shorter, but at least that.

Dr. Andy Galpin

I wouldn't take any action based on any of your data for those first 30 days. What you're going to want to look for are anything that lands outside of your normal average, back to that standard deviation, for more than three to five days. So one day of a bad mood, one day of a high body weight, one day of reduced vertical jump performance, not a big deal. What we're looking for are looking back at your 30-day average, getting that score, and then you're tracking after that 30 days. And any time you see something that is more than one standard deviation, and you can Google how to calculate a standard deviation, if you have 30 days of information, that's pretty easy. If you come anything outside of that standard deviation for more than three consecutive days, or say three days out of four, or something like that, use your best judgment, then you might want to consider something is happening.

Dr. Andy Galpin

We are not going to make reactions on respiratory rate being elevated for one day. We're not going to make reactions on my sleep being a little bit down. Too many things play into these scenarios, and it's really acute fatigue. It doesn't tell us that we're plateauing, it doesn't tell us that we're stalling, and it definitely does not tell us that we're overtrained. We might be a little bit fatigued, but remember, causing adaptation requires overload. So a little bit of fatigue when we're trying to cause adaptation is actually what we're looking for. So once we've got that established, if we see a metric that is more than two standard deviations off for more than a couple of days, then you might take action immediately. You're following the program, and you just start really falling off a cliff. And again, as a scientist, I'm actually using a pretty strong definition here, which is two standard deviations off my 30-day norm.

Dr. Andy Galpin

What I'm trying to get the point at here is we don't want to overreact to single days. We want to make sure if it's kind of off for a number of days, three to five days, we're going to pay attention. If it's really off, though, for more than a couple of days, then we might take action a little bit before that five-day window, but probably has to be pretty substantial decrease in numbers before we're going to worry about it. Okay? If either of those scenarios happens, that big change, negative change for a couple of days, or a smaller but more sustained change for a long

time, then we have to start digging ourselves out of the hole, and we got a whole episode to talk about how to do that. I'd like to take a quick break and thank our sponsors. Today's episode is brought to you by Eight Sleep. Eight Sleep makes smart mattress covers with cooling, heating, sleep tracking, and more. I've had one for years, and it is glorious.

Dr. Andy Galpin

I even put one on the bed in my guest bedroom because, as you'll hear me talk about endlessly here on the Perform Podcast, there really is nothing you can do that makes a larger impact on your health and performance than getting tremendous sleep. The Eight Sleep is a game changer because I run hot, or as my wife calls it, I'm a furnace. And that's particularly driven by the fact that I often have to do my exercise training in the evenings, which is honestly not always great for sleep. But this is also the case of many of the athletes that I work with who don't have a choice when they compete. And so being able to cool down immediately in bed does wonders for both sleep latency and sleep quality. Eight Sleep recently launched their newest generation of the pod cover, the Pod 4 Ultra. The Pod 4 Ultra has two times more cooling power, yet is virtually silent and even has snoring detection that will automatically lift your head in a few degrees to improve the airflow and stop you from snoring.

Dr. Andy Galpin

Go to eightsleep.com/perform to save \$350 off their Pod 4 Ultra. Eight Sleep currently ships to the USA, Canada, UK, and select countries in the EU and Australia. Again, that's eightsleep.com/perform. Today's episode is also brought to you by Momentous. Momentous makes supplements of the absolute highest quality. For example, we've long known about the numerous health and performance benefits of fish oil. I've personally been taking it for probably 15 years or more. Now, you can get fish oil anywhere, but personally, I only use Momentous because it's never once given me a fishy aftertaste, and more importantly, every single batch is NSF tested to ensure the lead and mercury levels are undetectable for purity and safety. Their fish oil is pure, potent, and sustainably sourced. Another major benefit is that you won't find any fillers in their fish oil. See, the dirty secret in the industry here is that most companies will add non-EPA and DHAs to their fish oil to keep their, quote, "fish oil count high," but to keep the active ingredients, and therefore costs, low.

Dr. Andy Galpin

And it makes you actually feel like when you're purchasing it, you're getting more fish oil at a cheaper price, but you actually have to double or triple your dose to get the same amount of active ingredient, which means you end up spending more money in the long run Or you don't, and you get worse results. If you want to give their fish oil a shot or any other Momentous product, go to livemomentous.com/perform to get 20% off your order. Again, that's livemomentous.com/perform to get 20% off. So now that we're all on the same page, let's dive

into our three areas, and we're going to do it in the way that makes the most physiological sense, and that's get into plateaus. So why are we stalling? Then get into, well, how do I then get out of that plateau and optimize my performance, all the way to our last category, which is, well, if I didn't do that correctly and I kept going with my training, how did I actually land myself in over-training?

Dr. Andy Galpin

And so that's why we're going to start off and go in this particular order, and we'll get going with plateaus. And the first one I want to get into is actually plateauing muscle growth. And that's because there's actually a lot of scientific research behind the physiology of plateaus. At some point, there is a physiological limit between how much muscle one could put on. But the reality of it is we don't really see that happen very often scientifically. Caveat, of course, there's not extensive amounts of randomized control trials on world champion bodybuilders, although there is some. But the reality is most of you aren't that either. And so for the general person listening here, if you are plateauing with your muscle growth, it's probably not because you've reached your genetic limit. Though it's possible, it's not most likely the scenario. In fact, what's most likely are a number of other things, which is what I'd like to get into.

Dr. Andy Galpin

And probably the most common one is the fact that it's actually normal. Most people think something's going wrong or their training is inappropriate, they have some big issue with their physiology, but the reality of it is a plateau or a short-term stalling is quite normal. And if you think about the basic progression of muscle growth, you will understand quickly why that's happening. We have what are called kind of the newbie gains, right? That's not a scientific term. That's definitely Coaching Andy coming out there, not Science Andy. But that's a nice way to think about it. If you compare an IFBB pro or a world-caliber bodybuilder or fitness or physique competitor to somebody who's first day in their gym, obviously, the rate of progress is much greater in that person who's new to training or in their first couple of years to training relative to somebody who is 10, 12, or even potentially 20 years into their strength training path.

Dr. Andy Galpin

And so number one, it's normal. It does not represent dysfunction to go two, four, maybe even eight weeks with very minimal progress. For a couple of reasons. One, you are actually now slowing down the rate of progress. And so when you first started, it's not crazy to see 4% or 5% increases in muscle size in your first training phase. You wouldn't see that after five years of consistent training. And so you're maybe not plateauing, but the sensitivity of measure is now exceeded. What do I mean by that? If we were to take a muscle biopsy of you and we measured muscle protein synthesis rates, or we actually were to take advanced technology with lasers and microscopes, and we actually looked at the size of each muscle fiber, we could probably

measure and see changes in muscle fiber size. But they may or may not equate to you visually looking and seeing that your biceps muscles are any larger.

Dr. Andy Galpin

And so in this particular case, a lot of people think they're plateauing because their methodology of measurement is their eyeballs. And that's not particularly sensitive, especially when now you've gone from increasing a couple of pounds of muscle every month to increasing a couple of grams of muscle. You just don't have the fidelity in your eyes to see it, so you may actually not be plateauing. That is the most likely scenario. So for muscle size, people will really commonly see these explosions of muscle growth their first three to six months. And then after that, the rate really slows down. It now takes you typically six to eight weeks before you can see a visual noticeable change. So continue to go after it. It's unlikely you're actually plateauing. You've just slowed down your rate of growth. The reason muscle growth slows down as you become more trained is because of the mechanisms of how muscle fibers actually work.

Dr. Andy Galpin

I describe those in a lot of details in our other episode, specifically the one where we focused on muscle. And so I'd encourage you to go check that out if you want to hear about those mechanisms. But what's actually interesting here is that same issue, those limiters to physical domain size, don't exist for strength. And so this is why you will see people who peak or appear to peak pretty quickly with muscle growth, but they don't with muscle strength. We don't have any actual mechanisms in our body that say, "Hey, you can't get any stronger." There's no limitation there. It is a combination of movement efficiency, technique, neurological adaptations, some muscular adaptations. But in the case of muscle hypertrophy, we're talking about almost exclusively muscle fiber size, and that has a limit for the molecular mechanisms that I described in that other episode. So how do you know if you're actually in a progress if you don't have access to a muscle biopsy or a laboratory?

Dr. Andy Galpin

Well, for muscle growth and performance, strength, speed, power, things like that, I really don't get too concerned until we've crossed a four to eight-week window or so. Now, if you're a little bit less trained, I'm thinking more towards that four-week line. But if you're really, really highly trained, I'm looking more towards the eight-week timeline, which is to say, if you're really, really, really, really trained, say an Olympic-caliber athlete, or many years of focused, well-programmed strength training background, and you're training hard for seven or eight straight weeks and we've seen no progress in performance, now I'm going to be concerned you're at a plateau. But if that's you and you're three or four weeks in and we haven't gotten any stronger yet, I'm not particularly concerned because that rate of improvement is small. That said, if you are new to training and you are four, five, six weeks in We haven't seen progress.

Dr. Andy Galpin

Now I might actually be concerned that something else is not dialed in. So that's that kind of time window there. So I'd like to turn our attention a little bit now and talk about what we do know of the physiology of plateauing. As always, we try to have a bunch of references and resources in our show notes. You can go download these papers directly for those of you that like them or want to learn more about the details. I will give you one of the titles of a paper that I found particularly interesting. This is a 2022 paper, so pretty recent, titled "A Subject-Tailored, Variability-Based Platform for Overcoming the Plateau Effect in Sports Training: A Narrative Review." It does a really nice job of outlining the global areas, and I'll try to summarize it now, but wanted to give you that actual resource and direct name of that paper for those of you that want to dive into those detail. So what are we looking at here?

Dr. Andy Galpin

Globally, plateaus can affect any area of your physiology. This is everything from your central nervous system to your peripheral nervous system, your cardiopulmonary, muscle, metabolic, energetic, endocrine, immune. All of these areas are affected and influenced, and influence the development of a plateau. And so because of that, as we said at the intro here, it's not one area that's affected by a plateau or that causes a plateau. So there's not one area that is a target. More likely, because if you think about the immune system, you think about the metabolic system, covering every area of your physiology, you're more likely to see benefits by deploying solutions that target systems rather than local. And so if you feel like, for example, your progress in growing your glute muscles is slowing down, you wouldn't necessarily want to go in and just directly target your glutes. You probably want to do entirely systemic recovery activities or plateau activities because the reason your glutes aren't growing, if they truly aren't, which as we just described, they probably still are actually, but the reason they're not growing is because of a global metabolic issue, a global energetic issue, an inflammation issue, an endocrine issue that is going across your entire system.

Dr. Andy Galpin

So generally, target systems for your recovery or your getting past your plateaus rather than the local direct affected area. Another really cool paper that targets the mechanisms of plateau of muscle growth came out of Jeremy Loenneke's lab at Ole Miss. Jeremy's done a ton of great research in the global areas of muscle growth, and specifically things like blood flow restriction training. But lots of interesting stuff there. The paper there, which I believe is actually open access, is called "The Plateau in Muscle Growth with Resistance Training: An Exploration of Possible Mechanisms." So we do not know the definitive answers here, and so this paper just sort of presented what's possibly happening and what do we know. And in that, they outlined three big categories of potential areas. One is going to be an increase in catabolic sensitivity, which is to say the things that break muscle down get elevated and heightened.

Dr. Andy Galpin

One more time, I'm not saying that is exactly what's happening. That is one potential area with some indirect information, some papers, but more research is needed, and that makes sense, right? So if one of the reasons that you are no longer continuing to grow muscle is because you're breaking it down more or they are more sensitive to the same stimuli, then that would blunt your overall growth. The second area they cover in the paper I think is much more interesting and has a lot more data, and that is the concept that there are molecular breaks in muscle cells that slow down muscle growth. This could be coming, and probably is coming from a number of different areas within the cell, and so I'd like to quickly talk about these things right now. Now, one of these things is what's called the myonuclear domain, such that is to say each one of your muscle cells has thousands of nuclei that hold and regulate your DNA.

Dr. Andy Galpin

This is what controls muscle protein synthesis and therefore actual muscle fiber size. One of the things that can potentially happen, there's been a lot of research, and I've spoken about this in actually a number of my episodes of my guest series with Dr. Andrew Huberman on his show, "The Huberman Lab." You can hear more about that there. But the molecular domain theory says that basically, each one of your nuclei don't want to let your muscle cell get too large because then there's too much area for it to control.

Dr. Andy Galpin

A similar idea is actually there's new evidence that that may or may not be existing, and so I don't know that that's definitively happening, but you can see something in the cell is controlling it and saying, "Don't get too big because we can't control it or some other issues will arise." So that's one particular thing that could be causing molecular breaks. Another one is what's called anabolic resistance. Now, this has been around for a decent amount of time, and it is typically describing aging-related reductions in muscle growth. And so we become more resistant to anabolic stimuli. Where this is coming from is a lot of research that shows that the same amount of protein given to an individual as they get older doesn't stimulate the same amount of muscle protein synthesis. The same thing with resistance exercise. We know both of those are potent stimulators, and for whatever reason, that same dosage doesn't stimulate the same amount of muscle growth as you get older.

Dr. Andy Galpin

We also see things like a preferential loss of fast-twitch muscle fibers as you age relative to slow-twitch ones, and we see it actually differs from muscle to muscle. So it seems to be the amount of resistance or growth that happens in, say, the quadriceps muscles is not the same as the hamstring muscles. So there's something inherent to those muscle groups where some muscles or groups of muscles are totally fine blowing up and getting really, really large, and

others seem to break and slow down that process, and then don't want to particularly grow. For reasons we don't necessarily know. So all that we'll kind of call collective anabolic resistance. And this could be caused by a number of things like epigenetic factors, capillarization. So your ability to get tissue and signals and anabolic agents like hormones into a cell directly impact your ability to grow. This is one of the things we also know happens with aging, is the capillarization goes away, which means we're going to struggle to get the signals to grow in as well.

Dr. Andy Galpin

I mentioned the anabolic hormones, think testosterone here. This is one actually where there's a lot of misconceptions on. Circulating endogenous testosterone concentrations, especially those that get released immediately with exercise, don't actually play a huge role in muscle growth, especially for young people, but they probably do for people that are a little bit older. And so there's a lot of controversy, and you hear people say that back and forth, that testosterone has no relationship whatsoever to muscle growth. With the exception, of course, of people that have no testosterone or disease, situation like that. We're talking generally normal people. But in fact, you'll see that's probably pretty true in young individuals, but not the case in older, right? So some other factors that contribute to anabolic resistance are things like amino acid delivery, insulin resistance, general physical activity, and so on and so forth.

Dr. Andy Galpin

We could continue to go on, but a lot of things contribute to this overall anabolic resistance, okay? Not to take us too far off track here, but just to highlight how multifactorial muscle growth is. Things like that testosterone that I just mentioned, important probably for predicting or being part of the process of muscle growth for older individuals, but maybe not so important for young, unless it is clinically and medically dysfunctional. The same thing can be said for women. In fact, the resistance exercise-induced testosterone concentrations are about 45 times lower in women than they are in men, okay? So women have about 45 times less strength training-induced testosterone response than men. But that said, the amount of actual resulting muscle growth is about equal between men and women, right? The relative increase in muscle size, and this has been shown many times. The relative increase in muscle size with equivalent training, nutrition, recovery, so on and so forth, is about the same in men and women.

Dr. Andy Galpin

And so while testosterone is clearly important for a number of factors, it's not the only thing that determines muscle growth. So it's not the only thing to pay attention to for plateaus, therefore, it's not the only solution. Of course, we are talking about physiological dosages here, not people using exogenous testosterone or hormone therapy, things like that. That will change the equation entirely. And then the third and last thing here that's contributing to these molecular breaks is a new idea called the Sizer model, S-I-Z-E-R, like size. And that's really cool, and it basically says,

we think, we don't know yet, but we think cells have some ability to monitor their actual size and will actually only get to a certain diameter before they actually then decide to split and form a new cell. And there, again, from some of the things I've said, seems to be that this makes sense. We have not definitively shown this, and the world has not accepted this as 100% true, but it actually somewhat makes sense.

Dr. Andy Galpin

And so all of those things combined give you indication that there are some molecular mechanisms that are slowing down your ability to grow and potentially explaining your plateaus in muscle strength, whether you are young or old, depending on your nutrition, your recovery, your training, your innate physiology, what muscle group you're talking about, and a number of other factors. So to recap quickly, the very first one was that increased potential for catabolic sensitivity. The second one was the molecular breaks. And the third one that they bring up in this review paper is reduced anabolic sensitivity. So now the fact that we understand what's plausibly happening, this gives us direct insights about what to do about it or how to prevent it. And the easiest solution here is look directly at your nutrition. So in this particular case, if we know people that are well-trained have a lower muscle protein synthesis and breakdown, which the data suggests does happen, we have less protein turnover, we have less muscle growth.

Dr. Andy Galpin

Okay, great. By knowing the molecular mechanisms, or at least the plausible ones, it gives us insights into what to do about it or how to prevent it. So one of the things we've also seen is people that are highly trained just naturally have less muscle protein synthesis and breakdown in response to a training bout than untrained people. And so if that's actually occurring, we may have to try to stimulate muscle growth by maximizing other routes, not just necessarily resistance exercise. To back up one quick second, we know that strength training, resistance exercise, I'll use those interchangeably, is by far the strongest stimuli to turn on muscle protein synthesis. However, there are other ones as well. And so if we know that our response to that strongest one is suppressed because we're well trained now, then we need to make sure we're maximizing all the other ones to net the biggest muscle gain.

Dr. Andy Galpin

In fact, or if we're plateauing, if you want to think about it that way, then we need to push the hammers on every other avenue to stimulate growth possible. Easiest, most direct one here is protein intake, okay? We need to look at this in terms of potentially total, so maybe increasing the total amount of protein intake. We could also look at avenues like How much we eat per dosage. We could also start getting into things like the quality and specific amino acids within each one of them. Okay, that level of detail may be where you have to go if you are in fact being plateaued in your muscle growth by your muscle protein synthesis, anabolic resistance, or some

other mechanism that we just described. Now, this is particularly important when we're dieting. So we actually know 100%, without any ambiguity whatsoever, it is very clear you can add muscle mass while you're in a caloric deficit. This has been shown many times.

Dr. Andy Galpin

We hear people actually ask this question all the time, "Is it possible?" And I want to say definitively 100% it is possible. There's no question there. However, it's probably only the case for a short amount of time, and most likely in people that are non-resistance exercise trained. If you are even kind of moderately trained, it becomes very challenging to add muscle growth without actually adding more calories. And so this could be one of your first mechanisms. If you've gone the protein route and you feel like this is high enough, and the strength training quality is there, you may simply need to think about adding more calories. So if you are trying to stay really lean, and you don't want to go calories up, well, then you may have to make a personal sacrifice and make a decision there. So that alone, just the caloric intake, could be explaining one of your problems. If you look at folks that are highly trained, what they're typically, though not always, but typically going to see is they will go through phases of training where they will try to gain muscle mass, and because of that, they're going to go into hypocaloric or add calories, and they may add a little bit of fat along the way.

Dr. Andy Galpin

Ideally, we want to add mostly muscle, but you're going to bring some fat along for the ride. And then later on in the year or the next training phase, they will then reduce their fat intake. They'll lose a little bit of muscle along the way, but if you stack those two phases together, on the net, you've added more muscle and you've lost some fat. But it's very challenging to do this at the same time, though it is possible if you are non-strength trained, but probably only for a short amount of time. Another thing you're probably going to have to just become aware of is the fact that there's some evidence in the molecular side of the equation here that larger cells just become more metabolically inefficient. And so if you really are trying to maximize growth there, you may have to sacrifice some efficiency. What do I mean by that? Well, think about it like this. Most actually nutrients are used more towards the middle or interior of the cell.

Dr. Andy Galpin

And so if you, just looking at physics here, if the cell itself actually physically gets larger, then you have more time it takes to transport those nutrients in. You're going to be less efficient, you're going to be slower, you're going to be a little more wasteful. Now, muscle cells are pretty small, and so you think, "Oh my gosh, does that tiny amount really matter?" Well, yes, it actually does. So you're going to lose some nutritional efficiency, which means one more time, that's why you have to go extra calories. You have to maximize that protein or try to bring it higher. You have to start getting after quality and dosages per meal and all those things if you feel like you've

plateaued. I do want to reiterate one more time, I am not saying you have to maximize protein intake, you have to eat six meals a day, you have to maximize quality intake to see any progress at all. That's not what I said.

Dr. Andy Galpin

What we're referring to here are people who legitimately think that they have reached a plateau. They feel like they are trained consistently. Their recovery, their lifestyle, their sleep, their training has been consistent for several months now, and we're no longer seeing more progress. At that point, what do I do? This is where I'm saying, okay, if that has happened, now maybe consider adding more total protein. Maybe consider now playing with dosages per meal, and now maybe consider really breaking down the quality of the amino acids in each one of your protein servings. But this is not something you have to do day one, and I don't want to make people think, like, if you don't do this, you will gain no muscle at all. You absolutely will. We're referring to people who feel like they've really legitimately reached a plateau. One final thing to clarify, and that is we actually don't really know.

Dr. Andy Galpin

There's no papers I've seen that have definitively shown the need for a caloric surplus in highly trained people. We just don't have that out there. So this is just a suggestion based upon inferring what we do have from the molecular papers, and so it would probably make sense that if you're highly trained and you're at that plateau, that just getting more calories will help, but we do not have direct evidence to support that, at least that I'm aware of to date. I'd like to take a quick break and thank our sponsors. Today's episode was brought to you by Vitality Blueprint. Let me ask you a question. Have you ever had blood work done? Almost surely your answer is yes. But the more important question, did you find that it helped much? I know personally, being a young guy with generally healthy habits, I was always basically told, "Everything looks fine. You're right in the middle of the reference range," blah, blah, blah.

Dr. Andy Galpin

That sound familiar? I know personally, I always felt it was pretty underwhelming, but the reality is we can do a lot better. And here's an example. A friend of mine, whose name you would all recognize, was recently telling me that both he and his wife were concerned that something was wrong. See, they hadn't made any changes to their lifestyle, sleep, or nutrition, but they were both really struggling to recover from their normal workouts and had specific issues with attention span and memory. And so they got blood work done and were told everything was fine, you're in the normal range, and that's because it was. But this is a great example of how the value of blood work comes from the interpretation and analysis. And in this case of my friend, their problem was right there on the paper, despite everything being in the normal reference range. One example from their blood work to highlight this was a marker called albumin.

Dr. Andy Galpin

Now, this is pulled up during states of dehydration and down during inflammation, which means if you're dehydrated and inflamed, it's going to be right there smack in the normal reference range, right in the middle. So all I had to do was give them some very quick corrections to their inflammation and hydration, and boom, they were right back to feeling great again within days. Now, candidly, I was able to spot these issues on their blood work pretty much instantly because I've been doing this in our professional athletes for many, many years. But it wasn't until just this year that I teamed up with blood work wizard Dan Garner and built this type of analysis into automated software, which allows us to run over 100,000 calculations on your blood work and spit back detailed descriptions of exactly what's going on in your body, just like I did in this example of my friend. We call this thing Vitality Blueprint.

Dr. Andy Galpin

If you'd like to check it out for yourself, go to vitalityblueprint.com/perform for a special offer only available to listeners of this podcast. Again, that's vitalityblueprint.com/perform. I'll see you there, and let's go. Today's episode is also brought to you by Renaissance Periodization. If you want to put on muscle through science-backed training programs, look no further than Renaissance Periodization. RP, as we call it in the industry, guides users through effective and easy-to-follow lifting programs all through their hypertrophy app. These programs are designed by the absolute best in the industry, including one of my absolute favorite sports scientists and professional bodybuilder, Dr. Mike Israetel. You may recognize that name because I've referenced him and his work countless times over the years. So whether you're looking to put on muscle, gain strength, or both, these programs will help you achieve your goals and have produced results in literally thousands of men and women.

Dr. Andy Galpin

Renaissance Periodization also has a diet app that is backed by the latest science and innovation in the fields of nutrition and takes the complexity out of dieting, helping you achieve your ideal body composition. If you'd like to try Renaissance Periodization, go to rpstrength.com/perform to save up to \$50 off of your subscription. Again, that's rpstrength.com/perform to save up to \$50 off your subscription. So with all that said, I would like to turn our attention now to overtraining. When we talk about overtraining, the reality of it is many of you probably have heard it or used that term and maybe even think you've experienced it. But to be totally honest, and I don't mean to offend you, but it's very, very unlikely any of you have really experienced true overtraining. That term is used incorrectly the majority of the time, and I think it's helpful if then we start this section by actually explaining what overtraining is, what it means, and then therefore we can get into the physiology of preventing it as well as in recovering if it actually does happen.

Dr. Andy Galpin

Because while it's rare, it does actually legitimately happen, and it is really devastating for those folks. So to really start us off, going back to the beginning of the show, what we talked about is adaptation happens as a result of stress. And what we wanted to be in those three categories was category two, right? Where our stress exceeds our physiological resilience, so recovery capacity. We allow some recovery, and then therefore we come back with some sort of compensation. In the sports world, we tend to call that super compensation, so you come back bigger, stronger, faster, more improved, whatever. Well, the reality of it is if you extend that too long into category three, we can really get ourselves into an overtraining. But this is really how that works. The initial step in this process is what we actually call overload, and this is acute fatigue. It tends to take a couple of days to recover from, and when you do that, you get this enhancement in performance.

Dr. Andy Galpin

So you went and worked out, the next day, you may be a little bit slower, a little more fatigued, sore, things like that. So your acute 24- to 48-hour performance is potentially down. But if you give yourself a day or two or three days, you come back, and you come back not only the same, but better, right? That is overload. All effective training programs need some sort of progressive overload. That's the idea. All right. Now, if you put yourself in a position of overload and you continue to do that, so you keep training, you don't allow enough recovery, or you just continue to push the training, you get into a spot that's called functional overreaching. So you've done some overreaching. You've extended your body past what it can handle, but it had a function, which means it was beneficial. Okay, so functional overreaching tends to take a couple of days or a few weeks. This is to say maybe your performance is down, tired, slower, numbers getting worse, but you took a couple of days of either reduced training or entirely off, and a result, you came back not only to baseline, but you got that super compensation.

Dr. Andy Galpin

You got better. You got faster. This is effectively what all training is supposed to be. It's number two scenario, some sort of overload, maybe a short-term drop in performance or metrics, but that resulted in you eventually getting better. What we're after is functional overreaching. If you continue down that, so you continue to train too much or you don't allow recovery, and remember, either side of that equation can be the case, you can get into what's called non-functional overreaching. So this is an overextension of your physiology, and it did not serve a positive purpose. If you feel like you've experienced overtraining, most likely you have been non-functionally overreached, okay? What's the definition here? Well, recovery from non-functional overreaching typically takes weeks to months. So if you've ever been in a situation where you feel like garbage, you feel like trash, everything's going down, you're sore, you're sleepy, you don't want to train, you take a couple of days off and you feel way better, you

are not overtrained.

Dr. Andy Galpin

You were probably, in fact, functionally overreached. You weren't even non-functionally overreached, potentially, because you came back and you were better when you came back. That's normal training overload. Doesn't mean you shouldn't have taken the days off, but that's not over-training. Non-functional overreaching, in order to be there again, you need to have taken weeks to months off to then get back to baseline. Two or three days would not indicate non-functional overreaching. If you were truly in that spot, though, and you still continued to go down the spectrum of too much training and/or insufficient recovery, and you now take months or longer to recover, and your recovery doesn't even get you back to baseline, now you are really in what we will call true over-training. And so it's a bit semantic, I guess, if you want to think about that. It's also very hard to then document scientifically.

Dr. Andy Galpin

So in fact, you will see very little evidence of true over-training in resistance-trained models, in strength-trained athletes, and other sporting scenarios like that. Easier to find in endurance events, gymnastics, and other sports like that, though it is still very, very rare to see scientifically. Lots of documentation of non-functional overreaching, but true over-training is a challenge to get to. As I said a second ago, there's really very little evidence that true over-training happens with strength training. Other negative things can happen, like injuries or performance plateaus, but over-training is hard to get as a direct result of just strength training. Except in this paper, and I love this study so much. What I'm talking about here is a really classic paper from a gentleman who's probably done more work in over-training and overreaching than any other exercise physiologist, and that's Dr.

Dr. Andy Galpin

Andy Fry. So in this, and Dr. Fry did a number of studies like this, but this particular one, they did a one-rep max back squat, and they did 10 sets of that every day. And so what this would look like is a pretty standard warm-up, and I think it was on a Smith machine squat rack. I wasn't in the lab at the time, but they would do a one-rep max, and then you would rest, and you would do 10 of those. And if you failed on one of them, say rep seven, it didn't count. So you were there until you got 10 successful attempts at your one-rep max, and they did it every day for, I believe, 14 straight days. And they did a follow-up study. They did muscle biopsies and looked at a number of things across his studies: catecholamines, beta-adrenergic receptors in the muscle tissue. Lots of metrics over lots of different studies with similar models here. But in this one, they actually followed them for somewhere between two to eight weeks.

Dr. Andy Galpin

In fact, I don't remember this exactly, but I think they followed the individuals until their baseline

one-rep max came back. And what they found was the range was somewhere between two to eight weeks. So some of these people, two months later, had still not gotten back to their one-rep max. So that, to me, I think is the only real documented case of strength training-induced over-training, which that probably would have qualified for. But that said, the protocol's also fairly unrealistic. I have been around a lot of weightlifters and powerlifters, and weightlifters in particular will lift heavy in the same muscle group many days in a row for months at a time. But doing 10 sets of one at 100% one-rep max every day for 14 days, it's not particularly common. But that's really what we're talking about. So you have to probably go to that level of extreme to induce a physiologically over-training state by just strength training.

Dr. Andy Galpin

Doesn't mean you won't hurt yourself or have other deleterious effects, but getting a systemic fatigue to a level that will have these systemic physiological problems is challenging to get to with just strength training. So if you've done a lot of strength training and your performance is getting worse and it's not over-training, well, what is it then? You're probably looking at four possible scenarios. The first is the fact that it didn't actually meet a strict definition of over-training. If you want to look me in the face and tell me, "Andy, my strength is worse, my physiology metrics are down, I feel terrible, and there's all these negative things coming down," I call that over-training. I get it. I am totally understanding of that. It just didn't meet these definitions in this particular case, so no worries there. The second one is it's probably just high transient fatigue. You will get that with strength training for a number of reasons, but if you give yourself a few days, that'll probably go away.

Dr. Andy Galpin

Number three, it could be a mis-timed peak. We will get to that in the next section. You're overreaching, you're functionally overreaching, but you didn't see that performance bump on that day you wanted just because you mis-timed it a little bit, and we'll talk about that next. And then the third likely scenario is lack of available data. As I mentioned, we don't have extensive research on this because it is hard to do. I will tell you from my take, I don't think it's super common. I think you're more likely to run into other issues like fatigue, like joint health injury, before you'll see that systemic shutdown that would cause true over-training. That said, you're much more likely to experience or get on the risk of over-training in things like team sports or moderate to long-duration endurance activities. If that's the case, what should we be paying attention to, to understand if we're actually there or to prevent it from happening?

Dr. Andy Galpin

We can go in a number of different directions here. I want to highlight a couple of things. I want to start with basic biochemistry. So there's a lot of molecular biomarkers that one can look at that are indirect indicators of that. Because this is systemic fatigue, we see disturbances in the entire

chain of immunology, in biochemistry, in endocrinology. There are markers that go all over the place. We've described some of these in the past. This will result or present itself in actual whole-body responses, underperformance, performance drops, muscle weakness, soreness, chronic fatigue, struggles with sleep. Changes in mood, appetite, weight gain, weight loss, changes in perceived exertion, so things feel harder than they used to feel, and so on and so forth. And so really it's like, well, wait a minute. What situation happens which we are progressively overloading and we're not getting more tired, we're not getting more sore?

Dr. Andy Galpin

And so the signs and symptoms of overtraining on the surface are really the same things that happen with just getting closer to competition anyways. So it is, and has historically been, a giant challenge for people to say, "Okay, at what point is this just the fact that I'm getting closer to competition, so I'm more nervous, so I'm not sleeping as well? My desire to work out is going down." All of this stuff can happen in people, and they could be in a normal spot, or they could be in a really bad spot. This is why I do think going to things like blood biomarkers give you that next step of saying, "Okay, are we actually seeing a change in physiology, or is it really these perceptive markers, these whole muscle markers that could just be normal response?" And it is an impossible web to completely unwind, but I will give you what information we have right now. To start you off with, I'll point your attention to a 2017 paper called "Hormonal Aspects of Overtraining Syndrome: A Systematic Review."

Dr. Andy Galpin

Does a really nice job of laying a bunch of stuff out. In that, they will include many of the examples of signs and symptoms that I just mentioned, in addition to things like hydration can change, creatine kinase markers, cortisol awakening response can be altered, growth hormone, so on and so forth. Lots of potential things that can go on that list that you might want to take a look at. One marker in particular I like is the testosterone to cortisol ratio. Now, you'll see data on both sides here. Admittedly, some have found it more predictive, others less so. I have found in my experience that it actually is pretty sharp. It is not, and in fact, I don't think you're going to find any single marker that can definitively tell you if you are non-functionally overreached versus overtrained or anything like that. However, I have found that if you look at this from that passport context, so if you know somebody's history and background and you really start to see that moving, it is something that'll alert my attention, and we'll try to differentiate and see whether that is just the adaptive overload response or if we are really seeing signs that we're going in the tank.

Dr. Andy Galpin

And so you'll see stuff there. Lots of work on this from Andy Fry, who I mentioned. Keo Hakkinen, Mike Stone, other big names in this exercise physiology world have published a lot in

these areas in different models of weightlifting and powerlifting, shorter-term, longer-term studies. So there is actually quite a lot of information. But the T to C ratio for me is more telling of training stress than the individual measures by themselves, meaning the individual testosterone or the cortisol. So I don't really care that much about somebody's testosterone level as a marker of their overtraining or their cortisol level. The T to C ratio would be way more telling for this particular outcome. More specifically, what I'm looking for there is a prolonged decrease in that T to C ratio that has been associated with worse physical performance, reduced muscle protein synthesis, also been shown to predict worse training progress or performance improvements, and the marker we're looking for there is a 30% drop.

Dr. Andy Galpin

So if you see that number drop by 30%, you're likely not recovering enough. Now, I want to say 30% drop rather than give you an absolute hard number because of what I just said a second ago. It's not the number that matters. It's the progress or drop relative to you and your baseline. That's what we're looking for. What's normal for you? If you drop by more than 30%, I know recovery is not enough. If it's less than that, it's probably normal overload, and I'm okay with that. To further highlight a point I feel like I may have just glossed over, and this is the idea that a single biomarker or that baseline number is what matters. It really doesn't. I will explain in detail why you should not worry about that. A really interesting paper from a handful of years ago called "Biomarkers for Sport and Exercise: Tracking Health, Performance, and Recovery in Athletes." That was written by a number of individuals, but one in particular, my old friend, Marin Fragala, who I go all the way back to graduate work with.

Dr. Andy Galpin

Now, this paper was actually, I think, supported somewhat by Quest Diagnostics, so potentially conflict of interest to disclose there. Make that what you will or won't. But nonetheless, what they argue in this paper I thought was really eloquently written, is that, quote, "We determined that a comprehensive performance set of biomarkers should include key markers of, A, nutrition and metabolic health, B, hydration status, C, muscle status, D, endurance performance, E, injury status, and F, inflammation." What they've really done there is the layout and say, if you really want to understand the state of the system, you need to have markers from each one of those areas. This is exactly what I do in my coaching practice, exactly what we do in all of our biomarker companies. You have to look at this thing in a well-rounded way. There are lots of different markers you can pick within them. We have the ones we use at Vitality.

Dr. Andy Galpin

We have slightly different ones we use in our coaching system at Rapid Health and Performance. You can use different ones. That's fine. The key value I think here is the two things. One, it's not the baseline number that matters. It's how these things are changing for you.

And two, picking markers in different areas so that you see something in hydration and inflammation, but maybe your anabolic hormones didn't change. That's really key to know. Something from the muscle performance measure changed, or something from injury prediction changed, but maybe inflammation didn't. You want to know that information. So you want to have well-rounded understanding if you're going to choose to use molecular or blood biomarkers to track or monitor your overtraining. You don't have to, but if you're going to choose to, I would recommend using an approach like this that they've done in this particular paper.

Dr. Andy Galpin

The paper actually does a really nice job of giving you 10 or up to even 20 different markers you can select for each one of those major categories I just talked about. And so you're probably not going to do all of them in every scenario, but if you were trying to build something like this, it gives you a lot of information to get you started on that journey. Now, I would love to take you through all of these biomarkers and ratios and patterns that you can use to understand what's happening in your physiology, but for the sake of time, maybe we'll just stick to one specific example.

Dr. Andy Galpin

For no particular reason, what I've chosen to go after is markers of overall protein status. And so we've talked a lot in this episode about muscle growth and breakdown, and even if you're interested in fat loss or even performance, you still almost always want to preserve muscle. So for those reason, I've picked it and said, "Okay, let's make sure that along our training that we're not losing excessive amounts of protein." What you wouldn't want to do is just pick a marker in blood called total protein. That's actually something you can have measured, but it's not the only story. You should look at other factors that reflect overall protein status, like albumin; globulin, which is a calculated number, actually; blood urea nitrogen, or what's called BUN; nitrogen balance; and then overall amino acids. That would give you the most accurate representation. Couple of quick examples of this, if we look at something like albumin.

Dr. Andy Galpin

You wouldn't want to base all your information just on this, because it is what's called an acute phase reactant, which means it is actually reduced in cases of inflammation, but it is increased during dehydration. And so if you are slightly inflamed or slightly dehydrated, albumin might actually look like it's in the right spot, despite the fact that you clearly have other signs of dysfunction happening. And albumin specifically does a number of things. It is associated with growth hormone concentrations, although we don't necessarily know why. And so we need clarity as to say, what is albumin, why is it there, and what, in this case, is a normal number for high performance? That's not something defined in literature. And so if you were just looking at albumin and you're wondering if this is showing signs of potentially getting into over-training, you

wouldn't actually know what number to look for.

Dr. Andy Galpin

Not in the literature anyways. I certainly know what we look for in our case based on our experience, but not something you would find in the scientific literature. Now, I mentioned a second ago that you would want to pay attention to this total protein status if you want to preserve muscle, but you may also realize that it's associated with a lot of other things like total protein intake, overall catabolic state, which is the example I gave a second ago, but also fever and infection, glucocorticoid dysregulation, hydration, hepatic or renal urea excretion. So you can learn a lot of information about your overall health outside of just are you preserving all your muscle or maximizing muscle growth by really doing a comprehensive analysis of overall protein status. Similar to albumin, you could look at something like BUN. Now, we know that that's low in the cases of low protein intake, malnutrition, or starvation if we're getting extreme, or even impaired liver function.

Dr. Andy Galpin

It's high during lots of exercise, so it could be a normal thing that's happening, as well as high protein diets. And so you can run yourself a little bit of an algorithm to figure out if something's really happening here. In the absence of a true disease state, here's something to pay attention to. Now, this is kind of that next level of saying, how do these biomarkers combine to give us insights as to what's happening? In this example, if you have a low total protein marker, you have low albumin and high BUN, you're probably not having enough dietary protein. Right? We can actually walk back and figure out that's actually most likely what's happening. And so rather than me just saying you all need to be at one gram per pound, we can actually look at the markers and say, for you and your physiology and your situation right now, it doesn't matter what number we picked in terms of an intake, we're clearly seeing blood markers that suggest you're not eating enough.

Dr. Andy Galpin

So for your physiology, it might need to be more wherever that number is that we started.

Dr. Andy Galpin

Additionally, if that, if you're looking at somebody's dietary record and they are eating high amounts of protein, and you still came back with low total protein in the blood, low albumin, and BUN was high, then you will actually learn and say, "Hey, something else is actually happening here. Potentially, there is some sort of disease or actual clinical issue here, and we need to look elsewhere or refer out to a doctor of some type." So that's just one little example of how you can use these markers that can directly inform your action that's giving you an understanding, a state of whether you're not in dysfunctional overreaching, overtraining, or otherwise fine. Now, as I've been threatening several times now, I could go on and on, but I will stop there for the sake of

your listening experience, and we'll come back to some of this stuff in other episodes or perhaps next season. But to summarize where we got to with overtraining itself is actually fairly rare.

Dr. Andy Galpin

Most likely, you're either non-functional, overreaching, but in fact, a lot of the times, we're not even there. It is just overreaching, and we have not yet realized the performance benefits to it because we haven't matched it with recovery. The next section we're going to go into then is to making sure we actualize and get all the results from the training and hard work we put in by appropriately peaking, or what we will call in the literature, tapering. To start us off, I want to go back to the very beginning, and we talked about those three different states. State one, stress load is too low over physiological resilience, and we get plateaus or no adaptation. Point two, stress load exceeded physiological resilience. We allowed for recovery, and therefore, we got adaptations, and we were peaking. We just got done talking about number three, too much stress, not enough recovery, negative outcomes, overtraining.

Dr. Andy Galpin

So what do we need to do? What does recovery look like? How do we need to plan this stuff out? And what does the scientific literature say about peaking or tapering? As we get started, I actually recently made a tweet about this and was stunned by, number one, how popular and interested people were in it, but the fact that there was some confusion, clearly, on tapering versus periodization versus deload. When we talk about things like a deload- That tends to be a day off. You backed off for a week or two. This is something that can be done in response to just how you're feeling. Maybe you got sick that day, maybe feeling a little bit tired, and you backed off a little bit. It also can be planned. So a normal periodization or program design structure is often things like three or four weeks of intensified training with a planned week or 10 days or two weeks of deload. Okay? Super effective.

Dr. Andy Galpin

Something we would strongly encourage for muscle strength, for speed, for power, for endurance, and many other factors. So training for performance enhancements in physical attributes is a good idea to have some sort of back-off or planned periodized approach. That's not what we're referring to in this section. Taper is a specific time where we're going to extend that deload prior to competition. Fundamentally quite different. So that's what a deload is. Let me now walk you through and explain what an actual taper is, how it works, why you should do it, how much it will benefit you, and the research behind exactly what to do for your volume, intensity, frequency, exercise selection, and more. Tapering is incredibly effective at enhancing performance because of the basic model that we call fitness minus fatigue. So your physical fitness, sometimes described as your VO2 max, but in this case, even colloquially, your strength, your agility, your coordination, your skill, all those things we'll just call fitness.

Dr. Andy Galpin

So your physical attributes are actually pretty stable, and specifically, your VO2 max and aerobic endurance conditioning are quite stable. Your fatigue, though, is highly transient. Okay? So think about it this way. If you took the day off today, you would not get any weaker. You would not reduce your VO2 max. Nothing would change in your fitness. However, taking a single day off can dramatically change your acute fatigue. Some extra rest, some more food, a little bit of caffeine or stimulants can immediately change your perceived fatigue level. So if we think about fatigue being transient, of course, you can be fatigued often for a long period of time, but the actual effects of it are transient. They're acute. Fitness is pretty stable. And so if we know that, we can say, okay, prior to competition, we want to maximize our fitness but reduce our fatigue. So if we give ourselves some more energy a couple of days or so prior to competition, and we reduce fatigue, we're not going to compromise our fitness, and therefore, we should perform at a higher level.

Dr. Andy Galpin

And the literature will basically support that. In fact, I'll just tell you right now, I'll jump the gun a little bit. I don't know of a single paper that has ever appropriately designed a taper program and failed to show benefits. It is really quite strong, the well-roundedness and support for the performance-enhancing benefits of a reasonable taper. What's a reasonable taper mean, and what are those performance benefits? It can be quite extensive, and it can range. There are studies showing up to a 28-day-long taper of up to 70% volume reduction still don't come with performance drops. Now, it depends on how you're defining performance, so let's start talking details. So what do we know? It's been well documented. A really nice review from my friends Jimmy Bagley and Kevin Murach called "Less is More? The Physiological Basis for Tapering in Endurance, Strength, and Power Athletes." It's a little bit older at this point, I think about nine years or so, but it is a really nice, easy-to-read document that is open access, so you can check.

Dr. Andy Galpin

In that paper, you will see performance benefits in cycling, swimming, running, rowing. From the strength training side, weightlifting and powerlifting and Strongman, Highland Games, bodybuilding, even more recent research on CrossFit, team sports, volleyball, soccer, rugby, et cetera. And it all seems to show a positive benefit from taper. And the benefits are really well-rounded, and so it actually comes in what we call the whole body to gene to cell to everything else in between. There are molecular responses at the single fiber level. There are changes in strength and performance and sporting outcomes, winning more games, so on and so forth. So I'm so confident in these data because it's been done in so many populations, in so many different laboratories, in so many settings, in so many sports. It's at the cellular level, it's at the performance level, it's at the psychological level, and it is, again, almost all pointing in the same direction, which gives you tremendous confidence that this is a real and is a really

important phenomenon.

Dr. Andy Galpin

My favorite example that I'd like to take you through in detail is another paper that I co-authored. I was not in charge here. This was done when I was a doctoral student, but it was done by my friend Nick Luden, and this was a really fun paper. We did a study in which we looked at a collegiate cross country team, and we did this in season, which was awesome. So shout out to all you people that helped out with that as participants because it's hard to get athletes in competition to do a study like this. And so we looked at them. We did performance testing, VO2 max, muscle biopsies, both pre- and post- a three-week taper in season. So we actually did this, I think, three weeks before their conference championships, did their post-testing right before, and then the data collection actually happened in their actual races. And so when we say that we saw about a 6% average improvement in race performance, it was looking at their race times at conference championships as well as the three weeks before.

Dr. Andy Galpin

So what happened is we let these athletes just do whatever they were going to do for their normal taper, and they eventually did get to about a 50% reduction in volume by the third week. What that specifically looked like was week one, they dropped their volume by 27%, so volume was at 73% of peak. Then it went from 73% to about 73%, and then down to 50%. And they did this mostly by reducing their moderate intensity training. So they kept their high intensity speed stuff, their race pace stuff, or even above race pace. They kept their long, slow recovery runs, and everything else in between they cut. Now, we didn't ask them to do this. We just said, "Do what you want to do." And that's basically how they chose to do it. So that's one model of it for an endurance athlete. I already got to the end here, which is to say that their performance significantly improved. But I think what was most interesting is despite the fact that they got to a 50% reduction in mileage per week, we tracked heart rate, we tracked all these other things, but I'm kind of just cutting to the end here.

Dr. Andy Galpin

We saw no reduction in VO2 max. So despite running half the miles, they did not lose their physical fitness. We saw no change or reduction in numerous enzymes associated with aerobic metabolism, like citrate synthase and a bunch of other things. And more importantly, and interestingly, we saw a huge elevation in fast-twitch muscle fiber function. We saw about a 7% increase in fiber size, so diameter. So 7% hypertrophy of fast fibers by cutting training volume in half. There was about a 10% increase in single fiber force production. Velocity went up, though it wasn't statistically significant, but about 3% or 4%, if I remember correctly. And overall power was up about 10% as well. And you will actually see this consistently in the literature. Fast-twitch muscle fibers tend to be hyper-responsive to taper. We don't really see much in any of the

research on slow fibers, but the fast-twitch fibers, one, will do this.

Dr. Andy Galpin

The magnitude, which I'll cover in more detail in a second, is pretty standard with what we found in this particular study. And so you're going to see those things there, and one could argue that's potentially one of the largest contributors to that enhanced performance, is the fact your fast-twitch muscle fibers really tend to take off. You will see a large range in the research as well as in many practical settings about how people choose to taper, but I'll try to summarize what the science says right now collectively. Basic premise is that we want to try to reduce fatigue without compromising fitness, so we see enhanced performance. And we do this by modifying some of these variables in the following way. First is duration. How long should it be? We see success in a range from about two to up to 21 days. Intensity is typically either maintained or even slightly elevated. Now, some particular scenarios will slightly decrease it, but that's context specific, and I will give you those examples a little bit later.

Dr. Andy Galpin

Almost universally, though, you'll see about a 40% to 60% reduction in volume. Context will change that. Some do more. In fact, there's some documentation of people reducing volume by up to 90% and still seeing performance enhancements. But again, spanning the entire breadth of literature, you're going to see 40% to 60% as really, really, really common numbers that happen.

Dr. Andy Galpin

Frequency, which is how many days per week are you working out, tends to be the same or slightly reduced. I will tell you personally, I generally don't recommend going to more than a 20% reduction in frequency. Think about it this way. If you're normally used to working out five days a week, you probably don't want to cut it down to three days a week or two days a week. I don't have data to back this up. It's just been my personal and coaching experience. People tend to feel sluggish or a little bit slow, or their skill, especially if they're in a skill-based sport like golf or something like that, even running, shooting basketballs, your stride feels off. You feel a little bit sloppy. So we tend to keep frequency pretty close. If we do drop it, we drop it by about one day. So maybe we cut off one of our sessions. If we have 10 workouts in the week, we might drop it to eight or something like that.

Dr. Andy Galpin

But we don't want to do too dramatic of a drop in frequency because you just don't feel great after that. If you do all that, you will see somewhere between a 3% to 6% enhancement in physical performance. Now you may be thinking to yourself, "That's not much." Well, the reality of it is, pick any major race, say the Olympic Games, the difference between first and, say, fourth or fifth place is probably 1.5% to 2%. And so another way to think about this is all of your training, all of your sacrifice, and your dieting, and not hanging out with friends, and working

through pain and rehab, all that can be lost by simply not tapering appropriately. It can be the difference between winning the gold and not even making it on the podium. It's one of the reasons why I want to talk about this. It is incredibly powerful, and a lot of people mistime these tapers, and that's what results in you feeling great a week before and then flat on the day of the race.

Dr. Andy Galpin

Or feeling terrible running through a race, performing poorly, and then having and setting PRs the next week. Any athlete or competitor will tell you those are one of the worst feelings you can get. It feels terrible to just bomb in a competition. I have done this personally many times, and then set PRs a couple of days later, and you're like, "What the heck?" Like, "Where was that three days ago?" Well, this is potentially one of the reasons why you mistimed this peak. A couple of other broad themes you'll see in the research. One, people that tend to benefit the most from a taper are those coming from the biggest overload. If you've trained hard for two weeks, you probably don't need a taper. All right? If you had six weeks of moderate training, you maybe don't need to taper. The ones that have trained either the longest or the hardest. In fact, there's some really cool methods of taper, like Mike Stone has done in his lab at East Tennessee, where they actually intentionally do a week or two weeks of really aggressive overload leading into their taper.

Dr. Andy Galpin

So this is actually not their normal training. They even go harder or longer on that for a short overload, then go into their taper, and they see greater benefits from their taper when doing something like that. You can get into the details and read his papers and see the exact methodologies. Not for everyone, wouldn't work in every single sport, but that's a really good example of highlighting the point. If you don't have anything to taper from, you're not going to see a taper benefit. Remember what we've been talking about, what causes this stuff, what's happening to physiology. That should then make sense of who's going to respond the best to this. If you're doing something like running your first 5K, you probably would benefit from a couple of days of taper, almost surely, but you maybe don't need a 21-day taper prior to that competition if you've been training for six weeks. You've been training for four years, like we do with our athletes right now who are getting ready for Paris, of which we've got multiple in multiple sports.

Dr. Andy Galpin

The taper is actually very long because we've really been training for four years for this approach. Okay? A couple of other things to think about here. You're really not going to see any benefit from raising your volume during a taper. And in fact, there's enough evidence to suggest it can hurt. And so bringing up volume close to competition is almost always a bad idea. Okay?

One more time, I don't know of any papers or studies who have ever shown a benefit from raising volume during a taper, and I know of many that have shown negative consequences. So volume seems to be the big one we want to be paying attention to here. Now, in terms of intensity, one of the things you'll also see is either you want to keep that or raise it slightly, but no more than 25%. So that is a large bump right there, and is almost always going to come with negative consequences. Next thing to keep in mind is if you're going to keep your intensity the same or even slightly elevate it, you have to have at least a 25% or more reduction in volume.

Dr. Andy Galpin

Okay? So if in your situation you've decided to keep your intensity and you've only reduced volume by 10%, you're probably going to see no benefit. If, however, you only want to reduce your volume by 10% for whatever reason, but you're not increasing intensity, you might be okay. So it's that combination that you want to avoid. Either keeping volume or raising it, probably bad. Only lowering volume by a little bit, but keeping or raising your intensity, also bad. Okay? So if you're going to keep the volume around, you got to really make sure that intensity is accounted for or you're still going to run into problems. Okay? Those are some of the really big themes that you'll see tend to be true across multiple styles of performance training groups and laboratories. I want to share a little bit about the physiology of what's happening during a taper and why you're seeing these performance benefits.

Dr. Andy Galpin

There is evidence on every part of your physiology, for the most part. Your creatine kinase levels, your lactate, your sleep, muscle glycogen, hydration. I've mentioned fast-twitch muscle fibers. All of these things are enhanced or can be enhanced with a properly designed taper. Why is this happening? Well, I actually want to pull out a couple of very quick physiology examples. One of them in particular, I think, is to actually highlight what's not happening. So there are some misconceptions that I've heard a bunch, and so I do want to make sure we cover that. And the one that I'm drawing most attention to here is testosterone. So one of the things that generally does not happen during a taper is testosterone. It really will not change much. And despite the fact you're seeing these performance enhancements, I would not anticipate your testosterone increasing. It probably has gone down a little bit from overload training, but as I've shown a couple of times now, it probably takes a little bit longer than a two or 10-day, or even 21-day taper for that to be increased.

Dr. Andy Galpin

However, what matters is your performance goes up. And so this is another example of testosterone is important, but it's not the primary thing. It's not the king. It is not a direct tie to physical size or performance or anything else like that. So don't expect much to happen in that. I also want to highlight this because people will often do things like, "I think I'm overtrained,

therefore I've backed off or I've fully stopped training." Maybe they got a blood test done and their testosterone was low, and then they get their blood checked again, and their testosterone is still low, and now they're really confused or concerned. And I want to let you know that that's actually probably still normal. It's not going to respond for quite some time. It might. That's great if it does, but if it doesn't, you may or may not actually have something legitimately medically wrong with you. It is a pretty common thing.

Dr. Andy Galpin

In fact, most of the research on taper will show that testosterone is not going to change during a taper. However, other things like your glutamate to glutamine ratio are increased with over-training and are reversed with taper. So that is a much better molecular biomarker of actual over-training status than something like testosterone. Physical strength is a little bit of a different story, and this is where we see a lot of benefits. I've already highlighted the fact that the fast-twitch muscle fibers, which are somewhere between five to eight times more powerful than slow-twitch fibers, are hyper-responsive to taper. And so because of that, you see everything from total work capacity to peak power, repeated sprint ability, vertical jump height, max power, and so on and so forth, all have been shown to improve with as little as a week or even less of a taper. Hopefully, I've convinced you at this point, if you do a properly designed taper, you will see performance enhancements, whether we're talking about endurance or strength or power or anything between.

Dr. Andy Galpin

I would like to move now into telling you exactly how to do it. So what are the different types of taper? How do I actually execute them? I gave you a quick summary a few minutes ago, but there's a lot more detail there, and I know a lot of you are interested in that, so I don't want to stop you short of that information and tell you about the research and the science on different modes of taper, what people are doing, and how it may differ for powerlifters versus weightlifters versus soccer players or rugby players. So let's get into those details now. There are three main styles of taper. The first is what's called a step. This involves a sudden reduction in training load, and it's slightly more common than the other two styles, but it's not that much more documented. The additional thing to think here is strength training research probably favors this style over the other ones, but again, it is not a massive or overwhelming benefit here relative to the other ones.

Dr. Andy Galpin

So the other ones, the second one most common is what's called linear, and this is a constant reduction in load over several weeks. And then the third is actually oftentimes divided into two different styles, and this is called exponential. There's a fast exponential and a slow exponential. These ones are constant reductions. So if you think about linear and you think about a graph that has, say, 14 days on it, if you want to do a two-week taper. And if every one of these styles,

step, linear, and exponential, they all start at 100, and 100 is your maximum volume, whatever that number is to you. Okay? So all of us start at the same volume, and by the end of the 14 days, we want to get really, really low. The question is, how do we choose to get there? And what I should have clarified at the beginning is by style of tapers, I mean we all have to get to lower volume. How do we get to that lower volume is really determining the style of the taper.

Dr. Andy Galpin

So we're all starting at 100, and in 14 days, just to make this example easy to follow, we all want to get to roughly the same spot. Now, in a linear taper, you're basically going to go down in a linear fashion. And so let's say day 14, you did 100 miles, just to make numbers. Day 13, you might go to 90, and then you go to 80, 70, 60, 50, et cetera. It would be a straight line down in volume. That'd be a linear approach. A step taper is just simply coming right out the gates, day 14, going from 100 miles down to 30, and you just stay at 30 miles the entire 14 days. And so it's like falling off a giant step, if you will. It doesn't matter if you want to go to a 50% reduction or a 60% or 30%, or whatever it is. The point is, wherever you want to get to at the end, you go right to that number immediately and keep that pretty consistent the entire time. So you fell off a big step and kept that level the entire way.

Dr. Andy Galpin

That counters or that is different from the linear approach, which is to say if we're starting at 100 and we want to get to 50 by the end, we'll just go down in a linear fashion, 100, 90, 80, 70, 60, 50, et cetera. Hopefully, that made a little bit of sense. The one we're not going to spend as much time on here, exponential, fast and slow, is kind of a combination. And so we're still going to drop. In fact, we're probably going to end up with the lowest volume out of anybody, but we're going to drop pretty dramatically quickly. So we might go from 100 to 80 the next day. And then from there, it'll be more of a gradual swinging slope. So you can kind of see this as an arc, like a hammock, if you will. Right? So we'll just kind of drop pretty quickly, and then we'll slowly curve our way down to the bottom and kind of meet at the same level that the linear would've got to. So the total amount of volume throughout the entire 14 days differs between all these, but they're all still reducing volume one way or the other.

Dr. Andy Galpin

There's another thing we have not talked about, which is the complete cessation of exercise, such that you finish your taper, and then how many days do you take completely off of training? None before competition. Weightlifters, you're going to see something like a day, day and a half on average. Some people take the entire day before off. Some people do light barbell work or technique work, and then others take as much as two days off. I can tell you right now in boxing, in the UFC, they're never going to take the day off before. In fact, most people are going to do some sort of shakeout, as they'll call it, in the morning of. The day before is also weight cut day,

and so there's some other variables going on at those sports. But in weightlifting, day and a half to two days of complete rest prior to competition is pretty common. Powerlifters, it's probably more like two to five days. Powerlifters really do like conserving their energy, is how I will say it.

Dr. Andy Galpin

Strongmen, more like four, and then CrossFit, Highland, more like, again, two days or so prior to competition. In terms of intensity, you will generally see this is where some anomalies kick in, and I really want to highlight this because what's clear from the endurance side of the equation, as you'll see, is you almost always want to keep intensity around. But that doesn't work when your sport is lifting at high intensity. So you wouldn't want to lift, say, at 95% of your one-rep max for the three or four days prior to powerlifting or weightlifting competition. It's too high. But you could certainly run at 100% of your VO2 max three or four days before. That's totally fine. So it's a little bit of different things here. So in these strength sports, you will actually see intensity come down a little bit during your taper, and that makes sense. A lot of folks are going to get up to 85% maybe, but probably shut it down.

Dr. Andy Galpin

It's just too damaging and too fatiguing to recover from. Something like that in the week of the competition. Now, in terms of volume, though, it is actually really consistent. Weightlifters, about a 40% reduction in volume, typically. Powerlifters, 40% to maybe 60%. Strongman, 45%. Highland Games, 34%. CrossFitters, 40%. So it all lands right in that 40% to 60% range that we talked about earlier. Frequency is our last variable here, and we don't have anything particularly interesting to say here because it is exactly like we've explained. It's either going to be the same frequency or slightly reduced. One thing that we haven't talked about is this volume peak, and so what you'll tend to see for weightlifters is that their highest volume happens about five to six weeks prior to competition. It comes down from that, but they don't really hit their taper until that eight-week day. But their volume peaks a month and a half or so prior to competition.

Dr. Andy Galpin

And their intensity is going to peak about two to two and a half weeks out as well. So a little tidbit I thought we could throw on there that I found valuable and interesting in a couple of the papers. Last thing here, and this is really important. In the weightlifting, powerlifting, Highland Games, and other research, almost all of them had people report when they asked them, "Why did your tapers fail in the past?" You'll see an almost equal distribution of people who said, "My taper was too long," as well as people who said, "My taper was too short." And so while I can give you these sweeping recommendations that are general, the research is really clear.

Dr. Andy Galpin

People report their taper failing from an almost equal combination of saying it was too long and too short, which is to say these guidelines should be treated simply as that. They are rough

starting points, but please, you have to identify what works best for you and your physiology. Which means you have to compete a lot. This is why practicing, and this is actually something that people don't do a lot, and it surprises me, but you should practice a taper routine. You should go through simulations and see and document what exactly you're doing, and control it during your regional events, during your qualifiers, and going through these things as often as you can, and you will start to figure out for you and your physiology and your life situation what works best for you. I thought that was a really interesting nugget that I wanted to pull out to help you get the best for your taper. Because while I can share with you research, that's going to simply indicate what's most likely to work in most people most of the time.

Dr. Andy Galpin

But that's not you, and you want to help and perform you, and you want to help your clients. And so for that, you need to take an individual approach and make the best decisions possible for them, and that requires practice and diligent note-taking. Let's move on now and talk about sprinting speed. I'm actually going to be really short here. There's a cool paper that I'll point your attention to. It is a training and development of elite sprint performance and integration of scientific and best practices. An interesting paper from 2019, I think. But in that, they lay out a specific 10-day protocol, exactly what to do for the 10 days prior to competition. It was based on the work of Charlie Francis, the famous sprint coach, Ben Johnson, among others. And so I'll point your attention to that. You can go see that exact protocol, but it's really not worth me walking through it right now if you can just go download it and read it yourself.

Dr. Andy Galpin

But we don't really have much information outside of that on optimal practices for sprinters and taper. So we'll transition then now and talk about what we do know about team sports. More data here, most of it on soccer, rugby, volleyball, one particular study, and some basketball ones. And really it's the same rules as kind of everybody else. So we don't need to draw any specific attention to this, with one exception. And the reason I want to highlight this is you will see with team sports a need to pay attention to the entire year, such that most scientists and the information is going to argue you probably should have somewhere between two to three planned tapers per year. And now this is particularly relevant for college, high school, or even youth sports if you're doing multiple sports at once. If you're anything like me, and as a kid you started the year off in football, and then you rolled right into basketball, and then you rolled right into baseball, and then you rolled right into your summer work and lifting hay bales and building roads and things like that in the summer.

Dr. Andy Galpin

There was really no taper. It's probably smart if you are competing year-round, whether it's a single sport or multiple sports, to have at least two to three planned tapers throughout that time.

That's probably the most interesting thing we can pull out here that's a little bit different from what we've already talked about, but the rest is very similar to what we've already highlighted. One other little aspect is maintaining skill work. If you are a basketball player and you got to make sure your shot is on point, or a rugby player, or whatever else it is, make sure that you are prioritizing your skill work during your taper. And so you want to minimize volume, and the way to do that is to reduce the conditioning and reduce basic movement stuff and keep your volume through your skill work. So you keep your skills sharp, but you can keep volume down. You move at a play speed. You try to hit the ball as hard as you would in a game or close to it, or you try to run or jump or do those things close, but then you just don't do a ton of it.

Dr. Andy Galpin

So skills stay sharp, speed and power and strength stay high, but you reduce that cumulative fatigue by lowering the volume. Finally here to round us out with what we'll call endurance exercise, I'll point you to one more review article that highlights this, "The Effects of Tapering on Performance in Endurance Athletes: A Systematic Review and Meta-Analysis." Really great, covers a lot of stuff in that. They went over a whole bunch of papers and boiled it down to about 14, and found that pretty pronounced effects, improvements on time trial performance, time to exhaustion, no real changes, as we've described earlier, in VO2 max or running economy, and most of the athletes did a 40% to 60% volume drop, and the duration was somewhere like 7 to 21 days. Hopefully by now you've learned a lot about plateauing, peaking, and overtraining. Also, avid listeners are probably clear to the fact that I traditionally end the show going over the three I's, so what to investigate, how to interpret that, and then how to intervene on that.

Dr. Andy Galpin

But I've chosen to not do it in this episode because I've actually just weaved much of that stuff in along with the content as we went along. And so I don't want to finish on that, but what I want to do is finish on something that a lot of you are interested in, and that is many listeners are either aspiring to or currently working directly with high-performance athletes. I thought it would then be helpful for many of you, in fact, if you don't want to work that, you're still interested in what are these people really doing. So I'd like to share with you some insights of what happens at the highest level when we have to monitor, when we have to predict, when we've got one shot every four years, or maybe one attempt in a career to play for a World Series or an NBA championship or something like that. But then boil it also down and say, okay, what are some other specific examples that many of you can use to pay attention to all these things along the way?

Dr. Andy Galpin

I've given plenty of hints and direct tactics before, but I wanted to summarize all that for you as we wrap up. So let's dive into it and see what that looks like. Now, getting us started, if you dive into the world of performance, you will see almost everybody is tracking load somehow. They

are tracking mileage, or they're using GPS trackers to see how much area we covered in practice. They have some sort of physiology going. And so this world can be really extensive really quickly. But I wanted to give you a quick overview of what that looks like. Traditionally, most high-performance directors are measuring at least one thing from three specific areas. Area one is what we call tracking. So this could be things like LPSs or IMUs or GPS. It could be as simple as pitch count or mileage or something like that. So what is the actual person doing work-wise? Number two, what's the performance response?

Dr. Andy Galpin

So how's the game play? What's their physical strength? A lot of coaches will use things like a vertical jump, and these are traditionally being tested every single day. Really, really common for people to come in, do a vertical jump test every single day, and that's telling them where their system is at overall. So they're tracking total work. They're measuring performance, again, almost daily, if not three to four times per week. And then the third big category is what we'll call physiology and psychology. So they're looking at various markers of central or peripheral nervous system. This could be a tap test, could be HRV score, resting heart rate, something like that. They may be looking at biomarkers. I've given you examples earlier. Some are doing blood markers multiple times per week. Some are doing salivary. Some are just doing big blood draws before mid, post-season, something like that.

Dr. Andy Galpin

Could be sleep, could be mood, could be RPE, or anything like that. But you could basically say most people doing it well are taking at least one thing from all three of these areas. If that's within your capabilities right now, depending on your budget or interest, I would strongly recommend a similar approach. The technologies, the tools, the tactics are infinite within this category and always growing. And so we didn't have time, and I don't even know how you would attempt to cover all of them in all these areas. I think probably more appropriately is just to think about categorically making something that represents one metric from each of these areas, and choose your technology and frequency and all that based upon your budget and scenario. Now, when budget is of no concern, like I've been fortunate to have in several scenarios in my coaching career, you can get wild, and so it can look something cool like this.

Dr. Andy Galpin

We have recently completed a project that we call the Human Digital Twin, where data collection was, we'll just say, obnoxious. And we're able to collect everything from five large areas. Area one is what we'll call physiology, and this is both baseline and acute responses like we've been talking about. Autonomic nervous system, blood, urine, stool, saliva, sweat, hair, muscle size and symmetry, muscle quality, body composition, a ton of different areas that are giving us baseline physiology. Area two, performance, both, again, baseline and acute responses.

Strength, power, movement quality. We're talking about fully digitizing movement, full kinetics and kinematics, everything that's happening in practice and in performance of every movement. Endurance, portable metabolic carts, reaction time, neurological firing fatigue, cognition, performance, physical, mental, all up and down the chain, all being done baseline as well as acute challenges.

Dr. Andy Galpin

Area number three, environment. So we're looking at water quality, plastics, air quality, everything else we can get our hands on. Number four, psychology. Stress load, mental load, mental health, daily, acute, chronic, so on and so forth. And then finally, recovery, sleep architecture, resilience, amount of time and depth in each sleep stage, everything we can possibly get out in those areas. We were able to take all those data and now put those into a single model and use very advanced computing, if you will, to create a digital replica of these people's physiology, and then from there, we can actually create and run experiments on the digital twin and figure out how this person's going to respond best to training, nutrition, supplementation, back-offs, sleep interventions, whatever else we need to run. That said, what do you do right now? If you don't have any access or want to use anything like that, step number one, I would recommend if you're concerned about plateaus or over-training or non-functional overreaching, is to rule out things that are causing problems right now.

Dr. Andy Galpin

Meaning, if you feel like your performance is going down or you're recovering, make sure you don't have some sort of viral infection. You have a fever. Maybe you're experiencing depression. Your diet's crappy. You're not sleeping. You're drinking a little bit more than you thought. There's a work stressor that's bringing you down. Let's just make sure nothing else is actually happening that would be explaining these short to moderate-term dips that are really not an issue of your physiology and being over-trained. It's something that's actually directly explaining it. If that's the case, do your best to remove those, and we don't have anything else to worry about. So that's my starting tip number one that everyone should be able to do. From there, at the beginning of the episode, I talked about my MVP strategy, and I'll expand a little bit on that right now. Number one, I tend to pick things that I call early responders.

Dr. Andy Galpin

So if you only have the budget or ability to measure one or two things, I'm probably not going to look at things like a resting heart rate. Why? It is a good sign. It will tell you, but that is a low responder. It's not super sensitive, so the change in resting heart rate won't be dramatic And it's late in the game. Things have already happened in your blood, we can see. Things have already happened in something like your HRV. Heart rate response is going to be weeks delayed. You're probably into the problem already, and I like to stop it before it starts. So I like an early

responder. HRV is a great example. This is heart rate variability. This is a good indication of where you're at, overall balance of how much time you're spending in parasympathetic or downregulation, versus sympathetic or upregulation. Okay? Neither one of those are bad, but if you're spending all your time in downregulation, your HRV will be suppressed, and you're going to see that.

Dr. Andy Galpin

Now, HRV is far more sensitive than something like a resting heart rate. Okay? So it will tell you insights much sooner, but it requires a trend. Do not make any judgment or decision for your current exercise based on a single day's HRV. If you talk to experts in these areas that have done this for decades and have thousands of data points, or thousands of athletes and millions of data points, they're going to tell you, "Hey, look, we're looking for a three to five-day, maybe seven-day, maybe 10-day trend before we're super worried about it." Okay? So HRV would be better than resting heart rate, in my opinion, if you had to pick one. This is where I think things like blood work will tell you. You're going to see signs immediately that this happens, and you will see them, in my experience, before HRV starts to move and before resting heart rate. If you don't have access to that, another good one I've talked about a lot recently is respiratory rate.

Dr. Andy Galpin

Now, respiratory rate is pretty sensitive as well, and I feel like, and I don't have scientific data to support this, there is some, but it's not a landslide. This is now my personal coaching experience. I feel like this shows signs sooner. I can tell you this from my physiology. If I wake up and my respiratory rate is more than probably one and a half breaths per minute higher than my average, 100% something happened that night, or I'm getting sick, or something else happens. So my body responds really well to that, and the athletes we've tracked, the people in our coaching programs, the non-athletes, it is lined up pretty well. So I like to go after that one first, and that is not particularly hard to measure. One thing I would like to clarify that maybe I haven't talked, and we'll probably do full episodes later in the show about things like HRV, but this is nice because unlike a blood biomarker, where it's really only telling you information about that area, HRV is a systemic marker, so it's telling you that idea of where your entire system is at.

Dr. Andy Galpin

And so a lot of people make the argument, "I don't need all those other things you talked about in your human digital twin if I can get 80% there with that one single metric." And you might be right. You can get pretty close with something like an HRV. So that's the advantage of doing that. It cuts down data collection, gives you a broad stroke idea of what's happening in the entire physiology. It's nonspecific, but it will give huge advantage to people that are restricted to data collection. Okay? So a lot of value there. To kind of give you one more little personal insight, and

this is actually really cool, a paper from friends of mine in Stockholm, Filip Larsen, his group out there did a really cool over-training study, and one of the things that they found from that that I thought was super practical is the study found actually impaired mitochondrial function with over-training, and we saw some glucose dysregulation and things like that.

Dr. Andy Galpin

But what I thought was super interesting is they found this. If you take somebody who's exercise trained and expose them to a standard workout, we've talked about this now several times, and their heart rate is the same or lower, but their respiratory rate is higher, then you have a very, very strong likelihood that their nervous system is fried, that they're overworked, or however you want to phrase this. See, typically, the more fit you become, the lower your heart rate response is to a given workout. Right? The same training speed is no longer as challenging. So your resting heart rate comes down because your stroke volume's gone up. We talked about that in detail in our cardiovascular episode. However, a lot of people will do the same exact workout, and if they notice their heart rate's higher, then it's like, "Oh, man, maybe something's going on." And it might be. But if you look at your data and you don't feel great, you feel junky, and you realize your heart rate is the same or maybe even lower, and you might be thinking, "Oh my gosh, I guess my physiology is fine."

Dr. Andy Galpin

It might be, but it also might not be. And the way to differentiate that is if you see that heart rate, again, is the same or lower than it normally is, but your respiratory rate is higher, that's a pretty good indication that the system is pretty fried, pretty tired. You're breathing harder than you need to be. Your resting heart rate's lower. You're not responding like you should be to a stressor, and maybe some back off is needed in the future. To finish this off here, what I'd like to do is clarify a handful of things you can do that I call acute and chronic actions if you do feel like you're in the hole a little bit. We never specifically laid this out, but number one is rest. So if you are actually over-trained or close or non-functional or otherwise, the most important and direct thing you can do is recover and rest. But there's actually subcategories that fit into multiple areas. This include things like food, supplementation, thermal stress, breathwork, what I call brain distractions, light, rest, sleep, and a bunch of other things that can help you crawl back out of this, and maybe we'll do an entire show just on these and jump straight to them.

Dr. Andy Galpin

But I call some of these acute and chronic for a particular reason. So let's take an example of something like supplementation. If you look at, say, caffeine. If you feel kind of low energy and fatigued today, caffeine will help that acutely, but it's not going to chronically recover you from over-training. So that wouldn't be a chronic responder. You might have to do something more like sleep more or reduce training. Or try something that has been talked about a lot recently, like

biofeedback or journaling, social connection, work on recovering hormone status. Things like that might be needed to actually chronically fix the problem relative to actually giving you some short-term resolution. One that has been documented, actually from the CrossFit over-training study that I thought was very interesting, comes from carbohydrate. So one of the things that they noticed that jumped out really clearly amongst those folks that were experiencing more over-training or over-training-like symptom responses, is the carbohydrate intake was about three times lower in those individuals.

Dr. Andy Galpin

So just simply making sure you're not dropping below, say, five grams per kilogram of body weight per day of carbohydrate when you're doing advanced and high-levels training, if possible, is probably a good idea. So that will help, actually. In fact, that's one of the things we turn to quite often, is if people are just feeling low energy, we'll give them more calories, if you can afford that. Okay? So there's lots of tools and tactics. I actually have an entire table here that I've built out. Perhaps we'll put that up in our show notes. Ah, I'll do it. All right. I'll just commit to it right now. It'll be up there. And you can look at all these things, some that I call parlor tricks. So this is where motivational quotes or music or a movie or something will come in. And those are not going to fix your over-training problems, but they might give you an acute boost of energy if that's really all you're experiencing.

Dr. Andy Galpin

So, as I said at the very, very beginning, because performance is not one thing, and stress is not one thing, there's not one thing to track, and there's not one thing to do to solve them. You really need to think carefully about, in my situation, what's probably causing my largest constraint. What's my biggest area of opportunity, and what's within my reason, and preferences, and abilities, and skills in terms of what solution I want to deploy? Maybe you want to use more supplementation. Maybe you want to use more thermal stress, like hot or cold, or nutrition, or you need to just sleep more, or a combination of all those things. I hope that this episode just let you know you have a lot of options. That's one of the major goals I have with this show and with my entire strategy for science communication, is to not make people feel like they have to do certain things if that's not really the case.

Dr. Andy Galpin

And so you've got a lot of causes for over-training or plateauing and peaking. That means you also have a lot of opportunity for solutions, and pick the ones that are most appropriate for you and your situation. Thank you for joining for today's episode. Our goal is to share exciting scientific insight that helps you perform at your absolute best. If the show resonates with you and you want to help ensure this information remains free and accessible to anyone in the world, there are a few ways that you can support. First, you can subscribe to the show on YouTube,

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Dr. Andy Galpin

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Dr. Andy Galpin

Thank you for listening, and never forget, in the famous words of Bill Bowerman, "If you have a body, you're an athlete."