

Dr. Andy Galpin: Maximize Recovery to Achieve Fitness & Performance Goals | Huberman Lab

In this episode 5 of a 6-part special series on fitness, exercise and performance with Andy Galpin, PhD, professor of kinesiology at California State University, Fullerton, he explains how to optimize post-training recovery and how to avoid overtraining in order to better achieve your fitness and exercise goals. He explains the cellular mechanisms of muscle soreness and pain, why adequate recovery is essential for all physical adaptations, and how to enhance recovery using breathwork, thermal, movement, and pressure-based techniques. He describes how overtraining impedes exercise progress and how to assess if you are overreaching or overtraining, by using specific biomarkers and indicators. Like other performance metrics, recovery is a skill that can and should be trained, and that can be learned. This episode provides an actionable toolkit for how to monitor and improve your exercise recovery abilities, which will improve your overall mental and physical health.

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Articles

Brief structured respiration practices enhance mood and reduce physiological arousal:

<https://bit.ly/3xleMHI>

Altered brown fat thermoregulation and enhanced cold-induced thermogenesis in young, healthy, winter-swimming men: <https://bit.ly/3YuoDa4>

Other Resources

Carbon Dioxide Tolerance Clip (Galpin Guest Series Episode 3):

<https://youtu.be/oNkDA2F7CjM>

SHIFT Breathwork Assessment: <https://shiftadapt.com/breathwork>

BMJ tool for visualizing the variability of lab test results:

<https://www.bmj.com/content/368/bmj.m149/rapid-responses>

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[, Music] welcome to the Huberman lab guest Series where I and an expert guest, discuss science and science-based tools for everyday life, I'm Andrew Huberman and I'm a professor of neurobiology and Ophthalmology at Stanford School of Medicine. Today's episode is the fifth in a six episode series on fitness exercise and performance, and today's episode is all about recovery. That is how to maximize your recovery, to achieve your fitness and exercise and performance goals and how to avoid over training. Dr Andy Galpin great to be back today we're discussing recovery and I'm very excited to have this discussion because, as we know, despite the fact that different types of exercise can be used to trigger different types of adaptation, such as increased long distance endurance, anaerobic capacity, strength, Hypertrophy, Etc, the workouts themselves are not actually when the progress occurs when the adaptation occurs, and this to me is extremely interesting because it parallels what we see with so-called neuroplasticity, which is the nervous system's ability to change. In response to experience, we sit down to learn something we experience something and that is the trigger for rewiring of the nervous system. But the actual rewiring occurs away from the

experience or the learning so too, in Fitness and in exercise recovery is where the Real Results actually emerge, where we get better. So I'd love for you to explain what recovery really is and the different types of recovery certainly different ways to enhance recovery and I'd also love for you to explain whether or not there are ways that people can become better at recovering, because if indeed recovery is When progress emerges, when we get better well, then anything that supports our recovery and gets us better at recovering ought to increase our rate and our degree of progress. Absolutely you nailed it in the description. What people really want is some sort of change, whether you are talking athletes or general population. This change is uh, some sort of improvement in muscle function, reduction in body, fat, higher functioning metabolism, whatever the case is, and the only way that happens is we talk about. The equation of stress causes adaptation, but, as you alluded to the piece in the middle is only if you can recover from it and so the game we're playing here is we all agree. We want more adaptation. That means we need to bring more stress into the system, but we then have to ensure that our recovery outpaces the stress input or else no adaptation will occur. In fact, what happens is you will actually be in a negative spot and start going backwards, and so what I would love to do is talk about how we've handled this and I've had a decent amount of experience. Here I was fortunate enough to do my master's degree in the laboratory of a gentleman named Andy Frye who's, an nsca Lifetime Achievement Award winner and he studied in large part recovery over training overuse overload in a lot of areas. In addition, I've been fortunate enough to work with individuals from high functioning CEOs and Executives, who have little time for Recovery, High job stress to in to athletes uh and they think of the example of pitchers in Major League Baseball who have to recover in a matter Of four days that they can pitch again at maximum velocity, so I would love to outline some of the tools and tactics strategies that we use for all these individuals give you some foundational stuff, and I would love to maybe actually cover some things that most people Have never heard of some stuff, you may not have access to some technologies that we use some biomarkers and then even a whole bunch of things that are keeping with the theme of your show here: cost free or extremely low cost, so all those strategies what I'd? Also like to do is cover nutrition and supplementation and fueling and hydration and things, but that's probably going to have to be saved for an additional conversation that we'll do in the next episode. Yes, so we will absolutely hold a conversation about nutrition and supplementation where you can educate us about all the

00:04:17 Exercise & Delayed Muscle Soreness, Pain

Top Contour stuff all the way down to the fine details. I do have a question about recovery and it's one that I think most people are familiar with themselves, which is soreness, we think of it as a muscle soreness. But I was trained early on in my scientific career to always question the seemingly obvious, so a couple of questions about soreness. First of all, what does soreness really reflect? Is it really muscle soreness? It feels like it's in the muscles, but what other organ systems and tissues and cell types does it involve, and then I'm particularly interested in this concept, or this experience that many of us, including myself, had which is delayed, onset muscle soreness? Why would it be that when we are less in shape or when we perform a movement that is extremely novel to us, the soreness seems to arrive after a reasonable delay of maybe even a day. You know we're fine the next day, but then 48 hours later we are exceedingly sore and as we get more fit or more familiar with the movement, the soreness seems to arrive earlier. So I realized, I just asked you about three questions or more. First of all, what is muscle soreness at a cellular level which involves which organ systems and so forth? What does it mean if we are sore is something I know we'll get into a little bit later and then why the delayed onset muscle soreness? It's actually one question, so it's totally fine! You answered all. You asked all three, because I'm going to actually answer number three, which will answer number two, which will actually answer number one I'd love to tell you that I set it up that way intentionally but uh. I'M just happy to hear that where I was unable to be concise, you are able to be concise. Thank you. We are still learning a lot about this area. It's actually really difficult to perform these studies anytime. You ask a question about something like pain or soreness. You're immediately talking about perception - and there is obviously a physical component to that and there's also perception and so teasing those things out is extraordinarily challenging. That said, there has been a lot of work in this area. In fact probably um. You may have a show already out on pain or maybe one's coming down the road. We did an episode on pain uh a while ago, but it's definitely time to revisit that literature. I also have some amazing colleagues at Stanford who work on pain both from the uh cellular molecular side, but also from the psychological side about how our understanding of pain and what we believe about pain, shapes the experience of pain and Pain Relief. Amazing, that's that stuff is incredibly important and I'm glad we flagged that, and maybe we'll just call that good for now they could come back later for another one of your shows. So that being said, why does it happen? Uh 28 to 48 hours after you exercise? Well, that actually should give you some Clues into what's happening, so the traditional dogma of delayed onset muscle soreness, is what this is called is that it is a result of quote unquote, micro, tears and the muscle, and so you can sort of think. I challenge the muscle: there was some small tears in there and I'm feeling the results of that. Well, in fact, that certainly does happen and it can happen. That is not what's explaining your muscle,

soreness and in fact you can be quite sore from exercise and have no measurable amount of muscle damage and so much like anything else. When we're in this idea of pain, it's not a one-to-one explanation. There are multiple factors that are probably causing your perception of pain. Muscle damage can be one of them. It is not the only one, and it is probably in my opinion, though this has yet to be shown definitively, probably not even the leading cause of it, and so what's actually happening. Well, the reason is, taking you 24 to 48 hours is you can actually find various papers, literature reviews dating back in a number of years now over a decade that show these wonderful curves of an inflammatory and immune response, and we don't need to necessarily go through The entire physiology right now but effectively what's happening is those things have a little bit of a time delay, and so some of those steps happen immediately like right. When the exercise is there and then some of them are delayed six to 24 to 48 hours. If you know a little bit about this physiology, it's you have a combination of neutrophils and macrophages and a bunch of things happening, and this has a Time sequence. So what happens is by the time we get to this 28 to 48 hour window now the muscle soreness kicks in which wait a minute if I, if this was a result of my muscles being torn, and that happened immediately, wouldn't that pain start immediately well, the Answer is it would, and so that that is your first clue that that's not responsible for it. When we look at that immune response - and we see that that is actually Peak 24 to 48 hours later and then that's the same time, the pain kicked in. That's cooling you with the problem, so we have this immune response happening in inflammation. Then, all of a sudden we start getting fluid accumulation and now there are what are called nociceptors and you're, probably very obviously, you're very familiar with these, and these are pain receptors. What's actually interesting, is we don't necessarily know a lot of information about how many pain receptors are in muscle they're, not really in the belly? In fact, this is why I can perform my muscle biopsies and they don't really hurt. You mean in the belly of the muscle, correct yeah. We do have pressure sensors, though, and so, if you change the volume of the tissue, you will respond to that very very quickly, so by enhancing swelling in the actual muscle. That is immediately putting pressure on those pressure receptors. If you will that's the signal, so what's probably happening here, and I just I just hate to give you another bone. But a lot of delayed on some muscle. Soreness is probably just a neural feedback loop, rather than it is actual muscle damage yeah. It makes a lot of sense there's a lot of interactions between the types of neurons that control touch, sensation and pain, sensation and itch sensation. In fact, a lot of people um kind of collapse itch and pain together, Bingo yeah, you know, that's something, it's painful and it itches is a familiar thing for people mosquito bites and such um and, of course, there's the classic gate theory of pain yeah, which uh People will be familiar with and then I'll explain why I'm explaining this um, which is if you something hurts you

know you Bonk your knee or you stub your toe. We tend to grab that body part and try and rub it totally, and that rubbing is not a coincidental thing. It activates a set of uh touch: sensors that are, that respond to kind of broad dull touch um and that actively inhibits through the release of an inhibitory neurotransmitter, the fibers that control the pain signal. So anytime we rub a you know like a charlie horse, our leg or we or we stub our toe, and we, you know we wince, and then we grab the tone we got like squeezing it a little bit. That's actually deactivating or partially inactivating the the pain mechanism. So the idea that uh a swelling response would then trigger a neural response that then, would recruit the pain, receptor response here, I'm using broad, broad, brush um Strokes here to explain this um makes very good sense to me

00:11:35 Muscle Spindles, Reduce Soreness

Um now, and only now that you've explained how this process works, I can actually even add more to that. So if you remember how muscles work, so we have to have some sort of signal from the nervous system that has to actually go in and tell the muscle to contract. Well remember: there are a few episodes ago. We covered the physiology here of what's called a motor unit, okay. Well, what I didn't explain to you are called muscle spindles and we have talked about proprioception in an episode of before as well, but we never tied this picture together. So let me walk you through that really quickly and it's going to tie this Loop into a nice bow. So what happens is um? This motor unit is is coming in from what's called an alpha motor unit and that's going to be innervating your muscle, fibers, and that's going to tell the muscle fibers to contract. Those are typically spread out throughout the uh. All sides of the muscle in interior, exterior all over on the outside, though there is another type of muscle, called a muscle spindle. Now these are non-contractiles, so they don't have that actin and myosin and they don't produce Force. They are responsive, they are proprioceptive. So what that means is they sense stretch, and this is why, for example, if you were to stretch a hamstring and stretch any muscle group, it doesn't really matter or muscle. Its innate response is to fire back to close that distance, and this is what keeps you from say if you're leaning to the right, you can imagine that the example we give is, if you're, if you're standing on one foot, and you start swaying to the right. All right, let's say you're standing on your right foot, and this makes this easier for folks and you start swaying to the right like you're, going to fall on your right ear will hit the ground. The inside of your right, calf muscle will start being stretched. The outside will start being compressed right, so the stretch on the inside of the right calf muscle will sense that stretch and it will respond by Contracting that pulls you back

to the middle and stops you from falling. That's proprioception and muscle spindles sense stretch and tell you to contract the way that they work is through gamma motor neurons, and so these are sensory things. So what's happening is unlike when you tell your muscle to contract. It goes Alpha to the muscle contract. These muscle spindles work such that it is oh I've been stretched, sends signal back to some Central Point, typically in the spinal cord, and we don't actually want to go all the way up. The brain we've got a time delay. This is why these are subconscious autonomic right versus somatic, so the gamma is going to go back to the central location and then come back through the Alpha motor neurons until it to contract. So you have this wonderful mechanism of sensing stretch going back. Well, one Theory that's been put forward regarding muscle damage is that the pressure is actually being applied to those nerve endings of the muscle spindles, and that's actually responsible for the pain signal. That's going back and coming up to your brain and you're registering that as pain. Rather than it is actually in the the contractile units, so the muscle fibers that's a very intriguing idea, uh, because it would suggest that stretching muscles in order to alleviate soreness might be the exact incorrect thing to do. Yeah. Now, I'm not saying that's for sure for certain I'm just building off the mechanistic logic that we've laid out here, yeah, really that you've laid out here, there's the more effective principle based on exactly that, which is. This is generally why low level movement is effective at reducing acute soreness, because that's low-level contraction with the muscles and you're going to anti-stretch and get tissue out and get fluid out. Wow you're, literally pumping it out of the the cell. Yes and in our previous episode, where we were talking about programming, we're using the Wii, but let's be fair here where you were educating us, including me, um in the audience about different structures for programming, exercise, for specific adaptations Etc of the month week, year, scales, Etc. We had a brief um discussion about the fact that if one trains legs very hard with resistance training, you know some heavy squatting or dead, lifting it yeah or, and there's some soreness that oftentimes doing some quote-unquote lighter cardio or um. Some uh low impact work. The next day or or any number of different things that involve um, not high intensity contractions of the muscles, but that do require contractions of the muscles that it can alleviate soreness more quickly than if one were to Simply lie around. And you know. Watch Netflix or something yeah, that's exactly right, the um to go back just a little bit as well the if that's really the case um. The question is like: where is this inflammatory signal coming from and while there's much to be learned there, there is a little bit of information right now that suggests it's potentially coming from free radicals released from the mitochondria again that may or may not hold up as More research comes, I'm not sure, but if you remember back to our uh conversation on endurance, so we talked about the electron transport chain and aerobic metabolism and regardless of whether or not you're getting energy from

glycolysis or carbohydrates, remember, they have to be finished through aerobic Metabolism, so even if you're lifting weights and you're using carbs for your fuel, you have got to finish that metabolism by running it into the mitochondria and Performing oxidative metabolism. As a result of that that electron transport chain runs. So, theoretically, if free radicals, which is which are hyper-reactive oxygen species, basically they're oxygen molecules that are missing in electrons, so that they react to a lot of things, they're the opposite of antioxidants. By the way, this is the oxygen molecules with extra protons, so they can balance the charge if those leak out that in and of itself is going to be a massive, inflammatory signal and that's probably what signals the cause of these neutrophils and macrophages and kicks off This entire Cascade again, I believe we need more research there. I need to look into it. Maybe it's more definitive than I that I know, but that's probably what's happening potentially what's happening rather causes that Cascade in Signal. Also, what you have is this combination of. Well, if that's the case, why am I not getting tremendous amount of muscle damage when I do more aerobic based exercise? Well, because you don't have the mechanical tension pulling on the fibers, that's actually causing damage to the cell wall that allows these free radicals to escape the mitochondria and the cell wall. So that's the best. We can postulate at this moment as to why those things are happening and then why again low level exercise tends to enhance even things like percussion, so using either instruments that put a low level of vibration into your leg or like pneumatic boots. So you can massage all these things are generally probably helping because they're moving that stuff out a demon most specifically so pressure comes off of those nerve, endings and the muscle spindles, and allows you to stop receiving that signal of pain. Despite the fact that you didn't actually regenerate tissue at all yet fascinating, and I think that beautifully frames where we're headed next, which is to talk about all the different modes of recovery and how to accelerate them and perhaps even how to combine different forms of recovery In order to become better at recovering and in doing so make faster progress with Fitness

00:18:56 Exercise, Homeostasis & Hormesis; Blood Test & Fitness Level

So to kick off this discussion about recovery and with the understanding that recovery is when the specific adaptations to exercise actually occur. I'D love for you to share with us what happens or needs to happen during recovery in order for us to get better at anything, endurance, strength, Etc, but also how specific types of exercise, stimuli and specific types of adaptations that we trigger so running a bit further. Lifting a bit more weight, slowing the

Cadence of a given movement, Etc. How those specific types of triggers for adaptation relate to the specific or maybe similar types of recovery that are required for us to make progress in one of our previous episodes. We were talking about how the Harvard fatigue lab really identified this idea of homeostasis or at least sort of championed it for it and that's important because and all levels physiology wants to return to homeostasis. So what happens in terms of adaptation? Is you've challenged it to a level that it realizes? If it does not make a change, it will not be able to get back to the same level of homeostasis. That's fundamentally what's happening. That is recovery, that process of taking an insult being temporarily reduced in functionality, causing a change so that now we come back and get what we often call in support performance super compensation. All that really is doing, though, is bringing you to a new level of homeostasis effectively. It is understanding if that same insult comes again. I need to be able to make sure that that doesn't cause the same level of disruption, and so we raise the bar whether this is enhancing our ability to take the same level of mechanical tension on the muscle and not result in micro damage. Whether this is being able to take the same reduction in energy and not have that compromise of sleep or anything, it's really fundamentally changing. So we can have a new level of homeostasis, because it's presuming it's predicting that that same insult is going to come again down the road. I wanted to clarify for people that when Dr Galvin says insult while he may actually insult me, um insult is the nerd speak terminology for some sort of damage inflicted to a tissue or system. So um he's speaking about the insult to the muscle or insult to the neuromuscular connection, created by adding more weight to the bar running a further distance um running a bit fast or or pedaling faster. That creates a micro insult or an insult. And now, because everyone is familiar with um, psychological and verbal insults, you'll never forget that biological concept, it's important. We tag another thing here, which is called hormesis. It's one of my favorite phenomenon, and it effectively means this that there is a dosage or toxicity, responds to almost everything. And if you think about this in the context of say drugs, what this means is, if I gave you 10 milligrams of something that it would be okay, but if I give you 20 it'd be a problem and eventually, if I go up and give you enough, This thing turns toxic: this is the case of everything from cyanide, where it can actually be in small dosages in nature. In fact, it's in many of the fruits that you eat, but it's not a dosage, that it doesn't matter if that dosage gets higher, though that actually can cause problems, and if it is high enough, it can actually kill you instantaneously. The back end of that, though, is because you introduce this micro insult as you framed it for me perfectly, your body will then adapt to it, and that's really what's happening with exercise adaptation is, it is a hormetic stressor and why that's important is, if you look At the immediate responses to exercise you see an extremely large increase in inflammation, you see, oxidative stress, you see a whole

Cascade of autophagy, like all these problems quote unquote happening. It's what's actually quite funny. Here is, as a part of my PhD, the academic portion. I had to go through the medical side of the school, and so I was my physiology class was in med school, so I'm the only non-medical doctor in that class right, I'm a PhD. So I leave my lab. I walk across campus and I take physiology class with these folks and I died the whole time internally, because every time we would cover a new area, it was basically the the exact same value or number in a medical setting is like. Oh, my gosh they're, going to die and in performance setting is like this person's in fantastic shape. Is I I I've? Never it still amuses me to this day, obviously, because it's just simple things like total blood volume right and you cover like okay, if you have a patient come in and their blood volume is six liters, you know I can immediately get them on a diuretic of Some sort because they're going to have a heart attack as blood pressure gets up right now, I'm immediately thinking damn six liters that that person is super fit because that is actually a positive adaptation to training it's one of the most important, if not the most important Adaptation to endurance training is enhance, total blood volume, so you'll store more blood in your body when you're more fit than you are less fit. So I mean I could go on all these things. Sodium concentrations - potassium concentrations are like you look at these things on paper and you don't know if that person is about to die because they're 65 years old and out of shape or if that person is going to break a world record the marathon. This brings up a very important tangent, which is uh, for instance, if you go and take a blood test - and you are somebody who exercises very intensely uh with resistance training, you're blood creatinine levels can be way out of range, and if your physician doesn't know that You're doing certain forms of exercise might say: wow, there's a lot of muscle tissue damage occurring in your body yeah, as you mentioned before, your total blood volume is, is dangerously High, when in fact, you are far healthier and need much fitter than the person who, As numbers would be in range, that said, obviously there are um limits to these to these statements, whereby you would want to be cautious and take action to ameliorate, a very elevated blood, creatinine level or something of that sort. But the point you're you're bringing up is is also one about the field of medicine, which is that many, not all, but many Physicians don't take into consideration uh the outside activities that people are doing, and so it becomes a kind of a plug-and-play type, um type Way of looking at blood charts, yeah we've done many thousand athletes, blood chemistry and uh. We we don't use. First of all, we never look at disease stuff, that's not what we do. We take people that are healthy and try to optimize performance and blood. Chemistry is one of the best tools. If you really understand what you're doing there, you can get some incredibly powerful information out of blood chemistry that actually relates to what we're going to talk to today in terms of measuring everything from acute to Chronic dehydration to

sleep, deprivation can be identified in in blood Chemistry to optimization improvements in nutrition, supplementation there's a lot you can get there. If people are interested in that field, I would Point them to a gentleman named Dan Garner. It was just an absolute Juggernaut and wizard in blood chemistry for high performance, but well you can get a ton of information from that. If you understand the difference between exactly what you talked about. Looking for signals of increased risk of cardiovascular events, 25 years down the road versus, is this: the optimal value for high performance in an athlete, which is what our our database and all of our software and stuff does, is only looking for those things. So I'm going to talk about some of the biomarkers to look for a little

00:30:20 Recovery Timescales, Adaptation & Optimization

Bit later salivary so some blood stuff, but we'll maybe save that part of the conversation for down the road. Tell me about different time scales of recovery. Sure this is actually where I was trying to answer your question for and then I got myself way off track, but the reason I brought up the Hermetic thing is: if you understand that some things in the acute say, 24 to 40 hour period, look terrible. It's actually fine right, so this is the stimuli, that's causing adaptation. So the reason I brought up the medical exchange there is because you, if you looked at inflammatory markers and then you mentioned some of them, you would see that they are highest acute within seconds to minutes to hours after exercise. However, that's exactly the stimuli needed to bring them down chronically, okay and so chronically meaning. Maybe in that moment they are elevated and then maybe they're coming down 24 hours later in 48 hours. However, if you were to compare your resting level say that Monday, before you worked out to your resting level, that Monday the week following the week following that, what you would probably see is your Baseline inflammation goes down, and so we got to be really careful. Are we talking immediately post-exercise man, these markers look terrible? Maybe my recovery score is awful, Etc. That's not necessarily a bad thing, because what we're like looking to do is to not only change what's happening today, but we're trying to cause adaptation that may take us weeks or months to actually access. I love that you're highlighting this principle, because one of the more obvious ones to me now that you've said this is heart rate. Absolutely. My heart rate goes very, very high during exercise, and I do that fairly consistently or even semi-consistently. My resting heart rate will actually be quite a bit lower. That's a fantastic example! Really what you're getting at here is this concept, where I think it's important to differentiate between adaptation and optimization. Now we hear that word and I use it and most scientists hate it, but it's a good communication tool, optimization

if you're optimizing for the current moment, you're almost surely compromising the late adaptation right. If, if I were to say, do the thing right now that makes you feel the absolute best in the world and you're like great, you took a nap and you had a donut like awesome, you feel amazing, but you know it's causing long-term issues. The same can be said on the back end, if you're never choosing things that make you better right now, you're never actually going to see an adaptation. So what we're really doing with this recovery conversation is playing this game of balancing immediate gratification with the long-term gratification, and how do we identify how much to do now versus not? How do I use a value or a marker? Whether this is how tired I feel today, how sore I am today versus a score on an app or a tracking metric, but this is a blood marker, anything and understand. If that's what I need to cause the adaptation, I want a week a month, three months from now in the case of some of our other athletes, it's even up to four years right, we're trying to cause adaptations that will get us where we want to get in the Olympics or World Championships or World Cup, or wherever we're going to be so that's the framework, we have to think about recovery. We we maybe falsely think about it as I need to maximize my recovery today and you could do something like taken anti-inflammatory, whether this is a supplementation or a drug, or maybe this is ice. Oh cool, that's great! That will enhance your recovery in this moment. That'll make you feel better today, probably tomorrow, but what we know is that blocks the signal for adaptation, so you're not going to get the same results. You know four six, eight weeks from now. So when we talk about recovery, we have to understand what tool am I using and why and in order to do that, we have to understand what am I training for and what am I trying to maximize if I am in the middle of a season with an athlete and we are competing tomorrow, I am going to head towards Acute recovery right because I have to actuate that performance right now, if I am starting the off season, I'm not hedging towards recovery, I'm actually hedging towards adaptation, so we're not going to deploy any of these, especially things like there's evidence that a combination of vitamin C And vitamin E will blunt hypertrophic adaptations because they're anti-inflammatory with antioxidants right other other Studies have shown? Maybe they don't have uh an inhibitory fact they may or may not point is conceptually. You want to be careful of what you're trying to optimize for, and you have to have that forethought and that alone is going to dictate your decision making with whether or not again you get in the eyes uh you do that now we will cover some tools, Like massage that are pretty fine to use, you don't have to worry about those blocking

00:35:10 Adaptation & Biomarkers Levels

Long-Term adaptation, but others you're going to want to be very careful about so this principle that you've laid out for us, which is that there's a set of events that occur during exercise that trigger the adaptation and that sets in motion a number of adaptations that occur. During recovery that then give us the exact opposite response to what the trigger was so I'll go back to the heart rate example: um heart rate is close to maximal or maximal. You do that enough times within a short you know a week or so or two weeks and you're resting heart rate goes down. As I recall a few episodes ago, you said that your maximum heart rate doesn't really change. That much. Is that correct? Yes, okay, but your resting heart rate can go down quite a bit yep. Is that a general theme meaning do we have a more or less set upper limit or ceiling for things like inflammatory markers for heart rate, maybe even things like stress and what we do when we deliberately trigger stress or a dramatic increase in heart rate or dramatic increase in inflammatory markers is that we are lowering the floor, but that the ceiling remains the same. It's very dependent upon the marker, so in the case of maximum heart rate, it will not change with the exception of one thing which is age, brings it down. Training will not change it up in most circumstances. If you look at something like an inflammatory response, I suppose, theoretically, there is a ceiling, though I'm not aware of it um. I can tell you right now, looking at blood markers, the things like creatine kinase, so remember the conversation about metabolism and with that we use the phosphocreatine as one of our primary fuel sources for explosive exercise. Well, if we're using phosphocreatine this creatine kinase, remember, kinase are enzymes that that function to break things down for the most part, so creatine kinase is the enzyme you use to break down creatine when you do that. A lot, then that creatine kinase gets out of muscle and seeps into the blood myoglobin is actually another fantastic marker. By the way, myoglobin is, if you think about hemoglobin being in blood, is the molecule that carries oxygen around when it's in the muscle tissue. Then it's myoglobin mild, meaning muscle and it's the same globulin thing. So there's a bunch of markers you can look at muscle breakdown and one of the things that you can see is a creatine kinase level. That's elevated after say, um, one bout of exercise and, and you might, it might be up. You know five or six-fold. I've actually seen this number in offensive lineman in the NFL, be something like 500 plus fold, so even within just one category to the next. That number can get extraordinarily high and if you know this is actually one in an important point here, if you're paying attention to any mechanistic research or you use you're, using that to inform your decision making, you have to be extraordinarily careful of magnitude and what I mean by that is, if I were to be running a western blot looking at a signaling protein um and a muscle uh did this activation of this protein turn on mitochondrial biogenesis, and I saw that whatever intervention we gave it, whether it was a nutrition thing or a drug or an exercise - and I saw that that signaling protein increased by 20 percent. I

would basically assume that to be totally physiologically irrelevant, because in order for that to be important, it totally depends on the market you're looking at, but you some markers I might need to see four or five six hundred fold increase before. I know that that will actually be enough to be what we call physiologically relevant others if they're up one or two percent that is relevant, and so you really want to be careful when you're either reading papers or looking at Social Media stuff. If people are just talking about this, marker increase this much, it may not matter, it may be totally irrelevant physiologically, and so you have to that does also, if you're wondering like how the hell are, the all these people. Well, that's how they can trick you a little bit and intentionally or not. It could be just they're trying their best, but they don't really understand that area enough, and so that's an important point to pay attention to. So. To answer your question again fully, it would be hard to determine if there was truly a maximum level um. Some things don't want to move like blood pH. It doesn't really want to move the range that you're going to move from, is you know like 6.8 to 7.4, and if you get up to like 7.9, like you're, probably in big big big trouble, other things again can go up 500 5 000 fold, and so The markers will really determine that answer well at some point in the future. I'D love to continue this discussion around the topic of stress, specifically yeah um, and maybe we will get into that a little bit later today when we um get into the use of deliberate cold exposure, because that's certainly um has effects related directly to temperature on tissue. But it certainly has mental effects in terms of raising one's level of perceived pain. It's fun um, where some people love it and some people love it for the feeling they get during it. Um deliberate cold exposure. Some people only like it for the feeling that they get after it not unlike exercise totally. I love to train. I love exercise, but I know many people who uh um. They loathe exercise, but they love the feeling afterward. So this will be a theme that we will come back to. Thank you for indulging my interest in

00:40:36 4 Recovery Levels, Enhance Recovery

That semi-tangent, I think it's a relevant tangent if there is such a thing, if you can now return us to the different time, scales, yeah and modes of recovery, because I think where we are headed is how to get better at recovery. Yep. Let'S talk about the tools, let's talk about what to measure and identify for all four of these distinct levels, so level one is what we call overload and just very quickly what that means is. I did a workout today. The sign and symptom of overload is your fatigued. Acute performance is down, so I worked out hard right now. If I were to go, try to do a maximum effort, I would be reduced in my ability. The recovery period for acute overload is minutes to days right. That's generally, what we call

acute overload and that's what we're looking for right. So we systems should theoretically see that hormetic stressor come back in response, come back, bigger, better, more efficient, Etc. If you were to continue training in that state, like most of us, do and say I did a workout today, I had a little bit of acute overload going to work out again tomorrow. A little more acute overload can work out the next day a little more acute overload. Even if you took a day in between it's that doesn't matter right, you just continue these acute bouts of insult then you're going to be pushing into the absolute golden Target, which is what we call functional overreaching. So you have over reached what you can currently do and it results in a functional outcome, and what we mean functionally here is performance is enhanced and again performance being whatever you deem it to be you're stronger, you've, enhanced muscle size, your mitochondria has improved you've, whatever The thing is, it's not just a physical performance thing right, amazing, recovery time for functional overreaching is typically a few days to maybe even a week or so, and so typically, what we see happen is prior to a competition. Individuals will do what we call a taper, which is a reduced training volume for some short period of time, and there was the reason they do. That is to again. Actualize is the phrase We year is here the adaptations, and so you worked hard for six weeks and you know, theoretically, the workouts. You did three four five six weeks ago, once you allow, the system to recover will be actualized, which means your performance will be enhanced. Here so functional overreaching is the golden Target. Okay, if you were to be at the point of functional overreaching - and you continue to train so it intensified whether this was through intensity this through volume or really. As we said earlier, you had something holding back your recovery. It doesn't really matter right. It's it's sort of two sides of the same coin. Then you would move into what we call non-functional overreaching so you've over reached again, but now it is non-functional as in you did not see a positive benefit once recovery allowed. This typically means you have weeks it takes weeks to come back from, and you basically just get back to Baseline, and this is where a lot of folks are who end up in this vicious cycle, and so you're like man, I'm not getting the results. I want. I'M going to train harder, I'm not getting results. I want I'm going to train harder and harder, but because you've caught recovery isn't improved, you just end up in the same spot. So then you train more and you end up the same spot and you end up. Then just either blowing up or quitting and you're not getting where you want. If you were to continue past that point, you may actually be in what we actually call over training and that typically, is a considered to be over trained if it takes months to recover from so most people think they're over trained are really not you're. Just probably non-functionally overreached and again classic distinction is, if you took three or four days off and you felt better, you weren't, probably quote unquote over trained. You were probably just in this area of non-functional reaching. You need a little bit of

a back off if you - and this has been the case. I've had this happen with gymnasts and a cheerleader and some other things where they take a month off and we're barely seeing them start to come back to their Baseline numbers. In any number of areas, mood desire to train testosterone, cortisol ratios biomarkers in a number of areas - physical performance, vertical jump height, like all these things they just start to get back to Baseline, so over true over training is actually quite rare. Non-Functional overreaching is much more common and it is a shorter time frame scale. So when we talk about recovery, those are the four pieces that we're really thinking about, and so, if you are concerned about, oh I'm super sore. How do I get less sore? How do I either not be a sore next time? I do that same workout or I'm super sorry. Now. How do I recover those are playing in that first category of overload and we can certainly talk about how to figure that out. But the quick answer is you got to go back to our previous episodes and just pay attention to the volume intensity recommendations if you're getting significantly uh more damage or fatigue in a workout? You probably have increased your volume too quickly, or something else is dragging your stress bucket down, but generally, this is a problem of training. Um you either didn't warm up sufficiently. You're fueling strategy is off which we'll talk about in The Next Episode or you've violated. One of our principles of increasing intensity and volume sort of too quickly, if it's past that and you're getting to a stage where you're, just like I'm feeling beat up all the time my energy is going down, I'm just not feeling like I'm recovered. Now we're in this overreaching stage, so the the story I kind of tell here always is a few years ago I was working and my wife Natasha was in the garage training and I'm doing something and like she comes stumbling and she has this look on her Eyes and they're like her eyeballs, are giant she's, just like wobbling and she's. Like I effed up, I was like what do you mean you like effed up and she's? Just like, I read the program wrong and she's like Trump like what'd. You do like she was supposed to be doing 10 sets of three every minute on the minute and she did three sets of ten every minute on the minute and she was absolutely wrecked. She couldn't move for a few hours afterwards and then for days, she's. Just like you have to handle the kids like, I can't get out of bed. I can't move so that was like a classic example of all right like we don't need to fix recovery here, you're, just a dummy, and you did the dream way too hard too long like this is not we don't have a problem here. So if it's a situation like that, it's generally you just the program was way off. If it's constantly happening where you're, just like man like for whatever reason, every once in a while, I'm getting really sore or having a really bad performance in these workouts, then we need to go to our other stress bucket. Take a look at our allostatic load or allostasis and get figured out what's happening there um. So

00:48:19 Overreaching vs. Overtraining

I'M happy that you pointed out the distinction between functional overreaching, over training and being over trained. I think one one common mistake that people make in thinking about biology generally is that they think in terms of nouns and adjectives and not verbs amazing. I love that so much you know, biology is a collection of processes or processes depending on who you are and where you live, and who you trained with being over trained is a state that, in many ways, is an adjective you're over trained I'm over trained. It's like saying, uh, you know I'm an American, I'm a you know Czechoslovakian whatever it happens, to be right and in many ways people do start to associate with an identity, at least a transient identity, and they start making all sorts of decisions. It sounds like about what sorts of verbs they will and will not engage in, whereas I think if we look at things as processes and we assign verbs to them, then we can say: okay, I'm functionally overreaching or I'm truly over training, which is a matter of Degrees, correct right or under training for that matter, I'm not I'm reaching, but I'm not functionally reaching it's just it's just performance, and you know, just as with the nervous system, won't change unless you give it a reason to this is the reason why, if you can Perform something perfectly or speak a language perfectly. There'S there's no rewiring of the nervous system. This myth that we've all been told that every experience rewires your nervous system, it's different now than it was two seconds ago. That's that's a ridiculous, illogical statement. We know. That's not true if your nervous system can perform something, it has no reason to change and it won't muscles the same way. This is why you have to progressively overload you have to learn something new or challenge your muscle to do something new, it's same thing. So in the example that you gave uh with your wife doing this workout that turned out to be far more strenuous, she had functionally overreach. In some sense, she might have been over training or heading in the direction of over training, but the mistake would be to assume that she was over trained right, as I kind of it's almost becomes a bit of a state or a character assignment um, as opposed To a verb, and in any case, there's no perfect way to describe this - we're talking about nouns and adjectives and and we're also um talking about verbs. But I think the verbs are really anchored down in processes and things that we do actions that we can take and so um. If I may, I'd like to just highlight this, this idea of shifting one sinking towards verb actions rather than labels on the state that we happen to be in or the person that we happen to be right. Sometimes it even does become kind of character. Logical in the way that people describe it and uh, so I have to believe that there is something called over training that over training is real in other words, but that we don't ever really know if we're over trained, you nailed it. There'S there's. No, you know it's not like a red flag. Uh, you know shoots up out of your shoulder and say I'm over trained.

You know it's um, so in doing so, I hope that we can start thinking about some of the verbs, the actions that we can all take in order to ensure that we stimulate Progressive, overload one way or another and at the same time, that we don't fall into these bins of character assignment where suddenly we decide that we need to do X like take a month off or something like that, because I I'm beginning to realize um from our discussion that that's exactly the wrong way to go. Those are fantastic points I want to make sure it is clear that there is no clinical diagnosis for over training. There are no standards, there's no test or a blood panel. You can pull. That would actually identify you in that state. So your your distinction Here, Andrew of these are verbs, and rather than nouns is, is so wonderful because that is exactly the case. The only way we could really come retroactively, diagnose one with over training is, if again we had. You did weeks of recovery and you only got back to Baseline, so we can't do it in the moment. I can't take a single test, there's no subjective marker or anything that says you are over trained. It is simply, you are probably over training, and we need to reverse that quickly or in the case of the step before you are probably non-functionally overreaching. And if you continue to do this, you will probably enter a new stage where this is you're over training and we need to come back. So that's an important thing to let people know is there's no one thing we could actually point to that says you

00:52:53 Tool: Acute Overload & Recovery, Breathwork

Are here you are not a noun, this is a verb. So what are some tools that we can use to enhance our recovery yep? Let'S start off with that acute overload phase. So, in other words, I just did a workout and I'm feeling awful or I just did one two days ago and I'm super sore. How do I get rid of that right now? Well, there's a couple of things you can do immediately after your workout and then others that are maybe more actionable a day later or two days later and we'll just cover handful of them. We'LI do some nutrition and hydration and supplementation in the next episode. I'M going to cover everything else, not in that category right now, so a couple of things number one. You can actually start Kickstart that recovery process at the end of your current training session, and I guess I should say it this way. I strongly suggest you start this recovery process immediately after the workout you mentioned earlier about this idea of you got to get a really high peak of stress to cause adaptation, but I actually didn't explain that correctly, because what has to happen is you need that extremely High peak, but you then you have to be met with an extremely sharp recovery back down, and so you know you've talked about this before in some of your neuroplasticity stuff and in terms of what has to happen that caused the insult. And then you

immediately need to be able to recover to make sure that that causes changes in the brains same thing happens here. So we need a really sharp and high inflammatory response and then, if you do not meet it with an immediate recovery period, the signal won't be there to maximize your results. So what's that mean you can actually do a couple of things? Number one is actually listening to slow, paced, music there's evidence to suggest fast-paced music may slow down your recovery and slow pace when actually enhance it. So if you just change from you know your maximum get you up and get going music during the workout to a slower, lower Cadence that will help you kick start the idea of a similar note. You can also use what we call down regulation breathing. You could do them in conjunction or one or the other, whichever is up to you, so my personal favorite method here is somewhere between three to ten minutes of finishing your training session. Laying down I'd like to be in that position, you could certainly do it in the Lotus position, but I think laying on your back is generally more effective personal preference there, no science, I like the items being covered getting into this dark quiet sort of area and Then, just breathing through your nose in a structured, Cadence, there's a lot of different things. You can try an easy example. Is just box breathing so and you can imagine box having four squares. So what you're going to do is inhale for somewhere between, like three to eight seconds and whatever number you choose, you keep that same tempo, and so let's say you chose to do a five second inhale, that's going to take you up vertically and then horizontally for Your box is a five second hold and then a five second exhale and then a five second hold, and you just need to repeat that for the time domain. Now I typically honestly don't use a timer you'll, actually notice. A lot of people will like fall asleep or get really close to falling asleep in this period. You can do a triangle version of that, where you do an inhale, hold exhale and then go right back into your inhale or up there's a bunch of different tricks. You can try here, you need to play around and see what actually works best for you. Um 10 minutes is probably better, but if you can just at least give me three that'll work, if you're really really resistant, you can actually do that. Just in the shower, and so if you're going to finish your workout get in the shower again, just close your eyes in the shower, give me three minutes of focused relaxation breathing and that will accelerate the recovery process. I love it and I particularly love it because my laboratory works on stress and respiration, okay, breathing and the interactions between the two and I'll just mention a result that was just accepted for publication, so should be out by time this day. So there's uh. Thank you. Uh this is the beautiful work of uh, not me directly, although it took place in my lab, but as we know, it's the students at both doctors of um, Dr Melise uh, balbon uh in my lab. It's a phenomenal researcher that showed that a short period of five minutes of box breathing of exactly the type that you described or cyclic sign so two inhales, followed by an extended exhale to lungs empty. Ideally, the inhales are done through the nose. The

exhales are done. Uh through the mouth, although it could all be done through the nose, um or the mouth for that matter, but probably nose. Nose for inhale, inhale mouth for exhale or um uh in inhales, through the nose and and exhale through the nose. Cyclic sighing, as we refer to it done for five minutes, both of those produce very significant decreases in resting heart rate. The over time will increase things like heart rate, variability and so on and so forth. Um so provided that there are extended exhales. It seems like the calming response, and the reduction in overall stress occurs. The only thing that really sends things in the other direction would be something like cyclic hyperventilation. I'M sure you've observed that um and interestingly uh, when we had people just do five minutes of meditation which, during which, of course, they are breathing but they're just allowing their breathing to progress. However, it happens to be in that moment, um or moments across the five minutes uh. There were reductions in the same sorts of markers of stress that I described but not as significant as breathing. So I love the Brock's breathing tool, post, workout, um and there's some other Alternatives there too, that I just mentioned, but I think people greatly underestimate the potency of breathing for shifting one's nervous system function away from stress or if one wants toward more alertness and stress. I actually have a couple questions for you on that sure. I think the audience would appreciate this uh. How long were those boxes? Was it just user selected great question, so we use the carbon dioxide tolerance test amazing in order for people to determine how long the different sides of the Box should be, and you cover carbon dioxide tolerance tests. In a previous episode, we can provide a link to that clip um in the show, note captions, but, as you point out, it involves a long extended exhale to lungs, empty um and, of course, people could sit with lungs empty, but they have to accurately Faithfully as We say report how long it took them to empty their lungs. We use that as a gauge. Typically, if it takes, if people go to lungs empty in 20 seconds or less, I believe I have to go back to the paper and look, but I believe that the duration for each of the sides of the boxes as it were, was somewhere between um two And three seconds, if they had a CO2 discard time of anywhere from uh 20 seconds up to about 40 45 seconds, we use it. The sides of the box, where I believe, between four and six seconds and then for people longer than them who could discard their Arrow over a period of a minute or more. We used a box duration that is inhale, hold exhale, hold duration of somewhere between. I believe it was [Music,], um, seven, or maybe it was eight and as long as 11 or 12 seconds yeah. Those will get your kind of free diver types. Who can really do this? Who are really well trained for this sort of thing? The don't quote me exactly on those numbers, but that that was approximate. Those line up exactly with what what we've done. So I believe it's it's going to be close within seconds of non-important Distinction. Is it's going to be close enough, so that's great, and that was uh. It took them what six weeks. So this study was done over the

period of a month and then when they were swapped into a new pattern of breathing um, condition or meditation condition - and this was all done in the natural world, as we say, um they were wearing whoop bands. They were getting heart rate, heart rate, variability, sleep, data, subjective data about mood Etc. So there are a lot of measures, but this was um more than 100 subjects out in the wild of life um and we tried as best we could to track life, stress events and exercise, and things like that that was harder to control outside the laboratory. Really all those results speak to exactly exactly what you're describing here, which is that deliberate respiration that involves controlled holds and exhales really has a dramatic and very immediate impact on reducing our levels of stress. That's wonderful! I'm not surprised at all with your findings and what's really interesting about that, is you mentioned how the exhalation portion is primarily responsible for the down regulation and that's actually goes back to our previous endurance conversation, which is that in general at rest, at non-altitude increases in Co2 are the primary driver for ventilation, and so what that generally means is inhales are associated with an uptick and sympathetic State and exhales are associated with a uptick of parasympathetic State. This is generally, why folks will do things like exhale and finish that exhale right before they perform a very high Precision, neurological tasks. So if you're going to say, aim at a Target and shoot you're going to Exhale fully and then almost always execute that movement at the end of the exhale, because that's when you're in your highest parasympathetic State and lowest drive for ventilation. I have to say I'm not surprised at all that you guys found that there's actually other data that point to individuals, particularly after endurance. Training that can get back down to Baseline heart rate is going to be correlated with. Who gets the most actual results of their training. Said that if you take a bunch of individuals and put them through an endurance training program, and if you measure how quickly they can get back down to Baseline after each workout in general, those folks that are better at that are going to see greater improvements in Performance at the end of your say, four or six or eight week, training block and so there's a little bit of causation and correlation there that we have to untie. But I think it's enough to say: hey if you invest these three and in your case your your study was five minutes. It's only going to enhance recovery, you have a likelihood of increasing the results from your training, and now we also have additional benefits like being able to transition more appropriately into our next task, going to work going to see family whatever the thing is, and it's it's A nice close to, I asked you to be in a high, sympathetic State body, and I asked you to perform and to be under stress. I gave you recovery and now we're ready to transition in our next thing so that we don't take that exercise energy. If you will into our next

01:03:39 Tool: Alleviate Acute Soreness, Compression Clothing

task which may or may not want me in a sympathetic Drive state. So if somebody is sore following a workout, either locally sore in a muscle, group or group of muscles, maybe in their legs or chest or torso or maybe their whole body is sore as it sometimes is the case. What are some tools that they can implement in order to accelerate the? I want to call it moving out of that soreness, but it's really, as we know, the alleviation of the soreness through a bunch of different processes. What are the most effective tools to push back on that soreness and dissipate it yeah? Absolutely. First of all, it's not lactate! That's just a really important thing that we still hear people talk about. Is you know you're sore 24 hours later you got to do this thing to get the lactate out of there, as we talked about in the metabolism, uh conversation and episode that that is not the cause of fatigue and it's certainly not the cause of soreness. So not an actionable tip there, but just a pet peeve of mine. When I hear people say that that I get irritated so we can maybe end that conversation um strategies, tools, here's what you can do, you can actually wear compression gear that will help a little bit. There's a decent amount of evidence, suggesting, if you just were to you, know, put some tighter fitting clothes on Leisure, wear or compression gear. If you have it that can actually prevent a little bit of soreness from occurring. So if you're in the case of poor Natasha - and you realize you've just done way way too much or you went and hung out with your bow hunting friend and you trained way too hard, and you realize, oh, my goodness, I'm going to be very sore here. You can immediately put on compression gear and weigh that really for as long as possible. What are some examples of compression gear? I've seen people on the plane with those high high socks um, I mean anything that you wear compression gear for what you do for exercise. So whether these are just you know, compression pants and leggings and tight fitting leggings uh, whether this is a long sleeve shirt, that's like a rash guard, you would wear in you know Jiu, Jitsu or surfing, or something like that. As long as it's tight fitting, it doesn't have to be much more than that you can wear. I suppose you could get the socks, it would be great, but we generally just tell our leads them. They've put on a long sleeve compression shirts that they would wear for their training and then long, compression, leggings and that'd be fine. Can people apply these compression um Garb after training and still get some of the positive effects yeah? I have not seen any evidence to suggest that that would block adaptation. That may be the case. I I am not aware of those studies if that happens, but I certainly know that the information suggests it can hands a little bit of Muscle Recovery. But ideally one knows if they are about to do a workout that could trigger a lot of soreness yeah and then where's compression gear of some sort to offset that, and if so does it have to be local to the muscle groups that you're working on the Reason I asked about the socks is my understanding. The socks uh, the the compression

socks people were on the plane is that it's going to shift the patterns of blood flow, not just in the lower legs, but all over the body yeah you're, probably going to want to focus it on the actual exercising tissue, though, Actually, that's a really good question. I don't know the answer of whether or not you did an upper body workout only or lower body compression gear. If that would actually help that's a great question. It may have been done. I don't know, but I don't know the answer to that in general, we just tell people like where, where the whole thing as much as you can um, I actually am not concerned that you're wearing it during your workout. It is something you could put on afterwards or even wear just a little bit of compression the other day. Um we've actually did a really fun study. Uh. I collaborated with um Bill Kramer who's. Uh, you know, Sports scientist of the Year award. Is the bill Cramer award, if that gives you an indication out of uh University of Connecticut, as well as with Lee Brown, so two Lifetime Achievement Award winners and we we put people on a plane in stores, Connecticut and flew them to Cal State Fullerton. So a cross-country flight and some of them got to wear compression gear during the flight and others did not, and then they landed in California did a training bout put them back on the plane, went back to stores and I think they did another training bout when They got back there. There was a lot of data that came out of that paper, but one of the things that was clear is the compression group was effective at handling some of the blood related coagulation and other issues associated with long flights and particularly athletic performance. So that's actually a sneaky little Insider trick that I'll use a lot with people, particularly with athletes that are traveling, is just wear that compression gear on the plane. So you talked about that and that sort of rung that study to mind that as another effective strategy, so compression gear in general, as well as particularly on a plane, basically the tighter you can get it the better, without obviously making your hands purple and being uncomfortable And things like that, so it doesn't have to be overly tight. Anything will work and probably help. So I'm also doing that personally, anytime, I'm taking

01:08:27 Tool: Acute Soreness, Massage, Temperature

A flight like that as much as I can just to feel a little better when I get there. So what are some other methods that we can use to alleviate acute soreness? Well, if we continue down the same theme, which is saying okay, we'll use some sort of pressure manipulation to enhance recovery. If compression is one strategy, you can also use things like compression boots or garments, and these are nomadic devices that will you know, pump uh air outside you and compress back and forth. There'S any number of devices that will do this. You can

also use the physical hand, so this would be massage and body work they're, all really working as best. We can tell on the same mechanisms which are effectively moving fluid in and out of the tissue, as well as potentially enhancing blood flow, increasing capitalization and which is going to only get nutrients in and waste products out. So you can kind of pick and choose based upon your budget preferences availability timing, things like that, so those are all effective strategies outside of that really is the next largest category, which is now thermal and uh, and so far in this discussion, we've mentioned cold water, Immersion and I talked about in the hypertrophy section how you would not want to do that immediately: post exercise, which would be getting into cold water or an ice bath if you're trying to grow muscle mass. Having said that, there is good evidence showing that cold water immersion specifically is effective at reducing muscle soreness. So it is a fair consideration and it's a classic example of how there are no free passes in physiology. Nothing is always good or always bad. It's always about what are you willing to give up and versus what you're willing to get and the case of like cold water immersion? You may be thinking yeah. I might want some of the hypertrophic adaptations, but if you're in that phase of training, where you're actually trying to push more towards optimization in that moment, rather than long-term adaptation, then a an ice bath might be a great choice. In addition, if you fall into a scenario like Natasha did - and you realize like I'm just so unbelievably sore - this might cost me three or four or five or six days of training. It might be worth it for you to accelerate that recovery process by a couple of days so that you don't miss so much training. So it's just a it's an algorithm, it's an equation. What am I looking for again if I'm in season or trying to compete or if I have just done way way too much exercise, and I am really in significant pain. You would probably be willing to give up some small percentage of eventual muscle growth after a single session to get out of pain so of the cold strategies. Cold water immersion is clearly the best approach rather than cold air or some other tactics. So a cold shower is probably not enough here. You really do want to be either in moderately cold. This is maybe 40 to 50 degree, water for probably north of 15 minutes or you can be in sub 40 for as little as maybe five minutes to get some of the fact there and there's been a number of studies um. So I'm sort of summarizing a bunch of that kind of into one rather than going through them Point by point. The numbers you just threw out uh, which I'm assuming are um uh Fahrenheit um, seem seem really cold to me right uncomfortably cold. Absolutely so I always recommend that people ease into it as a protocol overall that they not immediately go to 35 degree uh cold water, if they've never done it before uh. That said, once people are comfortable being uncomfortable, because I always answer the question: how cold should it be exactly? Would you agree that it should be very, very cold so much so that you really really want to get out, but that you're able to stay in safely? Whatever that value happens to be, you absolutely

need to be safe. Having said that, we have actually, in our xbt Retreats, put dozens, if not hundreds of people at this point, uh immediately in the sub 35 degree water their first time ever and done. You know three minutes multiple rounds in a session, so they can handle it. But you don't need to go that crazy. If you don't want you kind of have to play a game right, do you want to be really really cold for a short amount of time, or do you want to be like kind of cold for a longer amount of time? I really the only mistake you can make is doing something like you know, 65 degree water which for most people is not very comfortable and doing you know five or ten minutes. It's just not going to be. It's probably not going to be effective. So if you're like man 35 is, is absolutely crazy and you want to do 55 degree, water and there's literature in that area. But it's going to say you need to probably be there somewhere, almost really north of 10 minutes, and some of it will actually show you need to be in there like well north of 20 to 30 minutes. So for my money I would rather go really really cold and get it done in five minutes, but um personal preference on this one. You can also make it a little bit easier on yourself. There is not nearly as much evidence, but there is some on contrast. Stuff so uh, this is when you go cold, hot and sort of back and forth. There are no really good rules in terms of how much should you go, how many rounds, how long and cold how long and hot again there have been a couple of studies but and obviously those studies use numbers, but that doesn't mean those have been tested to See what are optimal, which is a very big difference, so you can really just kind of play that by feel hot is good for Recovery. You just have to be careful because you are going to put more blood flow in the area, and so you may walk out of there with some additional acute swelling which isn't going to put greater pressure on there. So you have to kind of play with that. I personally really like hot for Recovery. I will feel - maybe not great in that moment, but the next day I tend to feel really really good. In addition, if I wake up the next morning and I'm really really hurting and I'm super stiff, a hot bath will help that um quite a bit, so you can play with some of those protocols. Again, you don't have

01:14:21 Cold & Heat Contrast, Cold Shower vs. Immersion, Sauna & Fertility

To do nice there's absolutely no requirement to do so. It is just an option if you're interested the studies of Dr Susanna soberg sure yeah are not directly aimed at alleviating soreness or recovery, they're more about increasing thermal capacity by a storage of uh Brown adipose tissue, not the blubbery fat but the stuff around the clavicles And around the heart that help you generate body, heat at rest and metabolism and so on, and the numbers there that um she's come up with again have not been tested against all the possible derivations just like

with breathing. We did five minute sessions, but who knows? Maybe a minute would have been equally effective. We just there are constraints on these sorts of studies, but the values that she's come up with, which seem to be good thresholds for making sure that an adaptation response is triggered by heat and cold. Is it ends up being 57 minutes per week, total of uncomfortable but safe heat in that case sauna, and that can be all in one session or breaking it up into a couple of sessions on the same day or different days, and then 11 minutes per week. Of cold either in one single session or multiple sessions, again one could do more um one could break that up over you know multiple days or do it all in one day or do it all in one. You know an hour in the sauna and then 11 minutes in the colder vice versa, although that seems a little bit extreme, especially for the uninitiated. But those are the numbers that have been studied. But as you point out, there are not a lot of really thorough studies examining different cold protocols according to temperature by time requirements. So there is a bit of subjective, feel required to establish a routine, and I would actually say this is another time to re-emphasize something. We talked about at the beginning of our conversation, which is that pain itself is not a defined outcome. It's heavily influenced by your perception, and so, if you don't feel like they work for you, they won't work. If you feel like they work fantastic, they do so. It's a challenging field to get really objective data on so there's always going to be a little bit of subjective nature. To some of these things, I can tell you anecdotally: we've used hot and cold contrast for a long time with athletes. Some love it some don't care for it and everything in between. So it's one of those things where I never mandate it. Of course, I can't mandate anything for anyone I work with, but I'm never you know like hey. Are you interested great you're struggling this area? Do you want to try this? You did and you liked it great you're struggling in this area, and you tried it. You didn't love it. Okay, fine, I'm not we'll find other routes, as we will get into there's a lot of ways to enhance recovery um. This is only one and it hasn't even really come down to stopping the problem in the first place, we're not we're just treating symptoms, which is first line of defense, but you really need to go back and figure out why it's happening to begin with, as a Solution, these are just different again acute symptom management tactics. One final point about uh, deliberate, cold exposure. I think worth mentioning is one of the reasons the shower is effective, but not nearly as effective as cold water, immersion or immersion in ice up to the neck is simply because of the reason you stated before, which is that most showers are not going to get That cold you're not going to get down you know into the sub 40s. Also cold showers haven't really been studied that much they have, but not nearly as much as immersion and people always ask why just think about the challenges of studying cold water exposure in the shower, where you can't really control for mango? How much of the body is covered, whether or not the head stays under different size bodies, Etc? Whereas when

people come into a laboratory, they can get into a cold large, and we know where the neck is. We know where the chin is and we can make sure that people's arms and um legs are underneath, but with cold shower sure you can make everyone face away or toward the shower, but it's really tricky and um for all the variations that were described. That said, would you agree that if one wants to use deliberate cold exposure, that cold shower is better than nothing and cold immersion in circulating, cold water or ice bath is better than um than cold shower yeah? What I'd actually say if you're looking for recovery for muscle soreness, I would say cold shower, is probably doing very little, because you're not going to be able to get enough cold water onto any muscle, besides, basically your head, so maybe you could try a cold bath And so you'd at least get some surface area coverage, but yeah if you want to use cold shower for all the other awesome reasons to cold shower. That's totally great. But if you're trying to use that to recover your low back and glutes from being sore from training in a good way, it's probably not going to do much the the immersion would be there. You actually also hit a sneaky other point, which is, if you can't get your water super cold, just make the water move. So if you have Jets and stuff you can turn on and anyone who's tried this and be like. Okay, I can do a 40 degree. Bath awesome, try 60, when the water is moving right, because you break up the thermal layer. Normally you have a little thin layer of water that you're heating up. You break that up. It's a whole new world, yeah, absolutely so being very still in the cold. Water is actually the weaker way to go correct that you can make your face stoic, but make your body circulate some water around you as long as we're on this. Maybe just one more point about heat uh: I've certainly used sauna, wet sauna, dry, sauna, steam saunas. Excuse me, jacuzzis can work pretty well yep um uh males. If you are looking to conceive in the 60 days following uh uh following sauna or um, hot tub do realize that it that both those approaches do severely limit the number of motile sperm um substantially. So for people that are not trying to conceive uh. Don'T think that this works reliably enough, that you could use it as a form of contraception yeah, but but for people that are trying to conceive. It really is detrimental to sperm Health right and so for that reason some people bring an ice pack and put it on the groin or near the groin when they go in but um, which is hard to do in a hot tub than a sauna. So here we're getting into the fine points, um or crude points, if you will pun intended, but um, but the idea is that we we wouldn't want anyone to approach these techniques and compromise their other life goals, certainly not allowed anywhere near these things. When uh, we were at that stage of Life, I'll just say the Natasha put an x on me hanging out with Laird. So for those reasons, she's like you're, not going in you're, not going none of this stuff, and I just had to wait right heat um heat and

sperm have have a relationship but it's not one that's positive for the sperm

01:21:46 Combine Recovery Techniques

Are there ways to combine the various types of stimuli that you described for inducing recovery? You talked about breathing based tools which, while they could adjust and indeed do adjust oxygen and carbon dioxide ratios and Etc. I'm guessing the major effect of those on recovery is going to be neural. It's going to be deliberate, calm of the nervous system, more sympathetic, based uh, as you mentioned, yeah most definitely, and then you talked about some movement based and touch-based approaches. Um, which will uh movement circulate, certainly will circulate blood, but also will generate contractions of the muscles yep right, which maybe, if, indeed again, it still speculates you, if indeed some of the soreness is due to excessive stretch or swelling at the stretch, ends of the of The muscles that would make sense so movement and touch and then thermal, are there ways to to combine these um that are more effective or maybe even synergistic yeah. I suppose you could throw on uh some compression garments put on a Pneumatic compression device and sit in the sauna. While you down regulate your breath like that would be fine. Quite honestly, though, you probably don't need to maximize all of them. We were joking. You could probably go for a light swim while regulating your breathing in cold water. You get the compression from the cold, water and and you'd be in a good spot, so you could certainly do that. The reality of it is. I generally look for some physical approach and then some holistic approach of the breath work. Basically, so I want breath and then something else if you knock those two things out you're in a good spot, so that could be breath while you're in thermal stress, so just controlling and doing the unregulation stuff. You have to also remember ice is a stressor and I'll actually show you some data here in a second about how that actually can enhance systemic recovery, although it won't happen in the in the acute minutes. In fact, it's going to take at least 30 to 60 minutes and then you'll eventually see a rebound effect, but acutely it's going to make you actually more sympathetic, which is going the other direction. He can do the opposite or it can actually drive you up. So it's a little bit dependent upon how you respond, what time of day and how you're, using so in general, I guess combining them is if you need it um, depending on what you have what's available. So perhaps you don't have a sauna, but you can take a hot bath great. Maybe you have some percussion device some tool and you can use that. But you don't have a sauna amazing. I don't have ice bath these

things. So I think, rather than thinking about an optimal combination of them, I would say just use a couple of the tactics based on what

01:24:34 Monitoring for Overreaching & Overtraining

You have and what is easily available in your situation, I'd love for you to teach us about some of the methods for longer form recovery, as it relates to overreaching and over training. Sure you want to think about this in a couple of phases. Phase one is to try to prevent it from happening in the first place, uh in terms of training load you're, going to just go back to our previous episodes, where we talk, give you specific instructions for how much to increase your volume and intensity per week, Etc. The other thing you can do, then, is do some monitoring and I'll go over some different tools: some cost free ones, as well as some some higher technologically demanding ones to monitor, to see if it's actually happening, and then the third approach here is what, if this Has already occurred, I figured it out I'm so how do I get back out of that hole? So I would like to just sort of tackle these one by one in order and talk about, what's happening, what tools you can use and why they're going to work all right so anytime we're talking about fatigue management here. Most people are aware of these terms because if you have any sort of Technology, you're, probably getting some sort of Readiness score or recovery score or strain depending on which app or watch or Tech you have. You have a little bit of vernacular change if you're in the sport performance world, you might be looking at things again like load or a GPS, tracking and monitoring, and really all of it is, is doing the same thing it's trying to either one predict a problem Is going to happen in a future and then placing restrictions upon you so that you don't run into that situation, the other thing is possibly doing is identifying a drop in physiology or performance, and then saying we need to get you out of this hole. That's really! What'S happening, and so when we think of the first one just imagine a scenario like a mileage limitation, uh pitch count in baseball and what has happened there is. Is you know, individuals in those fields have looked and said, hey what we notice is people who throw say more than 100 pitches in a game tend to start losing Effectiveness and increase injury rate. Therefore, we're predicting the next time you go to play. If you cross that threshold, we start having an increased risk of negative consequences. So therefore, we're going to cap your in this case pitching volume at that hundred pitches per game or whatever the case same thing with running, etc, etc. So you could just simply do that and there's actually really cool data coming out now on sport performance stuff. Looking at things like, I am using GPS trackers and trying to identify even position by position specific recommendations for how much distance you should cover in a

practice in a trending session um so that you can say, hey these positions, don't cross this threshold. These positions don't cross this threshold in basketball and tennis and all kinds of things like that. That's not probably extremely applicable to many of the listeners right now, but it is still conveying the idea that if we understand where we break, then we can stop ourselves from getting there in the first place. The functional example here is just thinking about basic things like: where do I start my training program and then how do I progress it and we've already covered those numbers in either case, though, you want to have three markers that you're paying attention to if you're concerned, You'Re getting into an overreaching phase or potentially going to lead to over training, or you want to get out as three unique things number one we're going to look for some sort of performance metric right. So this could be your times are going down your your squat numbers, your your power is going down any of these things, so it's got to be an actual performance number two, some sort of physiology, and so I want to see something happening with resting heart rate. Some biomarker is moving heart rate variability. Some other measure that is not influenced by you and the beauty of using biological markers are. If we contrast that to like performance - and I said: okay, here's our performance test. Every day you come in you're going to do a vertical jump and if one day you come in all of a sudden, your vertical jump is super low. I might think oh man, maybe we're starting to overreach. You also could be feeling lazy that day and just not have jumped very high on purpose, because you didn't want to work out the beauty of biomarkers. Are you don't get to manipulate them like that? They don't care, there's a downside to it, which is maybe they're. Just indirect markers right, and so I'm not telling you biological markers, are better than performance markers. What I'm saying is you want to look at both all right? In fact, you want to look at our third category as well, which is some sort of symptomology, and so am I am I having a symptom of overreaching. Am I seeing a performance Sacramento and then am I saying a biological marker as well? If you see all three of these popping up, you have reason to believe you've reached some overt reaching now. What you have not identified yet is, if that is functional, overreaching, non-functional, overreaching or true over training and remember you shouldn't be feeling great after every training session. You'Re trying to cause adaptation and until you back off, maybe even weeks or months later, to actualize the adaptation and get that super compensation and performance increase, you're going to have to invest a little bit so you're going to go in the hole. Any sport performance coach is going to look at numbers throughout the year and say yeah when we first start training in preparation for the season. We are going to see a drop in performance that day that week. That's part of the plan, though right. That's the stress, you're trying to accumulate, so you want to see all three of those markers you just want to pay attention to a couple of things. How long are they down for a day three days, seven

days, 15 days, Etc? If you're seeing a performance drop in a day - and I am far away from from performance uh so the day that I want to Peak for - I'm not going to do anything different. If I see two days in a row drop performance, I'm not worried. If I see more than probably in my opinion five days in a row of decrement, then I might start paying attention if you're in season, though or close to competition or whatever. That thing means to you, and you see more than a couple of days in a row of dropping, then you might actually want to take some some steps to mitigate that. So it really is important. You understand again, what are we trying to do? Are we trying to cause adaptation? Are we trying to cause adaptation, and I I have a very specific example of all this - we can run through uh here in a second and then, of course, a bunch of tools to to pull you out of those phases. But that's that's fundamentally what we're trying to do here. I would encourage you again, don't be too reactive and responsive to any one measure, I'm going to cover a whole bunch of them in a second, but you can get lost in in different things because they all have pros and cons. And so I know it's simple to just look at one score in your watch and make your decisions because of that or check your app. But you really want to be careful of

01:31:33 Overreaching/Overtraining, Performance & Physiology, Sleep

Doing that you're going to probably lead yourself in the wrong direction more often than you're going to help yourself. I'M curious as to why, when we overreach too much or too often where we are over training, that performance is diminished because, on the face of it it's kind of obvious you're, overreaching you're over training, so performance is diminished, but that's completely circular you hear about things Like adrenal fatigue and adrenal burnout, well, it turns out. Adrenal burnout doesn't even really exist. Absolutely not. There is a such a thing as adrenal insufficiency syndrome, but of course you know these phrases like burn out adrenal burnout over training, um they're thrown around it. You know as much as words like gaslighting and obsessive compulsive. You know are without any real clinical definition um or there are clinical definitions, but people aren't obeying them when they use the language. I do want to acknowledge. However, what is absolutely true, which is that overreaching too much too often over training? These can degrade performance but mechanistically speaking, what's going on, because I think if once we understand what's going on mechanistically, then I think we can all look at tools whether or not it's breathing movement, compression thermal psychological motivational, Etc and have a much clearer sense as to What'S going to work best and what likely won't work? I love this question so much because, as I mentioned at the beginning, I I was fortunate to spend my some of my graduate work in Andy Fry's Lab at the

University of Memphis and we did a lot in this area, and so we, in fact this is How I learned how to do assays and run Western blots and measure signaling proteins, and things like this, so this stuff is near and dear to my heart. We also did a bunch of really wild studies and he had done some before I got there, so I'm going to combine kind of antifrey's entire career and just highlight some of the big pictures of what he found there um. He was very interested in exercise particularly strength, training and trying to figure out this entire question right, which is like. Why is this actually happening when I work out too much, when I lift too much that all of a sudden, I can't sleep what's happening like? Why is my energy down? Why is my mood? My motivation reduced if I squat too much so we did a whole series of studies across this career and again I'll just sort of highlight some of the the some of the themes that ran through them. So the first one that jumps out to mind is early in his career. He did this really awesome protocol um, where he had people squat 100 of their back squat Max every day for two weeks, so you're coming to the gym, and I think this first one was on a machine and you did a one rep max and you came Back in every single day for two weeks, so these are what we would generally call kind of like that short to moderate range overreaching and, by definition some of them end up actually being true over training, because it would take the individuals sometimes two to up to Eight weeks to return back to their one rep max at the end of these protocols um, so some of them were non-functional overreaching or some combination of that well, along with that, he took a lot of blood samples as well as muscle biopsies, to try to look At what's happening, endocrinologically neurologically muscle, physiology wise to pay attention what's happened. So a couple of things that jump out there, one of his initial studies - actually, I think, the very first one he did when they ran that first squat everyday protocol. What they found is catecholamine levels change quite significantly and depending on kind of what you wanted to pay attention to there, whether it was epinephrine or norepinephrine or even some other markers. They basically increased by somewhere between two to threefold and so a little bit of understanding. Of sleep physiology if adrenaline is extremely high, epinephrine you're, going to have a hard time sleeping, so that alone was was first indication. This is like wait. A minute something's actually happening here, that's just beyond muscle, soreness, there's some sort of systemic fatigue happening and, as you rightfully pointed out, is not the adrenal glands becoming fatigued, that's sort of a bit of tongue-in-cheek at pedantics. It is cortisol, dysregulation and general stress syndrome, but it's really can be noted in in blood in terms of epinephrine and norepinephrine. Another study he had done of a similar realm was over the course of seven and a half days that people came in and did 15 training sessions, so it was really cool. These are these really short bouts of just ridiculous training and they said: okay, like something's happening with, with epinephrine and norepinephrine something hap something's happening with

testosterone. What's it look like inside the cell, so now muscle biopsies came on board and they started looking at things like map kinases, which are these signaling proteins that are tend to be associated with an anabolic response, say upregulate muscle protein synthesis and they do many other things. But that's like a big factor of them. They looked at various androgens and glucocorticoid receptors and they wanted to say like well. Maybe receptor, density or and or sensitivity is changing and in fact surprise surprise. That's exactly what they found. So they found both Androgen and glucocorticoid. Receptor concentrations were reduced, and so you can start to see a picture forming, which is like hmm, very similar to the insulin type 2 diabetes story, where you've you've really put yourself in a very high stress situation, so presumably epinephrine, Etc. Testosterone releases are extremely high. In response to that, to try to reach back to some level of homeostasis, you start down regulating The receptors for them, and so it's like the signal can only get so high if you're going to keep that gas on we're going to pull back the throttle and The receptor so that the total signal stays the same if that makes a little bit of sense. Well, that becomes obviously problematic um. So then, like a final follow-up study here, that is important to note, is they did another protocol which was really really cool and they said the first ones weren't enough. So how about this we're going to come in every day for two weeks and we're going to do 10 sets of a one rep max every day, so they were coming in and they would do 10. One rep Maxes every day for two weeks and what's really cool about that study. If they didn't complete any other repetitions, they had to repeat it until they had 10 successful one rep Maxes on that, given day um, absolutely brutal brutal protocol. I wasn't there at the time um. They had finished that right before I got on campus, but I was actually able to be around when they were doing some of the final analyzes there of the tissue um. What they want to look at in this particular study was beta, adrenergic receptors, which are those receptors were that are going to be epinephrine and such are going to be binding for so again similar story here. Um, perhaps are we losing overall sensitivity because of this extreme sympathetic stimulation now, actually, thinking back, what would have been pretty cool is if they had another group that did it and then did some down regulation breathing post to see if that can ameliorate some of the Problems, but no of course, this was 20. plus years ago, or something like that, so a couple of things that happened is the one rep Maxes dropped by. I think around, like eight kilos by the end of the two weeks, if I remember right like the group average, was something in the neighborhood of 151 kilos, so these were pretty well trained individuals and it went from rather, I think, actually it was about 160 kilos And they dropped to like 152 kilos. It's something close to that. What was more significant, though, was their power dropped by 35 percent, which is really really interesting, because if, if you pay attention to declines in physical performance over time - and I mean that, like through aging, what you'll see is

people can hold on to muscle mass pretty? Well, it will go down by about you know, one percent or so after the age of 40.. However, strength will go down at like two to four percent and then Power by eight to ten percent, and if you look at actually World Records across strength, Sports by age, you'll see that they will decline by age, but not that much. However, if you look at Speed Sports by age, they fall off the planet, so it's very challenging to preserve fast Through Time whether this is fatigue or because of age. That's really important, because that'll then tell you hey a little bit of a canary in the coal mine is not necessarily your strength, but your speed, and so a lot of different techniques that we use to measure performance. Remember that's our Triad right, symptomology, physiology and performance. You're generally, better looking at speed based performance tests rather than strength based performance tests to get an earlier indication of potential overreaching or over training, so anyways back to the the individual study there um in that same group again, we have the same problem where it took Some of them two to eight weeks to come back so what they had to do is, I can't remember the exact time frame. I probably should have thought through this, but they had they had to come back, something like every week or every couple of days, even after the study finished until they got back to their Baseline, one rep max and some of them it took them up to eight Weeks before they finally got back, so they probably were in a classic uh over training State at that place, which is was done in as little as two weeks, and this is also another point that people always ask like how uh like how long does it take? Is this something that has to happen over the course of months or like? If I were to go, do two days or this intense training camp for two or three weeks? Could I actually cause over training, and the answer is if it is actually truly enough volume and enough intensity, you probably can do some significant damage in as little as two weeks probably doesn't happen that often most likely you you're probably going to be reaching a state Of non-functional overreaching, but you may actually be able to put yourself in a position where it might take three or four weeks or more to get back to Baseline after a truly intense and again think about this protocol. It's like totally unrealistic for the most part, 10 sets of one of a one rep max squat every day for two straight weeks: um, some folks, if you're extremely highly trained weightlifter. You might do something like that when you're very close to say World Championships, but outside of that really specific scenario, it's a totally absurd training protocol. But that was the point right. We were trying to ensure uh ensure that over training was met or close. It's similar to when we've done and we've actually done. I think three studies in the center for support performance on Dom's muscle, soreness and in all those cases you do just like ridiculous leg extension protocols, because you're just trying to ensure you cause super soreness. If you don't, then you have nothing to study so um absurd training protocols, but but that's the point so nonetheless um as a result sure enough the

beta adrenergic receptors were down regulated by something like 37 percent um. What's probably even more significant, though, was the sensitivity in those receptors was reduced by like two and a half fold, and so it's like okay, wait a minute we're becoming desensitized in this timeline and we're also actually now starting to reduce our total concentration, similar, which is Actually an interesting, it was a very sneaky smart thing to do. Is they looked at nocturnal urinary, epinephrine and guess what that was also up by like 50 percent 15, one five, five, zero, five, zero yeah and so now you're, seeing this tie-in where it's like um? I'm seeing a response at the tissue level, I'm seeing a response, probably although they didn't actually look at pituitary. Anything like that, I'm seeing adrenal and other endocrinological problems, and then I'm also seeing this increase in concentration of Ben epinephrine. When I'm supposed to be sleeping and surprise, surprise I'm having a hard time sleeping symptomology, that's a very interesting finding about nocturnal epinephrine epinephrine, of course, is adrenaline. It's released from the adrenals no surprise there, but also from this brain area called Locus, ceruleus and the brain, and the Brain tends to be called epinephrine in the body adrenaline just to complicate everyone's understanding, but that nomenclature did not come from us. So don't blame us. The point is that rapid eye movements lead so called REM. Sleep is more abundant in the second half of the night. We know that the dreams associated with rapid eye movement - sleep are more emotionally Laden and that those dreams and those emotional states are actually important for discarding the emotional load of previous day's experiences. It's a sort of a natural trauma therapy if you will, because in the normal, healthy state those dreams are associated within the inability to release epinephrine at night. So for me, what you just described! First of all, it's the first time I've ever heard of it um, but it ties together something really quite clear from the Sleep Neuroscience literature, which is that when people are stressed, they tend to get less rapid eye movement, sleep that rapid eye movement, sleep normally is Associated with low levels of epinephrine, so whether or not it's causal or not, isn't clear but sort of doesn't matter for sake of this discussion. But what I'm wondering - and I suppose one could test for, but maybe observed, is whether or not people who are over in over training too much over reaching too much because of this elevated nocturnal epinephrine diminished REM sleep, whether or not their emotional state is also um Disrupted, because one thing we know for sure is if you want to disrupt somebody's emotional state, you deprive them of sleep and rap and eye movement - sleep in particular. The one caveat to that is for those of you out there that have heard that rapid eye movement, sleep deprivation, deliberate, rapid eye movement, sleep deprivation is a treatment for depression. That is true, but it's coupled with a next night enhanced rapid eye movement, sleep. So one of the major takeaways from all of this uh that I'm realizing is that no surprise daytime activities impact

01:45:41 Overreaching/Overtraining, Biomarkers, Cortisol

Nighttime, endocrine function, impact quality of sleep impact, daytime activities, yeah, actually, there's so many fun things I want to do here now um. This is actually why measuring eye movement is a very fantastic tool for understanding, total stress load and you can actually differentiate different types of stress, so caffeine use versus alcohol use versus sleep deprivation by actually measuring eye movements. That's actually what we do in our absolute rest. Sleep company is, in addition to getting a full PSD sleep study done in your bedroom, you're, going to get an eye tracking assessment which we're going to be able to figure out why you're getting there so um. Nonetheless, yeah, if you actually look at the classic signs and symptoms of over training or over training syndrome, it's going to be everything from performance. Decrements like we talked about um heart resting heart rate, is going to increase you're going to see things like HRV drop. By generally 20 or so percent, that would be a very large disruption in HRV, decreased body weight and then all the stuff Andrew you just talked about so motivation. Adherence appetite mood - all of this stuff are classically known associations with with overtrain and that's for the exact reasons you're talking about sleep disturbances and disruptions wanting to train motivation. All of this stuff uh goes part and parcel with non-functional overreaching and or over training. You can actually tie this back in a little bit more to some other biomarkers, and this is this is great, because this is the stuff we look for. This is the physiology stuff. We look for um, you've probably talked about shpg before which is a sex hormone, binding globulin. So it's this protein that that'll float in your body. That's going to bind up sex hormones in particular testosterone. So what happens with um over training? Is you can actually take this serially like week by week and you will actually see this number rise, and so, if you see this like say, you're using a a service like inside tracker and you're, getting your your blood measured every so often - and you see this Number start ticking up. This is actually associated with that because, what's actually happening is it's binding up all your free testosterone and that's just leading back to the circle we're talking about and you can actually see the same thing happen with calorie restriction does not eat enough calories, but in this Particular case because it actually happens in both scenarios, you know it's not an issue simply of being under caloric. It's clearly an issue of the training load being too high, so just to give another little tool. There'S I can get the link for it, but there's a website that was created by which Journal uh I'm slipping, but I'll get it to you. You can link it up where you can actually go in and plug in a number of values for mud chemistry. So if you got your blood work done and

you can plug in your pre-number and your post number so say you got it done and then maybe 10 weeks later you got it done again and you're wondering and you notice, hey my free testosterone's down or my Shpg is up, is it actually a meaningful number and you? It will actually tell you whether or not the change predisposed is physiologically Meaningful or not, or just within the error margin of the measure, and you can actually change like right there on the website. You can change your confidence interval, so it's really really cool. If you know, if you just have your own blood and you want to know like hey, I had any level this year and now it's you know here. Over there, it's a totally free resource created, gone through peer review, all that stuff and I'll give the link to that. So that's a pretty cool measure in addition to that, like probably one of the more powerful and easy metrics uh biologically, is to take your cortisol and DHEA ratio. So this is known to be associated with a lot of things. You want to be really careful. You don't want this number to be too high or too low something like 0.09. It is about cortisol to DHEA DHA, to cortisol ratio DHEA to cortisol I'd love. To tell you, I said it backwards on purpose, just to make sure everyone understood, but I got it backwards. Yeah I mean this ratio has been associated with so many things you have to do. You do have to be careful with Association right, not being causation, but everything from risk of infections, the metabolic health and and like other disease States, as well as more what we're talking about which is hey Mike am I am I getting sort of cortisolous Regulation, which Is what a lot of folks would call? You know again adrenal fatigue and no that's not really what's happening, but if adrenaline and epinephrine are off and testosterone cortisol is going to be along the right, and so you can also look at things like testosterone to cortisol ratios. So, there's a lot of things you can glean here to give you some insights into where you're going, if that, if that ratio is too high, that's going to be associated with metabolic syndrome and a bunch of other stuff. If it's too low that's going to be associated with a lot of cognitive problems like aggression and mood and a bunch of things like that, so again, you want to keep it right around that 0.09 ratio and most the time actually in some blood chemistry, stuff you'll Get a you'll get a report of that or you can calculate it pretty quickly. I'M sure we'll get into this in the

01:50:45 Cortisol, Daily Levels & Performance; Rhodiola Supplementation

Episode that comes next on uh nutrition and supplementation totally. What about compounds that lower cortisol, such as ashwagandha um? I can see now based on the logic you're spelling out that during phases of a lot of intense overreaching or frequent overreaching,

given that those compounds can indeed lower cortisol, [Rhodiola](#) Rosea um, one word to say, um two words, but the first one. More fun to say: [Rhodiola](#), folks and [Ashwagandha](#) I've been uh trying, [Rhodiola](#), recently um and mainly as a buffer to Output um. It does seem to have some good data attached to it related to lowering uh one's perceived threshold of how hard they're working. So in other words, you can work harder and not feel as if you're working really hard, which allows you to do more work. That's sort of the subjective description of how it works, but you told me that it um Can blunt cortisol and ashwagandha. We know blonde's cortisol. Both of these things, of course, can do other things, but are these um compounds that you sometimes will incorporate into a training? Regimen uh I've been using [Rhodiola](#) for probably six or more years like pretty consistently, not personally, but using it with the individual. You work with. You do need to be a little bit careful. I wouldn't say that it blunts cortisol, it is probably more purplely described as a cortisol modulator uh, which means sort of if it's too high or too low it'll help kind of keep it within normative range. Um, there's also. There is important to note. There have been a handful of studies at two of I know specifically showed that uh Rhodiola use kind of hands, strength gains. However, it may reduce muscular endurance, so we need more human data on this stuff and it may turn out that's not a concern. It may also turn out to be a concern, so nothing is, nothing is perfect and free. There'S no supplement. That is a Panacea and um. I have used again really in a lot of situations, because the other thing you kind of have to pay attention to the cortisol is: is you ha it's supposed to be modulated throughout the day? It's not supposed to be at this normal now. In fact, if you look at the normative values - um, it's typically uh described in uh micrograms per deciliter and depending on literally what company used to draw your blood if you're getting it through the blood depending on what which method they use to analyze it. The normative values are, like, frankly, embarrassingly all over the place: um they're, mostly going to be like 5 to 25, as a quote: unquote normative value, but that's outrageous. We also know those numbers vary massively by age by sex and throughout the day, and so, if you only are taking a single point, let's assume you're doing a fasted blood draw, which is what most folks do. It's really only going to tell you a lot about. What'S happening in that moment, we need to know well, like maybe let's say my cortisol was, if I'm a say, 38 year old woman and my 7am cortisol was 15 milligrams per deciliter, that's pretty good, but if it's 15 milligrams per deciliter at 3 pm, oh boy, I'M I'm probably having some issues right, so there's a change throughout the day and you need to be able to plot that curve. So you can actually well pretty standard practice that we do. Is we look at cortisol throughout the day we're going to take multiple markers, because I don't want to just see your Baseline cortisol? I want to see this curve throughout the day. That's going to tell me a ton about again as your sleep being caused by this regulation. Is it your training? Is it something else, so I would like take a

single Baseline blood marker of cortisol with a lot of grain of salt. We would typically measured at least three times throughout the day, so something like six to nine a.m, twelve to three and then something like closer to the evening oftentimes. We do much more we'll do like seven points or something like that throughout the day, depending on the situation. So you want to be careful of that um. Just since we're here, you can also get cortisol in uh through saliva and now the sort of pros and cons to that, because the the pro of doing it in your blood is it's it. It's much more stable, um saliva is extremely responsive to whatever happened these seconds before you took that test. The upside of it, though, is you, can do a bunch of real world life experiments so, for example, we will do this. Sometimes, if we want to see how an individual is responding to a given stressor, let's take it right, let's take it, take it in the you know, spin into the tube we're going to take it and we're going to go. Do this workout or this cold exposure, whatever we're going to do, take it at the end. We know that it's responsive to what just happened, but that's the point um. So you can actually there's sort of pros and cons, so you'll use the appropriate measure for the appropriate uh question you're trying to answer a couple of points and Reflections about cortisol. My first uh laboratory Duty was an undergraduate was in a was actually in a biopsychology lab at the time they didn't have the field of Neuroscience, as it's now called, it was called biopsychology or psychobiology. I didn't know that no there was used to be neurochemistry neurobiology. They had all collapsed into what we call now called Neuroscience, which was only some years ago, but my job was to collect cortisol samples, which means I I was collecting um spit, which means I was collecting saliva and the advantage of saliva based cortisol is free cortisol. It's the active form, as you mentioned, it's reflective of what happened in the seconds or minutes um, just prior a couple of things about the regular cortisol pattern across the day, because I realized that, while it would be wonderful for everybody to get their cortisol measured in Detail multiple times in Blood and and saliva, and so on. Some people just won't do that for whatever reason or can't do that. Yeah and the basic Contour of a healthy pattern of cortisol secretion is uh to have highest levels of cortisol in the morning. Um is actually part of the mechanism, that's associated with waking. You up viewing bright light, ideally from sunlight, but other forms of bright light early in the day actually can lead to a 50 percent five zero percent increase in that cortisol Spike, which is a good thing. People hear elevated cortisol, oh no, but this sets in motion a Cascade of things related to enhanced mood and alertness, immune system function, Etc. What I think it can be useful for people to understand is that many things will Spike cortisol throughout the day. Stress cold water exercise, but the idea is that it comes down to baseline or near Baseline um, rather quickly. One of the worst situations, as you pointed out, is when the highest level of cortisol is consistently shifted to the afternoon period. In fact, that's a pretty reliable signature of certain

forms of depression. This is worked by my colleague, David Spiegel at Stanford Psychiatry and the the great Bob Sapolski Robert Sapolsky of uh. Why zebras don't get ulcers, behave, Etc and fame lots of lots of popular books there um? I think that if people are trying to regulate their cortisol and they're just under, and they just understand that basic Contour that the Baseline should be, you know rise pretty quickly. After one rises in the morning, so it's easy to remember: rise rise rise out of bed and Rise cortisol with light bright light with exercise um with caffeine. These things will all increase cortisol and then, across the day, it's normal for cortisol to spike, but then to use some of the down regulation methods that you described in particular the breathing methods and exercise itself, as the case may be, but then to really pay attention To how much psychological and physical stress is occurring in the six hours or so or eight hours prior to sleep um? Does that seem like a a good sort of broad Contour of how to have a healthy pattern of cortisol release? Because you actually want the cortisol to reduce inflammation and initiate or participate in the recovery process, you will not see any progress from exercise training without a large spike in cortisol. It is critically important when we think of phrases like cortisol inflammation stress. This is not bad right. Physiology is not personified right there. Things don't like ate you in the body right, it is all, is not good and bad. They just are um the more you try to suppress cortisol the more you suppress adaptation. What you want is exactly what you mentioned. Large spikes met with large quick recovery, and you want to do that throughout the day and get that hormetic stressor. This is so going back to your ashwagandha and Rhodiola issue um it. I think it would be very short-sighted for people that do that, as this is a prophylactic okay, because you, if you blunt cortisol you're, going to cause immunosuppressant, especially early in the day totally taking ashwagandha before going to train, is, is counterproductive. Yeah. We do not just this is not a baseline part of our foundational package right if you go look at the athlete foundations or the athlete resilience, protocols that put together you're not going to see these things in there. For that specific reason, um any form of cortisol regulation needs to be done strategically. If you are excessively high and we're bringing you back down to normative values at the right time, then great, if you're normal, though then taking you down lower than that is actually problematic. The same thing is actually true since we're here for oxidative stress for information antioxidant use we mentioned, I think earlier about taking vitamin C and vitamin E post exercise will actually blunt adaptations, or at least has the potential to do so same thing right if you're modulating This response just because - and you have not done so because of actually biological testing that indicated you needed to do such then. You actually may be making things worse, and so we see this constantly with people who take a number of supplements and substances for sleep, and then they wake up the next morning. Groggy and your your cortisol suppressed okay great. So then they take

something for stimulation and then the rest of the day they're trying to reduce, and then I need this nasty cycle instead of just getting out of the way and letting cortisol do what it's supposed to do and then making sure again, you're teaching it so this is actually a coachable response. You can coach your own body to go down in the later part of the day and go up in the earlier part of the day. You want to make sure that you are driving that train with intent and so again to reiterate, if you don't need that you shouldn't, do it right, if you don't need to lower cortisol, you shouldn't walk around doing it, you're just going to suppress the state even further - and this is what's needed - this is needed for anabolic responses like you're not going to grow muscle if cortisol is not spiked, it's going to compromise it. Rather, so you want to be

02:01:25 Carbohydrates, Cortisol & Sleep

Intentional with these practices, especially in the form of supplementation, be very very intentional. I've heard it said that carbohydrates, in particular, starchy carbohydrates, can inhibit cortisol. Definitely, and this could be through the uh tryptophan amino acid related pathway that ratchets up to uh serotonin release. Probably some other things too. I mean the idea that carbohydrates, just stimulate serotonin is a little bit uh, overly similar to cellular mechanisms AMPK going up and immediately turning on there yeah right so um. You know, I think, we've all experienced this uh. You know we're stressed we're stressed we doesn't necessarily even have to be highly processed. You know uh fat associated, you know fatty carbohydrates, um, you know like potato chips and and potato chips and dip or these kinds of things. It can also be uh. Polarizable oatmeal Bowl pasta, um, which here I'm not trying to demonize um carbohydrates. I do ingest carbohydrates, um, minimally or non-processed carbohydrates um, most of the time, but not all the time, and they have a fairly potent effect on lowering stress and perceived stress and even quality of sleep, which is not to say that somebody has to load up on them like crazy, unless their glycogen is really depleted, talked a lot about this in the endurance episode. I know we'll touch on it more in the nutrition supplementation episode, but um in thinking about the relationship between carbohydrates and cortisol and what we've just been talking about in terms of cortisol as being vitally important for the adaptation trigger or triggering adaptation. It's probably a better way to put it, but that it can blunt cortisol taken post, training or um, maybe in the evening before sleep. What are some of the basic ways that one can think about and maybe use carbohydrates in specific ways in order to let's say, control cortisol rather than uh quash cortisol uh. You actually have alluded to it a number of times already, so we oftentimes will give people a lot

of carbohydrates at night. For some of these reasons, you're going to feel fantastic, a lot of people, it helps you sleep both get to sleep and stay asleep. Sleep Quality - you talked about specifically remember, think about it. This way, cortisol at its core, is an energy signaling molecule. It says we are in the need for energy, great um epinephrine's the same way you you'll start seeing, for example, cortisol will liberate free fatty acids. Put them in the bloodstream, get you prepared to do something. The problem is if it's continually elevated throughout the day, with no down regulation, we start running into issues right. So again, this is the differentiation between. Oh, my cortisol is slightly elevated all day versus I had a really big big spike after training, I had a really big spike after a breath, protocol, Etc, and then it went back down. So that being said, if you then ingest carbohydrates, you are telling it is quick to see the signal we have nutrients. We have energy again, specifically carbohydrates. Therefore, cortisol can sort of go back down. We don't need to be liberating free fatty acids and preparing uh the need for fuel, so you can help yourself go to sleep for many, as you pointed out many mechanisms actually of why carbohydrates will help you sleep at night um for some, not all people, but Some that would be one of the relationships it has with cortisol great. I look forward to hearing more about how the various macronutrients and micronutrients and so-called adaptogens this very mysterious group of yeah yeah compounds. You know the word adaptogen gets thrown around so much nowadays, but as long as we're talking about adaptation, I think that'll be fair play

02:05:05 Tool: Stress Biomarkers, Heart Rate Variability (HRV)

For the uh discussion in the next episode about nutrition and supplementation in my laboratory, when we study stress, we use a number of different markers subjective reports of how stressed people feel uh heart rate morning, heart rate, heart rate, variability, cortisol, free cortisol and on and on What are some of the other markers of stress as it relates to exercise adaptations and Recovery, because once again, I think we're seeing a lot of parallels between the study of psychological stress and the study of physical stress as it relates to exercise adaptation. Remember in terms of physiology stress is stress. This is why we have this cool term of valastatic load or allostasis such that it really doesn't matter which system you test, for it will reflect overall stress. You know you mentioned several of them. We've got done talking about some biomarkers, HRV and heart rate are another great example, because what you're trying to do is this, when we were talking about the muscle soreness thing, what we were really getting at was a marker of how do I fix the overuse in That particular muscle now we've really transitioned into Global markers of overuse and why

these are problematic or important to pay attention to rather is again. These are the indicators that you didn't just work, a muscle out too hard, but you have actually done something where you've compromised. All of your physiology to a level where you've influenced a circulating, catecholamine or something that's going to influence multiple markers. Now, like your sleep and your mood and your behavior, so that's why these things are problematic. That said, you could look at resting heart rate, not a bad thing to do. However, that does have multiple downsides. One thing we do know is your resting heart rate will Elevate with excessive stress load. This actually doesn't matter if it is physical, stress or psychological stress or a combination, so you will see that number drift up over time. Here'S the downside, though, it's not tremendously sensitive to smaller stressors uh. In other words, if you were to do something like alcohol is a very good example, you will see your resting heart rate Elevate with alcohol use, excessive tobacco use and psychological stress. However, if you do something smaller like hard training sessions, resting heart, rate's, not sensitive enough to pick that up, it will actually probably stay the same. So, for those reasons we don't actually use resting heart rate that much we will take it, but it's not our primary indicator. That being said, HRV is a better use, so just wear the quickly for those that are not familiar uh, your heart rate, let's say, for example, you, your resting heart rate, is 60 beats per minute. That means every second, it's beating. It doesn't actually happen on a consistent Rhythm such that it would beat on second, one beat on second two beat on second three Etc. The rate is more variable, so it might go, beat beat, beat, there's a variation in the heart rate and at the end of that 60 seconds in this example, you would have still completed 60 beats. They just aren't on the exact same pattern. Well, one thing: that's actually quite interesting is the amount of variation in your heart rate is actually associated with your overall sympathetic or parasympathetic State such that a large variation. So an arithmic pattern is generally more representative of being more rested and recovered and being more parasympathetic. You'LI notice, during times of extremely high stress, you will be very rhythmic, beat beat beat b b, and so this is a little bit of a of a confusing idea, but a high HRV is there indicated of a lot of variation, meaning you're pretty recovered a low Hrv, meaning there's not a lot of variation, means you're, probably pretty stressed and wired, so it's it's uh related to heart rate, but in my opinion it is a significantly better marker of that now one thing you want to pay attention to. If you do this a couple of things, there are some accuracy issues with many of the devices. Basically, everybody at this point probably has some device, that's telling them their hrb. What you do not want to do is simply compare your number to somebody else for a lot of reasons. Not all of these Technologies are actually even measuring the same thing again. Some of them are actually combining with other metrics and calling it your overall Readiness or your recovery, and so now we've. What

we've actually done is made a couple of assumptions and then stacked them on a whole host of other assumptions and then giving you a number, and you don't know what that sort of black box score actually even represents. So I would caution one against taking too much information from that if you are actually measuring HRV, even within that there's a lot of ways to calculate it that are not important here. So don't necessarily worry about the score and then come compare it to yourself, but not to others. What you will see is, if you use similar devices and techniques. Me is hard to find data here, but in general, people that are overweight might have a little bit of a of a lower score. As in a worse score, we need more information on that to be clear. So in large part, the best way to use something like HRV is to measure it under the exact same circumstances every day. So whether you're going to use just a device on your watch or your phone or your bed or anything else. Or are you going to buy a special HRV on it? It's fine just take that measure. At the same time, mostly, this means first thing in the morning. So you wake up. You go to the bathroom. You come back down and take your measure or something like that. You don't uh wait. Sometimes you took it before food, then, after look at your phone, like all these other things that can influence stress so so take. I didn't usually take somewhere between seconds to minutes to record, so you want to pay attention to that now. One of the things you'll notice is there is a natural change in your HRV that just happens, and so what you kind of really want to pay attention to is, I guess, answering the question of how much of a change in HRV has to happen for before. I should care - and it's hard to answer right. So, let's just say your HRV was a hundred. I just made that number up what, if you wake up tomorrow and it's 99.? What's that mean? Well, I don't know if you wake up tomorrow when it's 20.. That's probably a bad thing: well, where's that line it's hard. One thing I would recommend doing is taking your HRV for at least a month before you start using that value to make any changes, and you recommend taking it first thing in the morning, yep always roughly the same time. Basically, under the same circumstances, it doesn't have to be technical in the morning, but because your day will change on most days what you get into that's the most stable thing in your life. So I would take it then, and I would collect it for at least a day at least a month, rather maybe even six weeks and then give yourself basically a running average. So what we all quite honestly do is uh. We will actually track it for forever and then what we always look at is what does it look like today, relative to the last week on average, and then what does that look like to our historical average, and we always compare those things, and you also want To make sure you compare like to like so, in other words, I generally will not going to worry about today's HRV score relative to tomorrow's. What I want to look at is today's relative to this exact same day last week, not for athletes, but for non-athletes. This is very important, so imagine don't worry about the difference between HRV score and Monday compared to

Tuesday pay attention to Monday compared to last Monday and the Monday before that. That's because you typically have the same sort of weekly schedule and what you don't want to do is say, look at Monday's HRV score, which is a reflection of what happens Sunday and compare that to Tuesdays, which is actually a reflection of what happened Monday. You probably didn't do the same stressors on Sundays Monday, so you're not actually comparing the same thing. But if you have a General weekly schedule, you're likely to compare this Mondays relative to last Mondays because they're both comparing what happened on the previous day. So did that sort of Distinction make sense? Absolutely I do the same thing with body weight by the way, if you're trying to track body mass gain or fat loss or something compare like the like, you can look at the daily changes, but you need to pay attention to what that normal distribution is. So if you kind of do that, you know Monday to Monday thing, that'll give you a rough area of saying. Okay, my normal weekly variation is say five, so my average is 100, but I will fluctuate between 95 to 105.. That's my standard deviation is sort of a science. Dorks would call that if you start very changing more than five percent outside of your normal standard deviation, then I'm going to start paying attention a little bit and I'm going to actually run a little bit of an algorithm on this one. And so here is my thinking process when I get HIV really any metric, but HRV is the example we're using first step. Did I collect good data and what that I mean again. Did I measure it the same way I measured every single day or did I get up and look at my phone first and I realized oh crap, I forgot to take my HRV and then I went back and got there so say I had a 15 derivation From my normal number and then I realized oh yeah, that's right. I was up super late last night, doing whatever okay great I'm going to consider that bad data. You didn't good. If it's bad day, then I'm not doing anything ignore and bad data and you throw it out, you don't use it if you decide for the most part. Let'S assume it was good data. Okay, great then, I'm going on in my next question, which is it acute? In other words, is it just today right or is it chronic, as this is a is this pattern happening for more than five days, or at least three out of the last four or something like that three minimum is what I like honestly. I generally look at five or more days, that's a very big distinction if it is something that just happened today and the next question I'm going to ask myself is, and I am that adaptation phase am I trying to be in a phase where I'm trying to Cause insults of the body that it needs to respond with. If that is the case, I'm just going to ignore it right. In fact, it's almost sometimes a good sign, hey, we are stressing the body and it is stressed what we're doing is working amazing. In fact, if you don't see that it's sort of like maybe we're not doing

02:15:07 Tool: "Acute State Shifters", Stimulants, Dopamine Stacking, Phones

Enough to push the pace all right, so we're great. If the answer is no we're in a peaking phase, then we're actually going to use what I call acute State shifters. So this is a whole host of little tricks that I have that can change HRV or any recovery metric within seconds again. These are not chronic fixes. This is just I'm having a bad day today I feel like crap. Can I make myself feel better right now, and so I kind of call these parlor tricks a lot of the times and there's a thousand of them. We're certainly not going to go over them, but I'll give you some examples. Um you can pull out. First of all, physical movement, we'll do it you'd, be stunned, I'll just doing some yoga moving around doing some jumping jacks starting your workout. I mean you've probably experienced this. It's sort of cliché in our world at this point, but um. If you ever do any serious lifting over a serious amount of time, there will be days in which you walk in the gym and you feel awful and somehow that day you said a lifetime PR, oud yeah. That's a strange strange phenomena! Yeah, I uh! I I've experienced that more than a few times um, it's rare, the inverse is rare. However, you feel great, you have a horrible workout, it happens, yeah um, and it can happen for any number of different reasons. But yeah, I think the the former when, when isn't feeling very good and then somehow is a terrific workout, does set a kind of a seed of Doubt as to how good our subjective assessments really are, which I guess is why we're talking about um, objective assessments, Yep like HRV and remember, if it's a single day here uh you can even do hard training, uh people sort of have this idea like well. If you get up and your recovery scores down do a lighter day, that's probably I can probably never making that choice. To be honest, not in this situation remember this is one bad day and we are in a phase of even trying to improve performance right now, like we're, probably still training hard, you will again often see I felt terrible when I trained super hard and it totally Changed my day around this is all can happen. So exercise is my first love here, I'm absolutely breathing any sort of upregulation breathing. So we talked a lot about down regulation. Breathing just do the opposite right, and so this is when hyperventilation strategies can work instead of accentuating the exhale, you accentuate the inhale or you restrict the exhales. This is working on the exact opposite situation. You can also play little. This is where things like music motivational quotes if you're the type that follows people on Instagram that motivate you or can work with these things, um coaching tactics. These can be things like finding out or talking about that person's. Why um you sort of shared something that a mantra you use when you're training hard to keep you go better, I'm not going to ask you to share that now, but some people have this. Sometimes right or you may have this conversation with your athlete. We call this finding out your why right so finding out like. Why? Are you really here? What are we doing here and a lot of times you'll hear things like it's, because I grew up poor

and I don't ever want to be poor again. Okay, great! This is for my children or like any number of things, and you can pull that out on these days. You need to be really careful. That's why I call these parlor tricks, because when you play that card too often it starts to lose effect right and you can only dig to a whole so often before it's sort of like a um the same thing as with music right. If you every time you go to the weight room, it's blasting death, metal at level 10.. Well, eventually, it's not! It's no longer motivating right. It's no longer helpful, so you want to deploy these things strategically. Yeah. The the phrase that comes to mind is signal. The noise - you know the nervous system, especially the dopamine system and the adrenaline system, which are part of this larger system, called the catecholamine system. So that's dopamine, epinephrine norepinephrine the the get up and go focus on external goals, movement Associated it's and on and on that. That system responds best to high signal relative to noise. So if you're as you point out, um listening music every time drinking, a ton of caffeine, energy drinks, pre-workout nootropics and then you know stacking all those things uh sometimes refer this as dopamine stacking informally referred to as dopamine stacking you're doing all those things. And then you know first of all, then you're wondering why later that afternoon or the next day, you're feeling like you're you're under a cloud, it's obvious you're, you're kind of combine system crashed, but it's also that um, you don't necessarily become dependent on it. It's just that you start to wonder whether or not you have the internal mechanisms and motivation to train without those things, and someone tends to use them more and more, and then they have a diminishing effect over time. The rule that I've been um sort of applying has been. I never do two workouts in a row where I'm stacking in stimulants, loud music and any kind of uh sort of high potency inspiration. However, every set in the gym, or when I run, I really try and be diligent about form and attention to what I'm doing the one exception would be the long duration endurance work. Part of the reason I do that work is to let my mind go into states of drifting, I'm not trying to think in complete sentences or even close to it, just let my my brain kind of idle at a low hum uh, and for that reason generally Listen to something that's more of a story or don't listen to anything at all and just let my thoughts kind of spool through anyway. I don't want to take us too far off track, but I think this idea of signal to noise will resonate with the engineers out there, but since most people are likely not Engineers, it is the way that the nervous system works evidenced by the fact that, whatever Area of your body right now is in contact with a chair or any other surface. That's been in contact with for more than a few seconds. You forget that it's in contact with it, because there's low signal to noise. At that point, a similar note. You actually mentioned stimulants, basically there, whether you're, talking caffeine or any other stimulant any other cortisol, modulators or adaptogens. Any of these things fall in the category if you're not using them consistently and you're having a

rough day and all of a sudden, you throw down 200 mL grams of caffeine, it's going to change real fast, strong performance, enhancing effect yeah absolutely, and for these reasons, Right so we mentioned a couple of them: breath work, um, food, more calories, just eating some food, sometimes we'll give people like what we call Comfort Foods. So this is just like: hey you're uh. You know you're from Georgia and we know you love grits, so we're having grits for breakfast. Oh, my great like just something to change your mood, acute State, shifters um, to alter it. The other couple of Tricks here are light. So if we know that maybe say, multiple people are struggling that day, maybe we'll put on the lights extra bright, we'll bring in some extra things and just get it more light in there and not. It doesn't even count actually going outside and seeing the Sun. But perhaps we'll do that um and then other little tricks that I've learned over the years is uh. One particular thing I love is literally drawing a line, a physical line in the ground, and you look at that line and you say like I'm, going to train today and I'm going to accomplish this effort. I'M not going to walk past this line and into that training space until I'm ready to give that effort and that may take a minute or 10 or whatever, but it's the physical barrier is very important to saying, like I'm not just going to get through it. I'M going to actually perform the way I want to perform, or I'm not going to do it and I'm not going to cross this line until I'm ready to make that happen all right. I really like that tool. It also brings to mind the importance of at least thinking about how your relationship with your phone during training um Can perhaps help but also impede workout motivation and performance. In an earlier episode, you mentioned that if people are using their phone to play music during their workout, that they establish the complete playlist prior to initiating the workout and then not deviate from that playlist, as opposed to changing it in the middle. Because there's just too much of a uh of an Impulse to also check social media check, email, check, text messages, I mean the way I think about the phone. Actually is it's a bunch of little brain areas? It's got a memory system for you. It's got. Look up tables for lookup tables. It's got websites to look things up on the Internet. It's got photos I mean it is so rich with sensory data, and it's so closely linked to our own brain architecture. The algorithms are designed for those to be that way that I always think about it as bringing in a second person with me, but that person is my twin, that um has severe attention issues and for those that already have attention issues just think about this. As a twin that would then compound You by tapping on your shoulder talking to you all the time interrupting you uh, somebody that you like a lot, but that, frankly, is um is a little bit irritating in that they're they're interrupting your ability to really show up And also your ability to show up for them, so I started to think about the phone as um an entire individual and that it represents me and and certainly not the better version of me great exactly. You actually mentioned something else that will use uh, occasionally, which uh, what we call Brain Games or puzzles, whether this is a crossword puzzle or

something where you actually lose your thought of self for a second and your brain gets engaged in a task that you weren't regretting or even thinking about these can be stupid, little games uh it could be little challenges, especially if you're in, like a group or a team setting all right like we're going to play one round of dodgeball or we're going to play. One round of Thumb Wars, so you do encourage this yeah, I see so you would play like a thing. Instead of warming up like all right get in everyone, get going we're going to, you know, get your foam roller, your diamond. Whatever thing this is like all right, everyone line up and we're going to play Thumb Wars to see who wins right, just like whatever right all of a sudden you've snapped into a new mental shift, um or literally playing brain games playing Tetris on your phone, like Any of

02:25:04 Mirrors & Resistance Training

These things um can work in this acute setting. Can I ask you a question: it's not directly related to recovery uh per se, but I think it's worth mentioning um or asking about rather, which is the use of mirrors or no mirrors, while training um. You know the experience of seeing oneself and observing one's form in the mirror. I suppose has some utility. You can get some sense of progress that you might trigger um you're, almost specifically referring to resistance training. I suppose it could be cardio if you're running on a treadmill or pushing a sled or something but um you can see form um. You can get a sense of um. What your face looks like when you Grimace uh, but in all seriousness, um. You are without question a person, not you Andy, but um. One is in a less interoceptive mode when looking at themselves in the mirror, so extra reception, perception of things beyond the confines of our skin. Even if it's a picture of us interception perception of everything from the skin inward um, and so if we're looking at ourselves, we're diverting some allocation of our attention. Let's say: there's a hundred: these are arbitrary units and you can, I think, put 50 of your attention on the feeling in your body or the muscles you're training and 50 on how it appears in the mirror, or it could be 100 on the mirror 100 internally, Which you best accomplish, probably by closing your eyes, so obviously there are constraints here, certain movements, you wouldn't want to close your eyes, Etc in general. What are your thoughts on mirrors or no mirrors for resistance training? Specifically, it depends on the metric that you find most important, and what I mean by this is if you're training for say muscle, hypertrophy, there's emerging evidence that suggests uh actually looking at yourself in the mirror and even flexing in between sets, can actually be advantageous. Or it can augment muscle gains. Oh my there's uh support for all the the uh mirror, flexors, absolutely not not making fun of you. I

just uh. It is sort of interesting to be on the observing side of that, but Hey, listen, results are what people are. After yeah, having said that, if you're trying to enhance movement learning, then it may be detrimental, so if you're doing an exercise that is explosive and fast, it's probably not the best thing to be looking into a mirror. If you were to walk into any Olympic weightlifting Arena and you had any thoughts of using a mirror, you would probably run out of the gym very very quickly. You can't see yourself in time to make an adjustment with the movement. That's happening that fast and also we'll do exactly what you mentioned, which is it will remove your ability to understand and feel the movement, and so this is a big component to using technology for exercise at all. Is you have to make sure that the end point? Is you understanding you and your physiology more, not less when you Outsource learning to technology in this case, even if the technology is the mirror, you remove your ability to gain and truly understand that learning process. So you need to be very, very careful whether you're, using a mirror or whether you're using any number of apps, where you can record, say a movement and then watch it afterwards, and it will give you a breakdown. If your hand was in the right spot or if it was in the right spot, these are all great, but you need to then take the next step, which is to say, I need to be able to feel that position all right. So, in the case of performance, if you can imagine trying to learn a new technique say running technique, and you have to be able to watch yourself in the mirror to understand your stride in the right position. If you don't take the next step of saying. Okay, now I don't have to look in the mirror and I can feel when I'm getting out of rhythm or whatever the case is then you'll never be able to actually then use that in your race, and so it's very very important that people again pay attention To what is the dependent variable that you're actually interested in doing if you're trying to get better at something the tech is okay, as a

02:29:01 Tool: "Chronic State Shifters"

Starting place, it just cannot be the finishing place. Thank you for those Reflections, I'm curious as to what happens or what one should do if their HRV is reduced for maybe three or four or more days in a row. Absolutely the next question that I'm going to ask is in am I in that adaptation phase? If so, I'm going to still ignore it. Just like I did if it was a single bad day, but I'm going to start watching it very carefully. I may actually now introduce some other tests, so I may use a performance test uh we may look at something else. Maybe ask questions: maybe have some communication either with myself or somebody else, so I'm going to start paying more attention, but I'm still really not going to take much action until that crosses more than seven days of consistent problems. If it does do that or we're in a peaking

phase, then I'm going to go to another set of solutions that are truly going to pull me out of the hole rather than just be those acute State shifters. These are more what I call chronic stage. Shifters now some of these are actually very similar to the ones we've used before, for example thermal stress. So I can promise you if your recovery score is in the tanks and you walk outside and you jump in your 35 degree water and you get back out. What'S going to happen, is your HRV score immediately afterwards, I'm talking within seconds is going to be significantly compromised right, in other words, think about that remember, a low HRV means High sympathetic. I promise you cold. Water will put you in a high sympathetic Drive, however, and we've tested this pretty extensively, looking at HRV, zero, 15, 30, 60. 90, all the way up to 180 minutes post and on average, you will see your HRV score continue to rise after that, and so well. You'LI, have this immediate sympathetic response? You will immediately then respond. You know about 30 minutes on most people depends on the person, though, and that score will be improved for several hours afterwards, so heat can kind of have a similar effect. That, actually again, isn't is sort of an acute fix, but over time as we've described earlier, I can also have a little bit of a chronic effect. We can also then get into areas like sleep, and so now we're going to start playing and exploring. Why are you sleeping poor as well, or was your sleep score? Fine, but your HRV was low. That's a little bit of a different answer. If your sleep is getting compromised, then we're going to start going into and making sure we're improving our sleep in terms of like brain stuff, instead of maybe playing a game or having music or some of these other tricks, those aren't going to really have a chronic Effect, but you can do things like work on social connection. That's actually been shown to improve uh recovery over time. You can do things like journaling or meditation and those have an acute effect as well as a chronic effect. So again, if you go Journal right now, you probably feel better, but also we know that over time that will gradually improve things so um adaptogens and things like that also can have a chronic effect. So can things like electrolytes or food or hydration? If those things were were off so we're going to go to a whole number of areas, but those are the primary ones outstanding of all that, of course, it may be simply a time to go back and reassess our training program and that's truly the case. So that's where we're at, if so, we're probably going to either completely remove training or drop it to like 50 or so uh. Until we

02:32:43 Training Recovery & Resilience; Bowling Alley Analogy

Start rebounding back to Baseline and that's generally, the numbers we use for many people who are not training for a competitive sport and maybe aren't pushing themselves really

hard. You know maybe uh they're, they consider themselves. Somebody who exercises in order to maintain Health, um and Aesthetics and Longevity, Etc uh, and they never really finish any workout, completely exhausted, they're sleeping okay, their appetite's okay. Can we assume that they are recovering well um or maybe they're, not creating enough of a adaptation response like there's, no Progressive overreaching and so there's really no stimulus for Recovery? What I'm saying here is on the on the face of it, I think, is obvious right. If you don't train hard, there's nothing to recover from what I'm really saying is: is the ability to recover itself something that we need to train? In other words, can we get better at recovering, and the uh analogy here would be something like focus in order to perform work of any kind, but certainly mental work and physical work. We need to be able to focus. The ability to focus is the reflection of a bunch of neural circuits and chemicals and hormones, Etc. But we know roughly what those are, and we know that if you are poor at focusing for every small bit of time, that you can focus a little bit longer. Even if it's a matter of seconds, those circuits themselves get better at focusing and so on and so forth. So in other words is the recovery system. However, broad neurotransmitter hormones, neural muscular, immune based, Etc. Can that system or set of systems become better? Can we get better at recovering meaning? Can it become faster and uh more effective? Can we think of the recovery system as kind of a blade that gets sharper by engaging recovery, because if so, then there's strong reason for people who are not pushing really hard to push at least a little bit harder than is comfortable for them every once? In a while to make sure that that system doesn't start to slide back, remember, physiology is listening to everything you do and it is always responding. So the analogy that I will meet your analogy with that I use here is the bowling alley, so you've probably been bowling before and you've used the bumper Lanes right, the bumper Lanes I've gone bowling before and I've spent time in the gutter and I've spent time On the pins, okay, um, so it's been a while we used to have a bowling alley in the town where I went to and um it was fun we used to slide around on those shoes and like it all, the kids would hang out there and I Feel like do they still have bowling alleys. I don't even know it feels like something that may have gone the way of the the mid-2000s. I don't care if no one bills anymore, you're not going to ruin my good analogy. Okay, what my intent wasn't to ruin! Your analogy: um, okay, tell us about bowling. All the bowlers are going to come after me with with um bowling balls or something right. You're going to get blasted with all the stats on elevations cool so in. If would one were to go bowling and they didn't want to put their ball in the gutter yeah, you could put these little bumpers in those Lanes all right and these little foam pads that go in the gutter that if your ball is going towards the gutter, It hits those and bounces off and goes back in the lane right. Okay, so in this entire conversation - and this is actually true of a lot of the way people approach, their fitness and health people

are very concerned oftentimes with optimizing meaning. I want to make sure I don't go in the gutter. I don't want to hit the walls. So therefore, I'm going to try to improve the accuracy in which I throw the ball, so I want to make sure that I'm throwing it down the center of the lane more often, and I want to get my disc, my standard deviation tighter and tighter, so that I don't get anywhere close to hitting the wall, however, what they're not realizing is, if you do that the body will start shrinking the size of the lane, because what it basically says is huh we haven't had a ball touch us in years. We don't need to be this wide, let's get smaller and smaller and smaller. So it's not that you actually are having a reduced ability to recover, but you start becoming incredibly sensitive to that. So your two strategies for enhancing recovery are to practice getting closer of throwing that ball down the middle lane or to widen to widen the alley and that's exactly what you're referring to, and you absolutely should do that. And so what happens? Is you don't have to be so precise with what you're doing, because your ability to handle so many things is widened. So, if you're off now by four or five inches to the right, no problem because you've just tripled the size of your alley, that's exactly what you want to do so paying attention to two things: number one is getting better at accuracy. Maybe staying really tight with your progressions using nutrition and sleep to optimize your recovery and push your resilience is what we call this in fact, there's actually a biological way to measure resilience. We do that in all of our folks. This is scientifically validated stuff. I didn't just make it up. You can actually measure resilience and there's more and more coming out on this, but that's exactly what that term meant. So how well can you handle and bang things off the stressful? So when you see a reduction in say 10 of your HRV today for you that might make you feel terrible for me, I might not feel anything because I'm well adapted to large fluctuations and therefore I'm okay, the less and less. You do that the more and more responsive you will be to those slight deviations. So that is exactly the target. That's kind of what I allude to, and I say you got to understand: what are we optimizing for? We optimizing for making sure I don't feel any different today. Are we optimizing to make sure when I do feel different? I still am able to perform. So this is why you want to do things like maybe use some caffeine today and feel great, but if I have to use it every day, all I'm doing is shrinking my sensitivity there. So now, if I have to go a day without it, I can't train at all right. Caffeine is the easy example, because people understand how that whole system works, but this is really true of everything else, so yeah you need to practice this and the way to do that is to give yourself more stress to continue to bring in the stress from nutrition. From training from breath work you mentioned earlier about Focus the exact same thing right: it's not just about getting better right now, it's about training, a system, and you can clearly train that right. Um, we will often say breath. Work is a practice, that's exactly what we're talking about right, so you're practicing getting better at these things, you're practicing returning your focus, you're

practicing recovering and quite literally physiologically. You can up regulate whether we're talking enzymes, whether we're talking about Regulators, these will be up regulated. So then, the next time that insult comes in it's not as big as it's not as damaging so yeah

02:39:45 Trigger Adaptations & Stress Recovery

Absolutely you can, and you should strive for that throughout all the episodes where we've been talking about exercise at the core of that is this word adaptations, and I love that you mentioned that breath. Work can also create adaptations. The way I'm visualizing all of this now is that resistance, training with weights machines, body weight, otherwise, cardiovascular training, running jogging, sprinting, jumping and so on. Thermal training, exposure to heat exposure to cold in a dedicated way and deliberate respiration, AKA, breathing or breath work as a practice. All of those can be viewed as ways to trigger adaptations and in the context of recovery, the specific adaptations you're trying to engage are opposite to stress, in fact, with the exception of perhaps deliberate cold exposure. Maybe you deliberate heat exposure, because if the sauna is really hot, you can get the dinorphine release, which is kind of uncomfortable, but still in both those cases, the rebound from that. In other words, when you get out you shower, you go to bed the next morning. You do have this kind of blissed out feeling. We know why that is. That is the rebound to that uncomfortable situation. So it seems it doesn't really matter whether or not you're using resistance, you're doing cardiovascular training, using thermal approaches or you're using respiration based approaches. All of these are really ways of both triggering adaptations and, if applied properly, to actually help you recover from the stress and create the the literal result that you're that you're trying to achieve for some people. That might have been obvious. But I think for many people, including myself, this set of conversations that we've been having over the series, these episodes - It's really the first time that I've ever thought about exercise in these ways. In any event, it's just a reflection, but it's one that, at least for me um is tremendously useful because it has a lot of um organizational logic to it, uh, which at least appeals to my brain, because the more that things have a logic, the more For me that they become simplified and the more that the vast array of tools uh becomes uh becomes visible to me. As you said earlier, what is it? Let me make sure I get this right. It's um concepts are a few methods or many pretty close. Okay. How would you remind us how you state it methods are many Concepts. A few. Ah, okay, either way the directionality. Probably it doesn't matter. No, let's keep it right. The the methods are many uh concepts are few um Galpin's law. I i in science, you're not allowed to name things after yourself um, but

you can name uh things after other people, so uh it's a Galpin's law, because I'm definitely the one who created that idea right. Absolutely that was extreme and tremendous sarcasm to

02:42:41 Tool: Measure Recovery; Blood Biomarkers

Sword Ultra right, regardless uh. Here we go Galpin's law there you go one thing: that's in my head right now is we've thrown out a lot of options for folks, and maybe what we can do is try to simplify a little bit. So what I can kind of walk you through is how we measure recovery, if you will and how often and some tools and what I would recommend people do is not use everything. I said you want to pick one or two things per category that are most important to you, that are at your cost that are at your availability that are interesting and important relevant to you, and do that the reason I kind of wanted to cover a a Large number of things was to give them evokes options, but again I want to emphasize the point is to not measure all of them. In fact, you don't need to we um. I've ran this before with professional athletes, where we've taken blood urine every single day. We've done performance measures, uh vertical jumps on a force plate a whole bunch of things every day for years on end and what I can tell you is there's tremendous redundancy in physiology all right. Everything is Everything, so you don't need to do them and don't feel like you're missing out. If you aren't doing them, one or two metrics is probably fine. I generally recommend one subjective measure. This could be as simple as what's your mood, how do you feel today, great and one objective measure HRV a resting heart rate? Anything else right, so, if you even literally just did that you'd, probably have pretty good insight as to what you're doing so, maybe in fact I'll go more detail here. Um, maybe I'll, give you a couple of examples of things to measure every day. Some things that you should measure, maybe quarterly monthly and then maybe even some annually, and then you can maybe just pick a couple from each of these categories and have yourself a pretty good monitoring system. For what to do and I'll include some that are a little bit of Technology based and then others that are totally cost free and require nothing okay to start off, I would recommend taking something like HRV every day or or most days. If you don't have a device like that, you could also use honestly the CO2 tolerance test, and we've talked about that a number of times, and we probably have plenty of resources to go, find that, but that doesn't require anything. It typically takes about a minute or so, and you can do that under the same circumstances in which HRV, in other words, do at the same time every day have the same standardization stuff and that is actually been in our coaching experience, um, while, admittedly, there's no Peer-Reviewed research on this, yet just in our experience this tends to track extremely closely with HRV

and other metrics of recovery. In fact, we actually did do a pilot trial in my lab and it attracted decently well with both state and trait anxiety. So it's a nice metric, I'm not perfect, but you could take that. So if you wanted, you could do both but again remember you're, trying to capture systemic stress and so you're, really just showing you're measuring one thing two ways, so you don't necessarily have to have them both. I will do both just because I'm super interested in small differences, but globally they're going to tell you basically the same thing, so those are two things where we use again, basically daily year round or or close to it. If you want to go past that a little bit um you can look at, you can use an actual. A pretty old, commonly used survey called a d-a-l-d-a. I forget the exact acronym, but it is a fairly lengthy questionnaire and it accounts for things like how do you feel today? How did you sleep, um, any stressors, going on in your life? How you've been eating - and this is like fairly comprehensive, lengthy survey that came out - I mean Jesus - it's probably been around for 30 years or something is it's nothing new and been used extensively. I you would not want to do that every day, if you wanted to take some subjective measures every day we typically stick with, like I said, mood, motivation, something like that you would. You could perform this to all the test, though something more like monthly or at the end of each training phase. You know every couple of months and probably worth looking at: it's not going to tell you if you're in a bad spot today or tomorrow, but you would pick that up with the HRV or suit autonomous test. It would, though, tell you information, especially if you're working with another individual, about major life changes and if anything, it just facilitates that conversation right. I noticed you reported X, happening um. Let's, let's talk about that and can I help et cetera, so another kind of sneaky helpful one is, is simply body fat? Like I said, um non-functional overreaching and over training are associated with the number of things like energy appetite, suppression, changes and and body weight or body composition. So you can measure that monthly or even really quarterly uh, depending on what kind of athlete or individual you're working at or, if you're, trying to, especially, if you're, not trying to lose weight or if you're, trying to be at maintenance and that'll. Give you some insights as well so moving past that now, actually we're going to move into the realm of things that we call Hidden stressors. So those are all visible, stressors, um, so hidden stressors, the most common ones, we've sort of mentioned - and I would probably do this um well you're going to have to do these ones through serum. So this is blood work cortisol like we talked about and testosterone and then of course, testosterone, a cortisol ratio and then the other ones I mentioned you can do those quarterly. It's not bad. There are some blood markers that there's really no sense to do them. That soon - and there are other markers I mean in our system - our individuals are getting pretty extensive blood work, saliva, work, urine and stool, and so there's plenty of those things you just do not need to measure. You know every 10

weeks or so in this case you know cortisol, as you know, sort of changes rapidly testosterone can change pretty quickly, but if you're really trying to notice a large Trend, you know, certainly a quarterly or so is - is an appropriate time frame. I'M doing it every four or five weeks is probably unnecessary, so you can save yourself some money and do that other stuff. You can look at actually more like semi-annually in plasma like glutamine and glutamine to glutamate ratio, and it can maybe save the why you want to look at those for another conversation, but those are important um. We always look at something from the oxidative stress thing. So this could be something like tnf alpha or interleukin-6. Something like that again we're looking at that in serum and we're looking at that. You know like semi-annually and then another sneaky. Actually, one um that I love to look at is uh the neutrophil lymphocyte ratio, which will give you some pretty good insight. And again you could look at that like fairly quarterly. If that number starts to get really high, certainly like more than nine to one, you got a pretty good insight that something gnarly is going on with your immune system, so we will actually take action much lower than that number. But that's like a nice cutoff you'll see it's like that's very, very high number. So those are some things you can use most folks have the ability, hopefully to get some basic blood work done, get a basic, what's called a CBC and CMP um. If you have a great physician and you can get insurance to cover that - and you just go on and ask for a CBC and CMP they'll know what that means, you can Google that and they'll order it and you'll get all the information. Typically, that I just described or close enough and you'll get some insights and then again you can just use that free service. I mentioned earlier to check to see

02:50:06 Libido & Sex Hormones, Supplementation Caution

Whether or not the changes are just a matter of testing quality or actually physiologically relevant, what you just described is an amazingly powerful array of tools, I'm hoping that you can also mention a few tools that are either lower: cost, truly low cost or zero cost that, While they may not have the accuracy or give the complete picture that some of the biomarkers and other tools that you mentioned do that they can still provide reasonably reliable metrics that people can use in order to assess their level of recovery. Absolutely the CO2 tolerance test would be the first one and you can just take that metric anytime you'd, like the other ones we've talked about so far. Are things like your mood? We haven't mentioned libido, but that's another assessment that people also tend to have a pretty good grip on and they know what feels normal. So when things go out of whack, it tends to be a pretty good signal that people will recognize yeah and one note about that: um, something that came up in an

episode on uh on hormones both for male and female Health, that at some point it will Air, which is that you know, there's no objective measure for people in terms of libido across the board, meaning people vary tremendously: um age, life circumstances, um uh and on and on and so um. This is one of those subjective measures that I think people need to uh have some sense of what their critical Baseline really is, and I'm guessing that the time to assess that might best be when initiating or Midway through a relatively low intensity training phase um. Maybe during the time of year, in which all the other factors um that can influence libido, are not um at their maximum. So if you think about you know, light and dopamine and the relationship between those and the testosterone estrogen systems, we know that libido uh, testosterone, estrogen men and women tends to peak in the summer months. So if that's your Baseline, that you're, comparing to I don't know that that's as reliable as um thinking, something like the the fall or the spring yeah um, and so anyway, this again is very subjective, but would just encourage people to recognize that there's no standard numbers For this no lookup table and there's no equivalent of the libido BMI, the LMI um, no disrespect to the the acronym that probably is LMI um. So I think that it's just something to keep in mind as people um do comparisons or subjective comparisons. Is don't pick a comparison to an extreme try and pick a comparison to a average, as you know it to be that actually sort of reminded me. One issue that we have seen a lot lately is people if they're having libido issues or just even slightly noticing a drop. They just assume. That then, therefore means their testosterone is crashing and those things are certainly connected. But that is not necessarily the case and where that becomes a problem is then people then go on things like trt, Etc, with no true oversight and then all kinds of other problems so make sure that if you're going to take that step that you actually get Testosterone, measured and you're working with a qualified person to guide you through that process, don't just assume because you're having low energy or your libido is a little bit down, it could be simply training related, it could be sleep related could be any number of things um. So that's like a little bit of a word of caution. There, two quick points along the lines of what you just said. One interesting thing that I learned when researching our episode on testosterone and estrogen optimization. This was an episode that we've done some time ago, but is still available in our hubertlab.com all formats, Etc. Is that many people actually increase their libido and even their levels of testosterone and estrogen, as they progress from their 20s into their 40s if they take excellent care of themselves, including the correct exercise, adaptations, correct body fat to lean lean muscle, uh ratios? But of course they can go the other way too. A lot of people can be training to achieve such low body fat stores that libido can suffer so it you know, the age depend. Age-Related declines in libido are not necessarily written into the script of life. In fact, there are some data points from a really interesting paper. I talk about in

that episode of uh individuals. This was a study focused on males in their 80s and 90s, who maintained total and free testosterone as high as individuals in their 20s. But then, when you look at the lifestyle factors of those people in their 80s and 90s, they were doing a lot to create that that scenario. The second point is one related to what you just said: um, which is very true, which is people generally tend to assume that a drop in libido is related to a drop in testosterone, um and then assume that they need to increase their testosterone. And in some cases that is true absolutely, but it's also often the case that people who take estrogen or aromatase blockers, that is enzyme Inhibitors that prevent the conversion of testosterone to estrogen experience severe deficits in libido because of estrogen totally low. So estrogen blockers are as much an issue here as um low testosterone. Then. The final point is also one that many people now men and women are um. I think need to be aware of which is that dihydrotestosterone DHT is among the more powerful androgens for power output. Physical power output, but also for libido and DHT is strongly inhibited by certain things like turmeric. So a lot of people who are taking high doses of turmeric uh can experience drops in libido so there and who are taking um various compounds to prevent hair loss. Things like finasteride so there's a whole catalog of things that can reduce libido that are not directly in the testosterone pathway. It can be DHC related, estrogen related, and this, I think, points to the importance of yes. Take a subjective measure of your libido pay. Attention essentially be aware: don't you know, don't obsess but be but be aware and try and figure out what factors um are involved for you, but don't immediately assume that it what's needed is more testosterone and oftentimes um. The opposite is the case. Yeah yeah try to put on a lot of muscle with no estrogen good luck right and indeed a lot of um athletes in particular uh. You know competitive bodybuilders that have that you know Saran Wrap thin skin. If you get to know some of those people, when you talk to them, they they can look like the sort of comic book archetype of what um someone might might want to be. I mean that's not what this discussion or these episodes have been about, but oftentimes they can have um serious libido issues I mentioned earlier, and I will emphasize it once more. You need to be very cautious when you're taking antioxidants, anti-inflammatories, cortisol reducers. For all those reasons. Right, I didn't really sort of get in examples, but you just nailed another fantastic reason of it. We do not give those things prophylactically. I I strongly discourage people from just walking around taking supplementation of antioxidants, especially powerful ones, for no reason, if you have done some testing - and you have a good reason to do so - I'm fine or if you're, in a very specific, take training phase or something like That cool, but if you're just walking around doing that, you are oftentimes not always but you're oftentimes, causing problems that then you then try to solve. By taking more of those anti-inflammatories, I feel terrible low energy, a little libido blah blah blah blah, I'm too inflamed, Etc. So yeah

antioxidants in the form of food are fantastic, almost no issue. There is a good evidence. Actually there so don't worry about man. I shouldn't eat High antioxidant, rich foods, you're going to be fine. What we're talking about here is Pharmaceuticals and supplementation, where you can take orders of magnitude higher dosages very quickly than you could in the presence of food, so that distinction is also very important. Antioxidant rich foods are generally fine and thus consumed in totally absurd concentrations. Supplementations powders, creams, drugs, Etc is where you can get into problems so yeah. You want to be very careful of doing that unless you have a reason, we don't do that unless uh, we see a reason to do so in someone's markers, yeah and herbal compounds. Despite the fact that their herbal can be quite potent modulators of of hormones, um ashwagandha being an example, two herbal compounds that we've talked a lot about on our podcast before and and repeatedly, including in that testosterone, estrogen and optimization episode, uh, [Tongkat Ali](#) and [Fadogia Agrestis](#). [Tongkat Ali](#) is now taken by a large number of men and women, um, [Tongkat Ali](#) and [Fadogia Agrestis](#) typically men. I'M not sure that there are any good studies about the effects of [Fadogia Agrestis](#) in women. Those are herbal compounds that can have potent effects in increasing testosterone and luteinizing hormone. Do they work yeah? They work to varying degrees in, in most everybody, not certainly not in everybody um, but they do work, but they work because they're potent they have effects. So the idea that herbal compounds are not powerful um is wrong, and it's important to remember that that can cut both ways. Hence my mention of this uh observation related to turmeric, which is not to say that some people can't take turmeric and feel perfectly fine, maintain or even increase their libido, that I sure that can happen. It's just that for people that are very DHT sensitive. This tends to be an issue so, unfortunately, for many of these compounds, the only way to find out is really to try them or to just completely avoid them and decide. You don't want to try them as fine too, but there really aren't ways to predict. Who will respond? Who won't and who will be hyper

03:00:08 Tools: No-/Low-Cost Recovery Measurements

Responders and um in that case it's a bit of a it's a little bit of a wild west, I'm also sort of remembering what the point of this conversation was supposed to be, and maybe I'll return back to that which were some cost free or low cost. Metrics, that was a very fun tangent, but nonetheless uh another couple of ones you can do are uh grip, strength testing. So if you can buy a you know fairly cheap hand, grip dynamometer on any number of places. These are typically able to be purchased for 20 to 40, or something like that right um. You can

actually just test that every day I've done that uh in a number of athletes for a decent amount of time, uh. Admittedly, I don't do it anymore and that's not because I disagree with it, but because we just we're getting the information already and it was just too redundant. But if that's the only option, it is a great one to do. I mentioned Also earlier how I actually like speed tests over strength tests as an earlier indication of overreaching, and so because of that. I like a vertical jump test. If you have access to a force plate, that's great, and then you can get more in-depth characteristics of the force velocity curve and acceleration, and things like that used a lot in high performance situations. If not simply looking at you know your performance, and so you can kind of go back to one of our earlier episodes. When I described coloring my fingertips with highlighters earlier in my life, you could do the same thing and go out in your garage and every day jump up and touch that marker and see where you're at um. So a system like that could be done. You can also use tools like uh Force, transducer and do a standard movement. I can say a vertical jump or a high pull or something like that and measure the velocity and just compare that day-to-day of a standard load right. So you do it every single time. With the same load, um same similar thing could be done with like a medicine ball throw so you have the same ball. You throw the same thing and just sort of where you're at today you want to do a little bit of warm-up, but not excessive. Here you want to kind of get an idea of where your Baseline is and you don't want to influence it by the veracity of the warm-up every single day, because that alone again changes same thing with stretching acute static, stretching directly influences power production. So you don't want to go out there and one day do a 20 minute stretch before then the other day you didn't stretch at all, because that alone will cause deviations in your performance. So try to keep everything you can think of standardized and that'll. Give you a little bit better data remembering all of these values, the biomarkers, the performance stuff. They have normal variations. You just want to figure out, first and foremost what those normal variations are for you, so you have your normal number. You have your standard deviation when you start getting outside of that standard deviation, you start paying attention, and so that's kind of like what we typically call that the gray Zone, and so, if it is in the gray Zone, we're fine we're not adjusting, but if it's Outside of that, whatever that is for you recognizing that the grave zone is smaller for some folks and larger for others. But what is normal for you and your situation, and then you can make your decisions outside of that when you see numbers that are consistently or more than three to five days in a row or close for the last five days for the last six. Something like that, then you maybe have some cause for action. Well, that was an incredible description of the various tools and modes for recovery and I realized I jumped the gun a bit during our discussion about food and supplements, but I like to think that it serves as a

03:03:45 Zero-Cost Support, YouTube Feedback, Spotify & Apple Reviews, Sponsors, Neural Network Newsletter

nice precursor to the next episode which is going to be all about nutrition and supplementation if you're learning from and or enjoying this podcast please subscribe to our YouTube channel that's a terrific zero cost way to support us in addition please subscribe to the podcast on Spotify and apple and on both Spotify and apple you can leave us up to a five-star review if you have questions for us or comments or suggestions about topics you'd like us to cover or guess you'd like me to include on the Huberman Lab podcast please put those in the comments section on YouTube we do read all the comments please also check out the sponsors mentioned at the beginning and during today's episode that's the best way to support this podcast I'd also like to inform you about the Huberman Lab podcast free newsletter it's called the neural network newsletter and each month the neural network newsletter is sent out and it contains summaries of podcast episodes specific protocols discussed on the human Lab podcast all in Fairly concise format and all completely zero cost you can sign up for the neural network newsletter by going to [Hubermanlab.com](https://hubermanlab.com) go to the menu and click on newsletter you provide us your email we do not share it with anybody and as I mentioned before it's completely zero cost by going to [Huberman lab com](https://hubermanlab.com) you can also go into the menu tab and go to newsletter and see some example newsletters from months past thank you once again for joining me for today's discussion about fitness exercise and performance with Dr Andy Galpin and as always thank you for your interest in science [Music]