Welcome to the Huberman Lab podcast where we 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. This podcast is separate from my teaching and research roles at Stanford. It is, however, part of my desire and effort to bring zero cost to consumer information about science and science-related tools to the general public. Today, we're going to continue our discussion about hormones, and we're going to focus on how particular hormones influence our energy levels and our immune system. Now, last episode, I mentioned at the end that we were concluding our month on hormones, but we decide to include this additional episode, so this would be the fifth episode in the sequence of episodes about hormones, because there are two hormones which are vitally important for a huge number of biological functions that we will talk about today. But that are particularly important for energy levels and your immune system, and this is something that I get asked about a lot. So, rather than skip to the next general topic, today we're going to talk about the hormones cortisol, and epinephrine, also called adrenaline. You do not have to have heard the previous episodes on hormones in order to understand and digest the material from today's podcast. If I mention anything related to previous episodes, I promise to give a little bit of quick background to get everyone up to speed. Today, we're going to talk about the biology of cortisol, we're going to talk about the biology of epinephrine, as always we'll talk mechanism, and there are going to be a lot of tools. If you're somebody who struggles with stress and energy levels and balancing stress and energy levels, today's episode is going to be vital for you. If you're somebody who has challenges with sleep, or you're somebody who has challenges getting your energy level up throughout the day, and getting your energy level down when you want to sleep, today's episode is also for you. And we're going to talk about the immune system and how to enhance the function of your immune system. We're also going to get into some fun topics related to learning and memory, and how you can leverage cortisol and epinephrine in particular in order to learn faster. We're going to talk about so-called neutropics, smart drugs, and how they work, because there's several of them that tap into the epinephrine system that aren't often discussed, and that you have access to. We're going to talk about how caffeine can actually rewire your brain for better or for worse, and we're going to talk about the biology of comfort foods, and why they work so well, and what they're doing, and in understanding that, you'll be able to better understand your food choices as they relate to short-term and long-term energy. So we have a lot to cover. Everything will be timestamped. I want to just remind people that we caption every episode in English and in Spanish. The captions take a day or two to pop up on YouTube. So if you're not seeing those within the first couple days, please be patient with us in order to get captions that actually read similarly to what I'm saying. We go through a captioning service, and so we have them done by experts, and that takes a little bit of additional time. Meanwhile, if you have any questions as the episode evolves, please write them down. Please put them in the comments section. Please subscribe to the channel if you haven't already, and let's get started talking about how to increase your energy and improve and increase your immunity by leveraging the biology of cortisol and adrenaline. Before we dive into the biology of increasing energy and your immune system, I want to cover three topics that I promised I would mention from previous episodes. The first one relates to intermittent fasting. The second one relates to why your stomach grumbles. I forgot to mention the biology of that last time. The third is a powerful way to increase growth hormone, which is powerful for increasing metabolism, fat burning, and tissue repair, etc. That doesn't involve a sauna or wrapping yourself in plastic bags and going for a jog. So first intermittent fasting. Last episode I talked a lot about growth hormone and thyroid hormone, and I mentioned things like sauna and exercise and sleep and how they can increase levels of growth hormone within the healthy ranges. And why increasing growth hormone can be very beneficial, because it can burn off body fat, it can improve muscle and general tissue health, cartilage, etc. And we tend to lose, or our levels of growth hormone are reduced as we age. Many people asked me, well what about fasting? Everyone's been promised on the internet that intermittent fasting leads to these big increases in growth hormone. The reason I didn't mention it is that I couldn't find a study that actually pointed to the underlying mechanism. I saw lots of claims, lots of podcasts, lots of degrees behind people's names, sometimes biologists, sometimes entirely different fields, talking about this, but very few studies. And then I found what I would consider the study. We will link to this study. Turns out that fasting does increase growth hormone levels, and the way that it does it is fascinating. I mentioned in a previous podcast about hunger and timing of meals and timing of hunger, that when you're hungry, you release a hormone in your body called grelin. Sometimes actually called grelin. Thanks for all of you, grelinistas or grelinistas that corrected my pronunciation, it's both. Grelin or grelin, either one works. Grelin makes you hungry. When blood glucose, your blood sugar is low, grelin is secreted and makes you hungry. And it turns out that grelin, this hunger hormone, actually binds to the receptor in the brain, that normally binds what's called growth hormone, releasing hormone. So believe it or not, the hunger hormone can act like growth hormone, releasing hormone, and thereby stimulate growth hormone. Now the levels of growth hormone that fasting promotes through this grelin system are pretty substantial. It's about a doubling of growth hormone levels in the waking state. So we know that you can release growth hormone in sleep, intermittent fasting, it turns out can increase growth hormone by binding grelin to the growth hormone, releasing hormone receptor, and it does it also during the daytime. So yes, indeed fasting can increase growth hormone, not to the super levels that taking growth hormone would increase it or that a sauna could increase it, but it does seem to increase growth hormone. Later in today's episode, we're going to talk a lot about different patterns of fasting and eating that can control epinephrine. And so we will return to specifics about how long a fast you need to fast for two or three days or 23 hours. Fortunately for people like me who love to eat, that's not the case. So we'll talk specific fasting protocols later in the episode. We also said we're going to talk about tummy grumble when your stomach growls. It is not because of fluid sifting around in there. A lot of people think, oh, you know, it's fluid sifting around turns out that your stomach has smooth muscle that lines it sides. And when you eat something or you don't, every once in a while your stomach cinches off at the two ends like a bag with a hose on either end, because that's essentially what your digestive system is. And if there's nothing in there, what happens is the muscles that line the sides of your stomach that kind of extend around the stomach in these cables. Those are always there. And if you have food in your stomach, what they do is they turn your stomach. They literally turn the muscles of your stomach like a tumbler to help break up the food that presumably you didn't chew well enough because you were eating too fast. When you don't have any food in your stomach, that churning continues. And that contraction of the muscle and the turning, literally turning over of your muscles, they don't flip over completely. But the turning over the muscles, that's what causes the stomach growling. If you don't want to be the person in the meeting or sitting there in a quiet theater whose stomach is growling, chew your food better. That's the simple solution. And last episode I talked a lot about how sauna controlled safe hypothermia can cause huge increases in growth hormone release anywhere from 300 to 500, even 1,600% increases in growth hormone release, really staggeringly high increases. I point out that many people don't have saunas in their yard or in their homes and they would go through some other measures to increase safely their body heat, creating a steam room in their bathroom or jogging with extra sweats on this kind of thing. Many of you asked about hot baths. Hot baths will increase growth hormone, excuse me. However, the temperatures that you need in order to increase growth hormone are high enough that you run the risk of burn. So I really can't make any recommendations about hot baths, but if you can tolerate a nice hot bath, you are going to get some growth hormone release. However, the sauna has this advantage of you being able to enter 175 degree or 200 degree environment, provide a you're not pregnant, you're not a young child, et cetera, you can do that safely. And getting big increases in growth hormone, the hot bath will lead to lesser increases in growth hormone. We're going to talk a lot about temperature regulation in a future episode, but as always, if you're ever going to start playing with hypothermia or hypothermia, cold baths, ice baths, hot showers, hot baths that are beyond the kind of norm of what's comfortable, you have to be extremely careful and please consult a doctor. I think it's fair to say that most people would like to have a lot of energy during the day, if you work during the day, and they'd like their energy to taper off at night. And I think it's fair to say that most people don't enjoy being sick. Nobody wants to get sick. In other words, you want to have energy and you want your immune system to function well, to ward off infections of various kinds, bacterial infections, viral infections, et cetera. And it turns out that the two hormones that dominate those processes of having enough energy and having a healthy immune system are cortisol and epinephrine. Epinephrine is the same thing as adrenaline. In the body, we tend to call adrenaline adrenaline and in the brain, we tend to call adrenaline epinephrine. And I'm sorry for that. I didn't create this naming system. And the story behind it is uninteresting and not worth our time. I will use the words adrenaline and epinephrine interchangeably today. Cortisol is cortisol. And I just want to cover a little bit about what cortisol and epinephrine are, where they are released in the body and brain. Because if you can understand that, you will understand better how to control them. First of all, cortisol is a steroid hormone, much like estrogen and testosterone, in that it is derived from cholesterol. Now, that could be cholesterol that you eat. It could be cholesterol that's produced by the liver. As many of you probably know, the relationship between dietary cholesterol, the fats that you eat, and blood cholesterol and liver cholesterol is a very controversial one. It's a barbed wire topic. There are people that claim that dietary cholesterol has zero impact on circulating cholesterol coming from the liver. There are people who argue the exact opposite both with good data in hand, I would say. There are some problems for the idea that all your cholesterol levels are determined by dietary intake, namely that anorexics often have very high levels of cholesterol that their liver produces, even though they are eating very little and sometimes not eating at all. Understand that cholesterol is a precursor molecule, meaning it's the substrate from which a lot of things like testosterone and estrogen are made. Please also understand that cholesterol can be made into estrogen or testosterone or cortisol, and that cortisol is sort of the competitive partner to estrogen and testosterone. What this means is no matter how much cholesterol you're eating or you produce, whether or not it's low or it's high, if you are stressed, more of that cholesterol is going to be devoted toward creating cortisol, which is indeed a stress hormone. However, the word stress shouldn't stress you out because you need cortisol. Cortisol is vital, you don't want your cortisol levels to be too low. It's very important for immune system function, for memory, for not getting depressed. You just don't want your cortisol levels to be too high, and you don't want them to be elevated even to normal levels at the wrong time of day. So we're going to talk about how to control the timing and level of your cortisol. Epinephrine or adrenaline has also been demonized a bit. We think of it as this stress hormone, this thing that makes us anxious, fight or flight, you know, we used to get chased by lines and tigers and bears, and now we don't, and it's this ancient hangover, that's all wrong. The fact of the matter is that epinephrine is your best friend when it comes to your immunity, when it comes to protecting you from infection, and we're going to talk about why, and epinephrine adrenaline is your best friend when it comes to remembering things and learning and activating neuroplasticity. We're going to talk about that as well. Once again, it's a question of how much and how long and the specific timing of release of cortisol and epinephrine as opposed to cortisol and adrenaline being good or bad. They're terrific when they're regulated. They are terrible when they're misregulated, and we will give you lots of tools to regulate them better. Cortisol biology 101 in less than two minutes. Your brain makes what we call releasing hormones, and in this case, there's corticotropin releasing hormones. C-R-H is made by neurons in your brain. It causes the pituitary, this gland that sits about an inch in front of the roof of your mouth and the base of your brain, to release ACTH. ACTH then goes and causes your adrenals which sit above your kidneys and your lower back to release cortisol. A so-called stress hormone, but I would like you to think about cortisol not as a stress hormone, but as a hormone of energy. It produces a situation in the brain and body whereby you want to move and whereby you don't want to rest and whereby you don't want to eat at least at first. Epinephrine or adrenaline 101 in less than two minutes. When you sense a stressor with your mind or your body senses a stressor, excuse me, from a wound or something of that sort, a signal is sent to neurons that are in the middle of your body. They call the sympathetic chain ganglia. The name doesn't necessarily matter. They release nor epinephrine very quickly. It's almost like a sprinkler system that just hoses your body with epinephrine. That will increase heart rate, will increase breathing rate. In some cases it will constrict your blood vessels. It will also increase the size of vessels and arteries that are giving blood flow to your vital organs. This is why your extremities get cold when you're stressed and your heart is beating faster. More of that energy is being devoted toward your core. You also release adrenaline from your adrenals in, again, riding a top for your kidneys. Those are a second system whereby your system gets flooded with adrenaline in pulses. You can get one pulse, you can get 10 pulses. We'll talk about how to regulate the number of pulses. You release it from an area of your brain called locus serulius and that creates alertness in your brain. If you want to learn more about the stress response and all the details of that, including some protocols of how to regulate stress, please see our episode about stress. I go into a lot of detail there. I will touch on some of the same themes today, but I really want to cover energy and the immune system. If you're very much interested in stress per se and stress regulation, please see the episode on stress. We have cortisol and we have epinephrine. Their net effect is to increase energy. First of all, I want to give you a tool that will help you regulate cortisol and can also help stave off certain patterns of mental illness. It's not going to cure mental illness on its own, but it can support healthy state of mind and can help reduce unhealthy states of mind, including depression. The first tool is to make sure that your highest levels of cortisol are first in the morning when you wake up. One way or another, every 24 hours, you will get an increase in cortisol. That is non-negotiable. That is written into your genome. That increasing cortisol is there to wake you up and to make you alert. It's to stimulate movement from being asleep, presumably horizontal, to getting up and starting to move about your day. I've said it before, but I will say it again. The best way to stimulate that increasing cortisol at the appropriate time is that very soon after waking within 30 minutes or so after waking, get outside, view some sunlight. Even if it's overcast, get outside, view some sunlight. No sunglasses. Never look at any light so bright that it could damage your eyes, but do that for two to 10 minutes. If it's very bright, two minutes. If it's not so bright, 10 minutes. Do that because in the early part of the day, you have the opportunity to time that cortisol release to the early part of the day, which will improve, this has been backed by peer reviewed studies, it will improve your focus, it will improve your energy levels, and it will improve your learning throughout the day. It will also prevent a late shift in cortisol increase and late shifted cortisol, meaning cortisol that increases around 8 or 9 p.m. is a signature feature of many depressive disorders, including major depression, anxiety, and that of course correlates with things like insomnia, etc. That's a key tool and I don't know how many of you are already doing that, but it is vital to do. I mentioned sunlight even on cloudy days, and there are specific reasons for that. I want to briefly cover the data because in the episodes on sleep, I talked about brightness of light in regulating cortisol and sleep, and I talked about how to measure locks brightness, but I was not specific enough, I realized based on the questions that I've received since that episode. So here's how it works. Going outside and getting some sunlight requires that I also tell you how long and under what conditions I've said looking through a window is not as good, it takes 50 times longer to get as much light, etc. Many, many questions have told me that I'm not being specific enough, so I'm going to give you the data, and from the data you will understand exactly how long you need to do this each day. On a sunny day, so no cloud cover, provided that the sun is not yet overhead, it's somewhere low in the sky, could have just crossed the horizon or if you wake up a little bit later, it could be somewhat low in the sky. Basically, the intensity of light, the brightness is somewhere around 100,000 locks, locks is just a measurement of brightness. If you want to download the app, light meter, that is a free app that will allow you to do that, you can hold your finger down on the little button there, and you can move it around, and it will continuously give you a locks read out. It's not perfect, it's not exact, but it's pretty good, and it is zero cost. I have no relationship to light meter. On a cloudy day, it's about 10,000 locks, so 10 fold reduction, but bright artificial light, very bright artificial light, is somewhere around 1000 locks, and ordinary room light is somewhere around 100 to 200 locks, and it has to do with how much light scatter there is. So even if you have a very bright bulb sitting right next to you, that's not going to do the job, your phone will not do the job, not early in the day, to get the cortisol released at the appropriate time, you need to get outside. So let's just set a couple general parameters. If it's bright outside and no cloud cover, the light can be indirect, you don't have to be staring into the sun, please don't damage your eyes, we can't regenerate those neurons yet and restore vision that's lost. But if you have to blink, that means it's too bright, it's fine to blink, of course, please do if you need to get outside for 10 minutes or five minutes should suffice, but 10 minutes is sure to suffice. If it's a cloudy day, dense overcast, you're probably in need about 30 minutes. If it's light cloud, broken cloud cover, it's probably going to be somewhere between 10 and 20 minutes. And if you can't get outside or you're on an airplane and it's right overhead artificial lights or ordinary room lights, it's going to take you about six hours of light. And by time you reach the middle of your sort of wakeful period, it's too late, you won't be able to shift your clock and your cortisol will start drifting later and later. This is why it's vital to get this light on a regular basis to get that cortisol released early in the day. That sets you up for optimal levels of energy, it sets you up for great sleep. But today's not really about sleep, it's more about energy that cortisol pulse and the stress that you might feel early in the day from having a little bit extra energy. That is the energy that you want in order to move about and learn and do and do various things. That is a healthy level of energy. So please try and get that sunlight if it's within your protocols to do that and try and get sufficient sunlight first thing in the morning again within the first hour. That's the best way to make sure that you time your cortisol appropriately. Now throughout the day, you're going to experience different things. Most of you are not spending your entire day trying to optimize your health. Some of you might be, but most of you have jobs and you have families and you have commitments, life enters the picture and provides you stressors. And those stressors, whatever they may happen to be, a difficult coworker, some disappointment about something, you didn't get the raise you expected or you didn't get the vacation that you expected. Those will cause increases in cortisol and epinephrine. This is important to understand. You don't have the luxury of just having this morning cortisol and then having it taper off. You want that major cortisol early in the day, but then you can expect. You should expect increases in cortisol and adrenaline throughout the day. Based on events that are unpleasant to you. So for me, the events that are most unpleasant to me are things like traffic, emails that ask me to fill out a form for which I can't find the link. These kinds of things stress me out. I'm a human being. I don't lose my cool over them, but I can feel my level of alertness and kind of frustration increase, the normal kind of things that go with stress tense up a little bit. The key is these blips in cortisol and epinephrine need to be brief. You can't have them so often or lasting so long that you are in a state of chronic cortisol elevation or chronic epinephrine elevation. This system of stress was designed to increase your alertness and mobilize you towards things, get you frustrated and provide the opportunity to change behavior. That's what they were designed to do. So if you find yourself getting stressed and staying stressed, there are great tools that we provide in the stress episode that relate to things like the double inhale, exhale, the so-called physiological sigh. You can incorporate in an NSTR and non-sleep deep rest protocol, etc. But understand that the energy that you experience during stress that sudden increase in alertness and attention that comes from seeing something difficult. That is a healthy hormonal system and neural system that's working. And the reason it works is that cortisol, when it's released into the bloodstream, it actually can bind to receptors in the brain. It can bind receptors in the amygdala, fear centers and threat detection centers, but also areas of the brain that are involved in learning and memory and neuroplasticity. And this is why I say that neuroplasticity, the brain's ability to change itself in response to experience, is first stimulated by attention and focus and often a low level state of agitation. So understand that and you won't be quite so troubled about the little stress increases that you experience throughout the day. Now, there are ways to leverage stress, epinephrine and cortisol in ways that serve you and to do it in a deliberate way. There are also ways to do that, that increase your level of stress threshold, meaning they make it less likely that epinephrine and cortisol will be released. So I want to talk about the science of those practices because I get asked about these practices a lot, things like Wim Hof breathing, which is also called tummo breathing, things like ice baths, things like high intensity interval training, all of those things have utility. The question is how you use them and how often you use them. Those tools, just like stress from a life event, can either enhance your immunity or deplete it. That's right, those same practices of ice baths, tummo breathing, high intensity interval training or training of any kind can deplete your immune system or it can improve them. They can improve it, meaning they can improve your immune system. The key is how often you use them and when. And so I want to review that now in light of the scientific literature, because in doing that, you can build practices into your daily or maybe every other day routine that can really help buffer you against unhealthy levels of cortisol and epinephrine, meaning cortisol increases that are much too great or that last much too long. And of course, we'll talk about all the negatives that go along with having too much cortisol, too much epinephrine for too long. But you hear about those a lot. You hear about cushing syndrome, you hear about abdominal fat accumulation, you hear about sleep disturbances. I want to arm you with the tools first and then we can talk about the dark side and all the things that hopefully you'll be able to avoid entirely or that you can get yourself out of once you have the tools in hand. Let's say somebody tells you something very troubling or you look at your phone and you see a text message that's really upsetting to you. That will cause an immediate increase in epinephrine adrenaline in your brain and body and chances are it's going to increase your levels of cortisol as well. Let's say you get into an ice bath or a cold shower, even if you love the cold or if you hate the cold, that will cause an equivalent increase in epinephrine and cortisol. We don't know the exact levels, but it's probably about the same. Let's say you go out for high intensity interval training, you decide you're going to run some sprints, you do some repeats or you're going to do some weightlifting in the gym and you love lifting weights in the gym. Maybe you're like the powerlifting thing or you decide that you want to do some hot yoga or something that you really enjoy or you hate, you're going to increase your epinephrine and cortisol levels. There's simply no way around this. Let's say you decide to sit down and you're going to do some deep breathing, we all hear about the benefits of deep breathing. So inhale, exhale, inhale, exhale, you're going to get big increases in epinephrine and cortisol. The data from multiple studies support this. All of those are stressors in air quotes. Now there is a way that you can cognitively reframe what those are. You can tell yourself, I love high intensity interval training, I love weight training or I personally love exercise. I'm not crazy about the cold, I do some cold exposure stuff now and again and we're going to talk a lot about how to do that in the optimal way in an upcoming episode. But you know getting into the cold doesn't feel good to me. I tell myself it's good for me and I enjoy it at some point usually when I'm getting out. All of those increase epinephrine and guess what? They increase your levels of energy and alertness. So if you're somebody who struggles with energy and alertness, it can be beneficial provided you get clearance from your doctor to have some sort of protocol built into your day where you deliberately increase your levels of epinephrine. And your levels of cortisol. And I want to put the emphasis on deliberately. So how would you do that? Well, it's quite easy to turn the shower cold and get into that. That will wake you up and it literally wakes you up because of increases in epinephrine. You can do deep breathing of the sort where you inhale and exhale repeatedly 25 or 30 times. Maybe hold your breath for a few seconds on an exhale and then repeat so called Wim Hof or two more type breathing. Lots of adrenaline is released into your system when you do that. You will have more energy afterwards. So it's really important to understand that the body doesn't distinguish between a troubling text message, ice, two more breathing or high intensity interval training or any other kind of exercise. It's all stress. Cognitively reframing that and telling yourself, I like this. I enjoy it is not going to change the way that that molecule impacts your body and brain. I sort of chuckle because people would love to tell you that all you have to do is say, oh, this is good for me. No, what it does to tell yourself that it's good for you or that you enjoy it is that it liberates other molecules like dopamine and serotonin that help buffer the epinephrine response. Now the way that does that, I've talked about previous episode, but I'll just mention that dopamine is the precursor to epinephrine. Epinephrine adrenaline is made from dopamine. Okay, cortisol is made from cholesterol. Epinephrine is made from dopamine. And that's why if you tell yourself you're enjoying something and because dopamine is so subjective that you can in some ways, as long as you're not completely lying to yourself, you can get more epinephrine. You get more mileage or more ability to push through something and you can sort of reframe it, but it's not really cognitive reframing. The cognitive part is the trigger, but it's a chemical substance that's actually occurring there. It's dopamine giving you more epinephrine, a bigger amplitude epinephrine release, and it gives you some sense of control. So here's a protocol that anyone can use if you want to increase levels of energy, if you suffer from low energy during the daytime or whenever it is that you'd like to be alert. Pick a practice that you can do fairly consistently, maybe every day, but maybe every third day or every fourth day, maybe it's an ice bath or a cold bath, maybe it's a cold shower, maybe it's the cyclic inhale, exhale breathing protocol, I described. If that wasn't clear and people always ask for a demo, I'm not going to do the whole thing right now, but I'm willing to do a few rounds of this or a few cycles, I should say, so it's inhale. I would do that more deeply, more like you do that 25, 30 times repeatedly. You will start to feel warm. People in the yoga community say you're generating heat, you're not generating heat, releasing adrenaline. Inhale, exhale, inhale, exhale 25 or 30 times, you will feel agitated and stressed. That's because you're releasing adrenaline in your body and that's because you're releasing nor epinephrine in your brain. And you'll be more alert. Then you can follow that 25 or 30 breath cycles with an exhale hold and hold your breath for 15 to 30 seconds. Always always always do this on dry land, never well driving, operating heavy machinery, all the standard safety protocols, never near water. Please people have passed out and died doing this with breath holds in water. There are several deaths associated with it on land. It's probably safer, clear it with your doctor, but 25, 30 breaths, exhale, hold 25, 30 breaths again, exhale, hold 25, 30 breaths again, exhale, hold. And then if you like, you can do an inhale and hold if that's within your margins of safety. So if all these protocols, all these activities are just equivalent, they're just stress. Then how do we make them good for us? How do we actually benefit from them? Now, of course, the cold itself can have some health promoting effects. It can increase brown fat thermogenesis and metabolism, high intensity interval training or other forms of exercise. Of course, has cardiovascular effects that can be good for us as does weight training, etc. But what we're talking about here are ways to increase energy and to teach our brain and body to teach ourselves how to regulate the stress response. So in addition to the benefits of the actual practices, what we're talking about is building a system so that when you experience increases in epinephrine and cortisol from life events, you're able to better buffer those. And we are also talking about ways that you can increase energy overall. Because that's what today's episode is all about energy and immune system. And indeed, we will talk about how you can actually leverage specific protocols to increase your immune system on demand. There's great scientific data to support that one can do that. So there's a biological mechanism that's very important if you want to do those things. Increase energy and your immune system on demand. Learn to buffer stress on demand in real time. And it means taking these protocols, these practices, whether or not it's cold water or ice bath or exercise or any of those, and making one small but very powerful adjustment in how you perform them. But in order to make that adjustment, I can't just tell you the adjustment. I have to tell you the mechanism so that you know if you're doing it correctly or not. This is really a case where if you can understand a little bit of mechanism, you will be far better off than just adopting protocols. So if you take away nothing else from this episode, except what I'm about to tell you, please take away the information I'm about to tell you. Cortisol, as I mentioned, is released from the adrenals and it combined to receptors. It can have action both in the body and in the brain. In fact, it combined the so-called threat detection center in the brain or one of them, which is the amygdala, also called the fear center. It can do that because cortisol can cross the blood brain barrier. It can be released in the body and cross this biological barrier. It's like a fence that keeps things out of the brain, but cortisol has passing rights. It can go through. Epinephrine cannot. Epinephrine is polarized. The shape of it is such that it can't make it through the blood brain barrier. That's one of the reasons why it's released both from the adrenals in your body and released from this brainstem area of the locustarulius in your brain. That's a powerful thing because what it means is that the body can enter states of readiness and alertness while the mind remains calm. That is biologically possible. It's not just a psychological trick and there are ways that one can do that. I'm presuming at this point that you're getting your morning light to time your cortisol increase. I'm presuming that you want more energy or that you want to increase your immune system. It's function and it's ability to combat infections of various kinds. What I'm suggesting is that you pick from the palette of exercises that are out there or tools that are out there to increase epinephrine. There are a lot of ways to do that. You can do that as I mentioned through cold water through exercise. You can even do that by having confrontations with other people. At a biological level, it is identical. If you like to go online and place the kind of comments that will read the kinds of things or look at the kinds of things that agitate you, you can, if you like, look at that as an opportunity. I'm not suggesting you do that. I'd like to see people taking care of themselves and each other in much less destructive ways, frankly. The prerequisite here is getting an increase in adrenaline released from the body. The simplest way to describe how to do that would be in the context of cold water or a breathing protocol. Then I don't have to deal with the unknown life circumstances that get you triggered or I could tell you it gets me triggered, but I'm not going to. Let's presume cold water. Let's say you decide you're going to take a cold shower. You get into the cold shower and if it's cold enough, that will be stressful. You will experience an increase in epinephrine. It will increase your alertness. Now, you're using this as a practice, as a tool to build. You could call it resilience, but the ability to stay calm in the mind while being stressed in the body, epinephrine is in the body. You do that by subjectively trying to calm yourself. You can do that by telling yourself it's good for you by emphasizing your exhales. Anything that you can do to try and stay calm despite the fact that you are in a heightened state of alertness. You do this with exercise, you can do this with music. Pretty much anything that will give you a really heightened state of alertness offers you the opportunity to try and stay calm in the mind. What you're trying to do at a mechanistic level is to have adrenaline released from the adrenals, but not have adrenaline epinephrine released from the brainstem to the same degree. So you're not just trying to buffer this. You're not trying to say, oh, this is good for me. This is good for me. I'm going to grind this out. You're not trying to grind it out. You're trying to move through this calmly while maintaining alertness. You're not trying to zone out necessarily, although maybe that helps. You're not trying to distract yourself. What you're trying to do is shift cognitively your relationship to the somatic to the body stress response. Now, I'm sure some of you out there are shouting, yeah, that's exactly like whatever, whatever, whatever. I agree. This is in many ways a self directed kind of stress inoculation, but we're not talking about this as stress inoculation. We're talking about this as a way to increase energy and focus. And the reason is that epinephrine when released in the body has a profound effect on the immune system. And when released in the brain has a profound effect on the ability to learn and remember information and to be alert. And so we're talking about splitting the location separating the location from which you have epinephrine adrenaline released. Okay. So let's say you are doing this practice simply to wake up. Okay. Coach, we'll do that exercise. We'll do that. The ability to stay calm in mind while having heightened levels of adrenaline and presumably cortisol as well in the body, but the cortisol is going to circulate everywhere. We'll talk a little bit about cortisol more in a moment. You could do that through some self soothing calming way. That's going to be highly individual. You do it by telling yourself you enjoy it, et cetera. But what you need to understand is that in the immediate period following that practice, your system, your entire brain and body are different. Your body is actually primed to resist infection when you have high levels of epinephrine in it for short periods of time. So the scientific study that explored how increasing adrenaline in the body can improve immune resistance is grounded in a well known phenomenon that increases in stress actually protect you against infection in the short term. So I want to look at the classic data first, describe what was done, and then I want to talk about the more recent study, which is immediately actionable. There are classic set of studies that are really based mainly on the work of somebody named Bruce McEwan who is at the Rockefeller University in New York. Bruce passed away a few years ago, but he had many decades of incredibly impactful work under his belt when he did. The work that I'm going to talk about next has been done in humans and has been done in animals and has really explored how inducing stress can enhance the function of the immune system in the short term. And when I mean short term, I mean about one to four days. I'm not going to go through all the details of the study, but essentially what they were doing was exposing subjects to some sort of infection either bacterial or viral infection and inducing stress. Sounds like a double whammy, right? You'd think that maybe getting a little electric foot shock or cold water exposure or something to increase your levels of stress in adrenaline would just make the effects of the infection worse. But no, quite the opposite. Brief bouts of stress, which now you should be thinking about in terms of cortisol and epinephrine release, were actually able to increase immune system function. Now, that shouldn't surprise you if you understand a little bit about how epinephrine works in the body and in the brain. It essentially is the signal by which the nervous system can inform immune organs, things like the spleen and other organs that make killer cells of various kinds, B cells and T cells, to go and combat infections, bacteria and viruses. How else would your immune system know that there was an infection? Your immune system can recognize foreign invaders, but the nervous system provides the signal, the sort of alarm signal that liberates the killer cells. That tells them there's a problem and to go seek out the problem, so to speak. So the duration here is really important because if stress stayed too high for too long, then yes, indeed stress can hinder the immune response. But for a period of about one to four days, it actually can protect you by way of increasing the immune response. Now, I can say with certainty that that effect is governed by epinephrine adrenaline released from the adrenals and not from the brain because they actually explored whether or not the effect exists in the presence of what's called an adrenalectomy or removing the adrenals. So I should just say without the adrenals, you don't get the effect. So we know that that effect comes from adrenaline in the body. What does that mean for you? That means if you want to increase your immune system in the short term, you want to increase your epinephrine in the short term. That's why short bouts of very intense exercise, probably no more than an hour per day, providing you're doing everything else right, sleeping in nutrition, etc. Maybe even shorter bouts of intense exercise or exposure to cold water or the cyclic breathing that I talked about before because they increase epinephrine, they will bolster the immune system. And we all hear these reports every once in a while. Seems to be the thing that everyone's wild, they'll be an article about how coffee can improve your immune system or something like that. Indeed, caffeine can increase epinephrine and dopamine to some extent. But most people are drinking it chronically. So its effects are probably due to increases in epinephrine and probably whether or not something like coffee or other forms of caffeine can improve or degrade your immune system will probably depend on whether or not you're using it in a way that it increases your adrenaline as a spike that happens rarely. For example, once every two or three months, let's say you have an infection coming on, yes indeed, what these data probably mean is that drinking some hot caffeinated tea or some hot coffee even provided you don't get dehydrated from it because you're also drinking some water can probably improve your immune system function by way of increasing adrenaline release. But so can the breathing so can cold exposure so can exercise the mechanism here is what's key and I keep saying that because what it means is that you don't actually have to know the specific protocol. I'm not trying to say do this particular protocol you have to figure out and it should be easy to figure out what short term adrenaline increasing behavior you're willing to do on a regular basis every day or two or three times a week. I could say well I'm not sick should I be doing these things often you know I would say two or three times a week at a minimum if your goal is to keep your immune system tuned up and you are in the presence of a lot of children for instance which carry a lot of bugs because their immune system isn't developed or you work in a healthcare setting or you're simply somebody who's prone to get sick. I can just say anecdotally I guess someone now calls this anacidata which I don't like that phrase because it's sort of I don't want anecdotal data to ever be misunderstood as anything but anecdotal data. anecdotal I can say that I've had instances where I felt a you know a throat tickle coming on or some sinus infection I will do the cyclic breathing that I described before 25 30 breaths exhale hold 25 30 breaths exhale hold 25 30 breaths exhale hold and then begin to hold and most times I didn't get full blown sick but I also take other precautionary measures to get sleep etc. So whether or not it was causal or whether or not it's just correlated I don't know however there's a human study that I definitely want to point out to you because it was published more recently than the McHughan work it was published in the proceeds in the national Academy of Sciences for the USA because they're proceeds a national Academy of Sciences for many other countries as well. The title of the paper is voluntary activation of the sympathetic nervous system that's the system that causes fighter flight and a K stress and causes release of adrenaline and attenuation of the innate immune response in humans this is Cox K O X at all P N A S Prostings the National Academy of Sciences 2014 and they incorporate the ever famous Wim Hof breathing Wim Hof breathing is much like the breathing protocol that I've described several times now in this podcast. It's also called two more breathing other people from other cultures and communities have called other things the naming really isn't important although I do think Wim is a pioneer in trying to bring these practices to the general public more broadly and was involved in this study. The study was done in the Netherlands it was communicated by Dr Thomas Horvath at Yale I mentioned all that Horvath is a terrific scientist I'm familiar with his work over many years. Here's what they did they injected people with E. coli and they had groups that either did the sorts of breathing I've been describing that increase adrenaline release although I should say I don't think you need that breathing to get adrenaline release you could do it with cold exposure you could do it with other things high intensity interval training as well and what they found was that the the response to the coli was quite different in the people that had a protocol in this case breathing to increase adrenaline so this is a remarkable study because what they found was that the fever the vomiting all the negative effects of E coli many of them and some cases all of them were greatly attenuated by way of engaging the adrenaline system in this case using breathing. They looked at inflammatory cytokines things like I L6 which I mentioned many times on this podcast classic inflammatory cytokine were reduced things like I L10 which are anti inflammatory were increased there were some inflammatory cytokines that were increased. What's the point here the point is you can control your immune system by finding away that you can increase adrenaline and this runs counter to what we always hear which is don't get too stressed or you will get sick. Learn to control adrenaline turn it on and turn it off learn to control cortisol turn it on with light in the morning try and turn it off and then when it spikes because of life events learn to turn it off learning to turn on and off adrenaline aka epinephrine and learning to turn on and off cortisol afford to you the ability to turn on energy and focus in your immune system that's the most important point from today's podcast and understanding that it doesn't matter what protocol you use maybe it's a cup of coffee and running up a hill five or six times that will improve your immune system function if you get adrenaline in your system. You can use a ice bath you can use a cold bad it really doesn't matter you get into an argument but I'm not suggesting you do that it really doesn't matter what's important is that you're able to then shut off that response and their ways to do that we will talk about but I want to talk about some of the other benefits of epinephrine and cortisol that occur because of their actions on the brain because these are many and they are powerful and they relate to energy but also the ability to learn if I haven't already convinced you that seeing light. Early in the day is good for timing your cortisol I should also mention that another hormone that I've discussed last episode which is thyroid hormone and it's critical for setting your level of metabolism is controlled in part by these circadian mechanisms and cortisol itself. The short takeaway on this is that if you get your cortisol release early in the day it will increase your energy throughout the day it will also time your thyroid release properly so there's yet another reason why you would want to get that light exposure early in the day for me that's a non-negotiable practice. If I'm on a plane I'll try and get it any way I can I'm not shining flashlights in my eyes yet but I really try hard to get that light exposure from sunlight early in the day without fail. And the thyroid increase has to do with the fact that your circadian clock itself is regulated by cortisol and the circadian clock times the release of thyroid hormone. I don't want to go too far off in that direction but there are a number of studies. Cal's beak at all KAL SBEK at all 2012 if you want to look it up on PubMed is it a great one that describes how cortisol secretion begins to rise during sleep and peaks shortly after waking or immediately before. And that times a set of neurons in the circadian clock then trigger the release of the releasing and stimulating hormones for thyroid. So a really important mechanism and thyroid will also tend to correlate with energy but mostly metabolism very important to have thyroid in check. Now let's talk about epinephrine and cortisol and learning and memory. Everyone has a story about being so stressed they can't remember something you know sit down to an exam I actually had this happen once sat down to an exam and just blanked. Just blanked it only happened once I don't know what happened I don't think it was sleep deprivation but I just completely blanked. And it was very hard for me to pull myself out of that ditch I did manage to do it but it was a scary experience. So I think most people think about stress and an inability to perform however most of the time increases in epinephrine provided they are not through the roof lead to improved performance. Now this has been shown over and over again on memory tests on learning new information on physical performance that when blood levels of epinephrine are low you don't perform very well. When blood levels of epinephrine are very high up to about 1500 to 1700 pg per mill if you anyone's out there who's actually measuring this stuff but I doubt you are performance goes way up performance gets better when you are alert and when you're a little bit stressed. Absolutely shown again and again and again if you get too stressed it's the mental side it's the epinephrine in the brain that causes people to either focus on their somatic response too much like they feel like they're sweating and they're focused on their bodily response they're not focused on what it is they're trying to do or say or perform etc. But epinephrine is a nootropic it is a smart drug that we all make internally and cortisol is as well now here's the twist that does not mean that you want epinephrine high during the exam necessarily. Memory and learning and performance are actually favored they are enhanced by epinephrine increases immediately after learning and that's something that's rarely discussed the timing is vital so if you learn some information you have a conversation you're trying to learn a new language a new motor skill whatever it is that you're trying to learn. The increase in epinephrine that occurs just afterward is what's going to consolidate the information it's going to ensure that the proper circuits and mechanisms in the brain for neuroplasticity are engaged during sleep later that night or the next night which is when the real rewiring occurs you might say that's crazy why would that happen well we have to remember none of these mechanisms evolved for us to do what we want and learn what we want necessarily although they will allow us to do that. We've experienced this before we might have gotten up gone outside getting our car drive to work or to somebody's house you're not thinking about much at all and then all of a sudden you see an accident on the road your alertness is primed if it happens to be a particularly gory accident there's going to be a lot of sensory information there all of a sudden adrenaline epinephrine is released into your brain in body. Guess what not only will you not forget that event but you will remember everything that led up to that event which has an adaptive function because your brain and bodies primary concern is safety right this is the neuro biological explanation for maslow's higher give needs is safety first. And so you have heightened awareness and alertness for everything that preceded that spike in adrenaline and cortisol so the way to think about this is if you need to learn something better if you're taking Adderall or you're taking a lot of coffee beforehand you're actually driving the process in the wrong direction you're increasing epinephrine for learning sure but past a certain point you're actually degrading learning and performance. The time to do that is toward the end or immediately after the learning because this mechanism is not simply devoted to negative events like a car crash or a trauma it works to make sure that the hippocampus that encodes memories as part of the memory encoding mechanisms is prime that it's told what you just experienced is important you're going to need that information later. And so I've talked many times before about using non sleep deep rest and SDR or ensuring good night sleep after learning but what we're also talking about is as the learning event tapers off as you're exiting that to make sure that your epinephrine levels are not tapering off as well. And this may be one of the reasons why the 90 minute cycle this so called all trading cycle for learning works because it takes a few minutes to get into rhythm of learning you can maintain that alertness for about 90 minutes no coincidence that these podcasts are typically about 90 minutes long. And as you exit that 90 minutes you're just going to start to feel fatigued you're not going to be able to continue to secrete up an effort at the same level. So I'm not telling you that at the end of this podcast you should give yourself a foot shock or that you should jump into an ice bath although I will say if you were to increase your epinephrine at the end of this episode by breathing or by way of cold shower. I'm willing to bet based on numerous published studies that the memory for the information would be enhanced because of this retroactive effect of epinephrine and cortisol. Put simply you can remember things better if you increase your alertness aka your level of epinephrine and cortisol after immediately after something that you want to learn. So I'm reminded by people here at the human lab podcast that the optimal strategy therefore would be a 90 minute session of focus or learning then immediately after cold shower or two mo type breathing or ice bath or something of that sort. Maybe a hard run or hit training if you can't get access to the other things and then shower up and do a non sleep deep rest and then get a good night sleep. Those would be the optimal tools and the organization of tools for enhanced learning and of course you could use caffeine to prime the whole process by drinking the caffeine towards the tail of the learning episode which is counterintuitive at least to me. I should mention since many of you use caffeine and I use caffeine I do drink coffee I love mushroom coffee I love mate I drink caffeine in various forms that there was a study that came out recently that is relevant to our discussion about energy and alertness and learning and the study came out just recently March 2021. It's Maghalas at all so M-A-G-A-L-H-A-E-S and it was published in molecular psychiatry which is a fine journal a peer review journal and the title pretty much gives it away. Habitual coffee drinkers display a distinct pattern of brain functional connectivity chronically drinking coffee changes brain connectivity and it does it in a number of ways but the key takeaways from the study as it relates to the study. What the circuits do as opposed to me just listening off a bunch of brain circuits which is kind of meaningless in this conversation is that people who drank coffee habitually every day had changes in their brain circuitry such that there was a shift or a bias toward anxiety even when they don't ingest caffeine. So a lot of times we think caffeine increases your levels of anxiety and indeed it appears it does if you use it chronically but not just to caffeine. It doesn't just raise your baseline of anxiety because of what circulating in your bloodstream it actually increases connectivity between the brain areas that relate to anxiety. Now that could be a good thing or a bad thing depending on how you look at it for people that have prone to chronic panic attacks or anxiety attacks that's not going to be good. Some people might use caffeine in healthy ways I believe I do in order to just increase overall levels of alertness. Although now not only am I going to start delaying my caffeine intake for two hours after I wake up for reasons I've talked about in previous episodes but I'm also going to start drinking it later in learning and focus sessions as a way to enhance plasticity around those learning and focus sessions not before. So interesting study feel free to it's free online you can access the full paper online we will put a link as well. I want to mention this this issue of Neutropic so called smart drugs which is not a topic that I particularly enjoy because I don't like the name I don't like the idea of a Neutropic because what is a smart drug well there's different kinds of smart there's creativity there's task switching there's strategy building there's strategy implementation and most of the Nootropics that are out there just cocktails of a bunch of different things that aren't tailored to the individual at all they all seem to have some caffeine or some call energy stimulation et cetera but there's an important way to frame this in light of today's conversation. Neutropics generally fall into two categories one category are Nootropics that increase blood glucose so these are compounds that people take the increased blood glucose and increasing blood glucose will improve performance and can enhance learning in some situations I'm not suggesting people take these things but here's just a list of a few of those some of them are legal some of them are gray market some of them are illegal. Parasitams oxeracitams that and aracitams all the tams okay elevate blood glucose that's how they work the neural effects that you hear our secondary or tertiary to the fact that they just increase blood glucose we know that because if you block the blood glucose affect you block the Neutropic effect okay others include and definitely don't take these please amphetamine cocaine those will increase learning in the short term in particular dosages but because they increase blood glucose and then of course things like painful stimuli or stress will improve learning by way of increasing blood glucose now stress and epinephrine that's associated with it not only improve performance during the learning about but as I mentioned before having epinephrine come up afterward will increase the retention of that information in the long term and then of course there's a whole category of Neutropics that don't impact blood glucose that work by increasing the colonergic system activity and these are things like Colleen, leccathen, Phosostigmin as a prescription drug, Phosodidal steering so there are ways to increase energy that don't require increasing blood glucose and this is vitally important the reason we're talking about epinephrine and cortisol for increasing energy and immune system function is because they are largely independent of blood glucose of course they interact with that system but we heard so much growing up you need to eat for energy but the energy that we're talking about today is actually a much more powerful one than the one that you derive from food it's we could call it neural energy it's neurotransmitters that create alertness and focus and the willingness and the ability to move and the willingness and ability for immune system to move in response to intruders so I think we all too often think about food as energy which is great because it is but there are other sources of energy that are neural and they relate to these hormone systems cortisol and epinephrine and that's what we're focused on today so up until now we've been talking about increasing energy and increasing the immune system by way of cortisol and epinephrine but I'd be totally remiss if I didn't cover how cortisol and epinephrine if chronically elevated or if elevated too high can have a lot of detrimental effects these are the things we normally hear about I'm going to describe some of those things but I'm also going to talk about ways to ameliorate them ways that you can adjust the cortisol levels even if you're stressed ways that you can adjust epinephrine levels even if you're stressed so that they have less of a negative impact I don't have to list off all the ways that stress is terrible and chronic stress is terrible I think you know insomnia your immune system over time will get battered and you won't be able to fight infection off as well right you don't want to be stressed for too long you can start laying down the sort of classic pattern of cortisol induced body fat in fact there's a whole literature related to comfort foods and why we want to consume comfort foods under conditions of chronic stress and it's quite interesting actually because it reveals something about the biology of chronic stress that's informative for how to prevent it or to down regulate chronic stress once it's occurred so let's talk for a second about comfort foods and the work that I'm going to refer to is work that was done by a very impressive scientist by the name of Mary Dolman her work goes back decades she was at University of California San Francisco and she asked this question that on the face of it seems kind of obvious but for which there was no mechanism known until Mary and her lab personnel came along the question was why do we seek high fat and or high sugar foods when we are stressed for a while why would that be and the reason is that the so-called glucaquoids of which cortisol is a glucaquoid it's caused as we've mentioned before by releasing hormones from the brain and acth from the pituitary etc but normally high levels of glucaquoid shut off the releasing hormones in the brain and in the pituitary they shut down in a so-called negative feedback loop so just like if testosterone or estrogen get too high that's red out or that is seen so to speak by neurons in the pituitary and brain and then we shut down our production of estrogen and testosterone if cortisol levels get too high if there's too much cortisol floating around our bloodstream there's a negative feedback loop and the brain and pituitary shut down c-r-h and acth which would otherwise stimulate more cortisol so cortisol levels go down so it's a beautiful negative feedback loop chronic stress however stress that lasts more than four to seven days and there's a way to think about what chronic stress really is in an actionable way causes changes in the feedback loop between the adrenals and the brain and the pituitary such that now the brain and the pituitary respond to high levels of glucaquoid cortisol by releasing more of them it becomes a positive feedback loop and that's bad it actually gets right down to levels of gene regulation and transcription and translation and so you really don't want chronic stress because it's a cascade of stress equals more stress equals more stress so this is why it's very important to learn to turn off the stress response you don't want it elevated for too long so there's one study that dominant colleagues did where they stimulate chronic stress by increasing corticosterone cortisol and they found that subjects would increase their consumption of sugar and fat in fact they would even eat lard it would just as sounds disgusting but they were willing to just eat more fat and more sugar and that led to all sorts of things like type 2 diabetes that led to dysfunction in the adrenal output etc and so the real key is to learn to shut off the stress response because the interesting thing is is that dominant colleagues and some studies that followed up on their work found that if the system was kicked into motion for too long then there was a tremendous shift over all towards anxiety because it turns out that body fat itself receives neural innervation it received neurons actually talk to body fat so now you have body fat releasing certain hormones you've got the adrenals releasing cortisol and all of that is feeding back to the brain to make you want more sugar and fatty foods so that's how the so-called comfort foods work and you should watch yourself next time you experience stress if it's a short term boudostress typically it blocks hunger if it's a longer boudostress typically it triggers hunger in particular for these so-called comfort food sugary and fatty foods it's kind of interesting how short term stress can actually block hunger it does that by activating or interacting with a system called the bumbison system bumbison is a peptide hormone it was actually I think it was named after some sort of reptile amphibians excuse me some sort of toad I think it was initially sequenced from the toad before it was later discovered in humans and I think the toad's Latin name is bumbina bumbina or something of that sort and so they decided to call this thing bumbison but it reduces eating and stress liberates bumbison and makes you want to eat less but chronic stress causes all these positive feedback changes which are not positive they're positive I'm calling them positive because they amplify the stress response over the end of the day the stress response over and over not because they are good for you so short term stress great long term stress really really bad other bad effects of stress that we can talk about and I won't list off too many more of these because you know so many of them you hear about them you really want to know how to control them I'm guessing is that yes indeed stress can make you go gray the rates at which people go gray meaning gray hair some cases gray body hair as well depend on some genetic factors there's actually the there a couple ways that we can go gray the there's actually a stem cell what they call niche in every follicle so you have stem cells in the follicle they can produce more and more of the given hair cell and they're actually peroxide groups you know we hear about bleaching hair with peroxide least in the 80s that was a thing but you can use hydrogen peroxide to bleach things and you can produce your own peroxide in the hair follicle that will cause the hairs to go gray in addition pigmentation of hair just like pigmentation of skin is controlled by melanocytes our old friends the melanocytes and I say old friends because on previous episodes I talked about why sunlight and getting ample sunlight can increase levels of certain things like melanocytes stimulating hormone which reduce hunger it can improve testosterone and estrogen levels and all the reasons for that well turns out that activation of the so called sympathetic nervous system which is really just another name for the system that liberates adrenaline from the adrenals and epinephrine in the brain drives depletion of melanocytes in hair stem cells so indeed there's a rate of aging that we will undergo based on our genetics but stress will make us go gray and the paper that you should look to if you want to read more about this came out very recently this is zang at all ZH-ANG at all nature fabulous journal definitely one of the apex journals 2020 so this paper showed that the activation of stress in various forms will deplete these melanocytes stem cells you do not have to worry about an ice bath or heart exercise or breathing increasing your levels of stress to the point where it's going to make you go gray we're talking again about chronic stress and if you want to offset the stress effects on graying of hair you can do that by either having a practice that helps you regulate stress on a consistent basis or something like non sleep deep breast or meditation if you can get access to massages or vacations those are great but having a practice to keep stress clamped so that it's not chronically elevated that will be great as well this is another case where sunlight we know stimulates melanocytes not just in skin but in hair and so getting ample sunlight having a practice to regulate stress will offset the stressed induced graying of hairs by way of stress induced depletion of melanocytes and if melanocytes sounds a lot like melanin you're right that's because anything involved with pigmentation in the brain and body generally has melano in the front of the word in some way or another so if chronic stress is so bad because of its effects on epinephrine and cortisol being elevated for too long then the question becomes of course well what's chronic stress how do I know the difference between chronic and acute stress and how do I keep chronic stress at bay because of all these negative effects I didn't even list out the number of other ones the effects on depression which certainly has a correlate with elevated cortisol thyroid hormone associated with low thyroid hormone is associated with depression mistimed thyroid once again getting your light and your feeding and your exercise and your sleep on a consistent schedule or consistent ish is going to be the most powerful thing you can do in order to buffer yourself against negative effects on mental health and physical health for that matter there are things that one can take supplements prescription drugs etc some of you out there may have or may know people to have cushions which is chronically elevated cortisol there are prescription drugs that we will talk about that can be used but most people are dealing with a situation where life gets stressful then less stressful stressful then less stressful I would say based on the data from McEwen and others Bob Sapolsky's lab over many years I would say any stress that lasts more than a day or two days or three days is starting to become chronic stress there's really no strict cutoff because we're not measuring everybody's cortisol for a moment to moment my lab has done experiments where we measure stress and people over time people very tremendously in their ability to have a really hard day and then fall deeply asleep that's going to be the ultimate reset is the ability to sleep well more or less undisturbed each night although one or two wakeups train then I probably not going to be too detrimental provided they're not too long and you're not viewing light during those wakeups or your phone but the things that you can take if you feel like you're chronically stressed and you're viewing toward some of the negative effects of stress are many there are some simple things that people can do in terms of supplementation all supplements of course have to be checked out for their safety margins for you because it's a different from person to person you're responsible for making sure they're safe for you if you decide to use them one of the most common ones is ashwagandha and it has a powerful angciliotic anti-anxiety effect you're welcome to go to examin.com and for zero cost you can see there so-called human effect matrix ashwagandha has many uses it's been used to enhance power output in athletes it has been shown to modestly increase testosterone it has been shown to modestly adjust things like low-density lipoprotein cholesterol the so-called bag cholesterol in quotes it has a profound effect on anxiety that's been shown in nine studies nine peer reviewed independent studies I mean funded by organizations that have no vested interest in the answer it has a very strong effect on cortisol itself how strong the decrease in cortisol known in humans is 14.5 to 27.9% reduction in otherwise healthy but stressed humans that's great six studies so that's and it mentions this is significantly larger than many other supplements now some people will say that taking ashwagandha chronically may not be good if you've heard about that or you can point to specific studies that indicate exactly why it's not good please put in the comment section or let me know in the comment section on YouTube would be best the studies I'm referring to did explore both genders the number of subjects was reasonably high 64 or more one to six months studies so these were long term studies that's great you like to see that not just in an acute study so males and females lots of different ages await excuse me overweight and non overweight they did blood draws of cortisol which is going to end as well as saliva test saliva is actually the best way to measure free cortisol also measure it from ear wax turns out which sounds pretty gross and kind of is but nonetheless that's where cortisol will accumulate in ear wax and in saliva the free cortisol but that's six very quality studies independently supported that all points of these very significant you know 14.5 to 27.9% reductions in otherwise healthy adults so if you're somebody who is dealing with chronic stress it's a stressful period in your life and you want to stave off the negative effects of stress well then ashwagandha may and want to highlight may be right for you it also does tend to lower total cortisol which is interesting can lower depression to somewhat minimal degree and can lower as I mentioned before things like low density lipoprotein so that I think ashwagandha comes through is kind of the heavy hitter in this department now what's interesting also is the other effects of ashwagandha that are downstream of reducing chronic stress in cortisol because cortisol has so many effects the receptors record is all all over the body and brain and so I'll just list these off quickly I'm not going to list off each study or talk about how many subjects in detail again you can go to examin.com if you want and just put in ashwagandha see reactive protein which is a marker of all sorts of negative health effects cardiovascular health even macular degeneration is notably reduced heart palpitations notably reduced serum t3 and t4 are old friends thyroid hormones from a previous episode are increased symptoms of OCD decreased both the obsessions and the compulsions right obsessions are of the mind compulsions are of behavior so there are a lot of things that are downstream of reducing cortisol lower heart rate lower rates of insomnia slightly improved memory why that would be I don't know because cortisol in the short term can increase memory I'm guessing it's from increased sleep decreased pain increased quality you know decreased reaction times things of that sort so the list goes on and on but all of those things stem downstream of decreased cortisol so if one were to decide to take ashwagandha in order to reduce cortisol given that you want cortisol early in the day to have energy throughout the day the time to take it is probably later in the day or in the evening I've never heard of it preventing sleep or causing insomnia of any kind that certainly wasn't listed as one of the major effects on examin.com I will take ashwagandha from time to time if I'm chronically stressed or if I'm not sleeping as well as I ought to you might think that with all my knowledge about sleep and sleep protocols that I would sleep perfectly every night but unfortunately have a dog that has a canine form of sundowners of dementia so he's up much of the night these days and so there's no way I'm getting a solid night of sleep lately and so I will supplement with ashwagandha and typically I'll take it before sleep and maybe also with my last meal of the day which is at least two hours before I go to sleep. Again you have to decide if it's right for you the dosages can vary tremendously I would just go by what's off what's on the bottle from a reputable brand I would also check out examin.com because it mentions a range of dosages that people have used and in various studies to different effects. Now there is something out there that some of you may actually be taking or ingesting that can increase cortisol and not so incidentally can decrease estrogen and testosterone because remember cortisol is made from the cholesterol molecule so is estrogen and testosterone so are estrogen and testosterone excuse me and it's competitive so you're either making more cortisol or you're making more of this asteroid hormones estrogen. And testosterone believe it or not licorice which I always thought of as a candy but licorice contains a substance that I can't pronounce GLYCYRRHIZIN which is of the GLABRA species of plant actually because of its chemistry this 18 beta hydroxycitric acid you don't need to know all that licorice black licorice contains a substance that increases cortisol and its increases not huge but is significant this has been looked at in females age 18 to 29 males and females age 18 to 29 people age 30 these are separate studies where I'm listing off the different ages ages 30 to 64 turns out that you can see pretty substantial increases in serum cortisol and decreases in testosterone and estrogen so that was complete news to me also increases in blood pressure that are pretty substantial that's going to be downstream of cortisol increasing cortisol increase blood pressure in order to engage the stress rate of cortisol. So I think that's a great idea to engage the stress response is part of the stress response increased hormones of other kinds that are associated with stress so who knew I didn't know maybe you knew previously if you did forgive me but licorice and some of the compounds in black licorice can actually increase stress probably not the thing to be ingesting during periods of chronic stress whether or not anyone has had positive effects of using it to increase cortisol in other contexts let me know but very interesting that the chemistry of licorice increases stress rate of cortisol. So that's a great idea to increase stress hormones and therefore you would probably want to almost certainly want to avoid it in conditions of chronic stress also if you're trying to optimize testosterone and estrogen liquor seems like a bad idea. I suppose one instance where you might want to use liquor should be if you're traveling and you're trying to wake up at a particular location because liquor has these effects on cortisol and cortisol is associated with the waking phenomenon and alertness and energy. You could use it in that regard however I would be careful to time it so that you're not getting too cortisol increases throughout the day two peaks so you're going to want to make sure that you're doing all the other things correct for jet lag and adjusting to jet lag and if you want to know what those things are including timing your feeding using temperature using exercise using light to adjust a jet lag more quickly please see the episode that we did on jet lag and shift work where I cover all those protocols in detail. The other compound that I think deserves attention is Apigenin apigene which is what's found in chemo mile. Apigenin I've talked about previously it has various effects one is it is a mild anti estrogen that's been shown in various studies and it does have a bit of an anxiolytic effect of reducing anxiety. I take it before bedtime 50 milligrams again you have to decide or figure out if that's safe for you or not I'm not suggesting you take it the major source of action is to calm the nervous system and it does that primarily by adjusting things like GABA and chloride channels but also has a mild effect in reducing cortisol so I show a ganda and Apigenin together or I would consider the most potent commercial compounds that are in supplement non prescription form. So you're probably getting the impression that cortisol and epinephrine are a bit of a double edged sword you want them elevated but not for too long or too much you don't want them for days and days and days but you do want to have a practice in order to increase them in the short term. We should talk about protocols that can set a foundation of cortisol and epinephrine that is headed towards optimal optimization is always going to be a series of regular practices that you do every day so sleeping at certain times light at specific times food at specific times certain foods etc and that's highly individual but there are some universals and we've covered a number of those in the discussion today. So in the real time, meal schedules has a profound effect on energy levels and as I mentioned before the energy I'm referring to is not glucose energy it's not burning carbs while running or ketones what I'm talking about is neural energy epinephrine and cortisol. Fasting and timing one's eating are two sides of the same coin so even if you're on a kind of standard three meal a day with a couple snacks in between diet or nutrition regimen you are fasting whenever you're asleep or you're not ingesting any calories unless you're hooked up to an IV of glucose you are fasting while you're sleeping there are several different kinds of fasting that can relate to epinephrine and cortisol I will do an entire episode on optimizing food intake for performance in the sports context. That's coming up but in the meantime I'd like to just talk about fasting as a source of epinephrine anytime when our blood glucose is low cortisol and epinephrine are going to go up if we fast for too long that is stress there's no way around that now that doesn't mean it doesn't have other beneficial effects running a marathon is stress but it can also have positive effects if that's your thing so stress has been demonizing and it's not going to be a good thing. Stress has been demonized as a term but we want to think about stress mechanistically as epinephrine and cortisol and then if we do that we can think about how to regulate its timing. So anytime we have an eaten for four to six hours levels of epinephrine and cortisol are going to go up pretty substantially. The exception to that which is if you are used to eating on the clock every two hours or every hour being half hour late or even ten minutes late on that schedule will induce stress most of that psychological stress but also the release of things like grelum that are going to make you hungry because they're on that eating clock. So one thing that many people do to great benefit is they follow a so called circadian eating schedule. They eat only when the sun is up they stop when the sun is down more or less the other way thing about this is they stop eating a couple hours before sleep and they eat more or less upon waking assuming that they're waking up more or less around the time the sun rises maybe plus or minus two hours. Okay so typical schedule now let's say you decide to do what I do which is I skip breakfast I drink water I delay my caffeine for 90 minutes to two hours and then I drink my caffeine and then my first meal is typically around lunch time 11 30 or 12 and yes occasionally I throw back some almonds or walnuts or something earlier in the day I do do that from time to time if I get hungry enough or if I just happen to see them I'm kind of a drive by eater if I see blueberries or nuts or something I just kind of pick them up and put them in my mouth I try not do that off other people's plates but I just have that habit of doing that from time to time but typically I don't eat until about noon. So I've got a cortisol increase I've got my sunlight in the morning so I'm getting a big pulse and energy early in the day and yes there's a little bit of agitation I am hungry sometimes early in the day sometimes no but my grill and system is used to kicking in right around noon. At the point where I eat as long as I don't eat carbohydrate in my case I know that my epinephrine levels are going to stay pretty high so for me it's usually meat and salad or something of that sort or fish and salad I don't particularly like eating fish. Because of the taste but I'm essentially low carb or keto ish throughout the day so I'm probably in a slightly elevated state of epinephrine and cortisol throughout the day some of you are fasting even longer you're pushing out till 4pm or 8pm or maybe you're even fasting around the clock anytime you're fasting you're increasing epinephrine and cortisol release you can do all the meditation in the world to keep your mind calm but you are closer to that edge of stress and you're closer to that edge of the day. So that's something that's just important to understand the description about comfort foods in cortisol was one of kind of an extreme case where cortisol systems kick over to positive feedback loop but we all eat to suppress cortisol in epinephrine. When we're hungry cortisol in epinephrine create an agitation so we go seek food when we ingest food that typically if it includes carbohydrate there's a blunting of cortisol there's a blunting of epinephrine in the blood stream. If you've ever had too much coffee to drink and you go and have a couple pieces of bread you will feel the we'll might describe it as the caffeine getting soaked up out of your system but what you're doing is you're elevating blood glucose which is more or less saturating the effect of caffeine in your system not completely but it's going to have that effect. If you're very stressed and you sit down to eat something it will calm you down yes because some of the blood that goes to your stomach but more so because these effects in blunting cortisol in epinephrine. So the important point here is that if you want to be alert you can do that by way of not eating of course please ingest fluids I know some people water fast out there I am yet to see good science on water fasting and why that can stimulate stem cells or people love the idea of after the Nobel Prize was given for auto phage and the idea that our cells clean up debris and sent us in cells yes that's true but the idea that water fasting is going to promote that I find rather amusing please send me the data if you know some great study. In a decent journal but pretty much this is something I hear about I don't think water fasting is a good idea nor she be drinking so much water that you kill yourself you can actually drink enough water that you that you die so I think ingesting water and healthy amounts is a good thing stay hydrated but if you want to be alert stay hydrated caffeine may or may not be in your regimen but fasting will make sure that your levels of energy are up and you will be primed very well for the next day. So I've been primed very well for doing a protocol of the sort that we talked about earlier in this episode of breathing or cold exposure exercise to get that increase in the immune system function and if you do that after learning after trying to learn something it will increase learning for that particular set of information whether or not it's motor or language or whatever happens to be mathematics programming. Fasting is a tool for many reasons can increase growth hormone etc but today I'm talking about fasting is a tool to bias your system toward more epinephrine adrenaline release and toward more cortisol release but still low enough that it's not chronic stress that it's not causing negative health effects but please know that if life is very very stressful if you're experiencing lots of stressors and you're chronically fasting. You are positioning yourself toward a greater likelihood of being chronically stressed in the ways that are negative negative effects on the reproductive axis lower testosterone and estuary negative effects on your hair will turn gray there's reasons for that your sleep will suffer your immune system will suffer so I think while it's nuanced our discussion today about epinephrine and cortisol increasing energy and immunity are designed to help you understand when you should be doing certain things when you should throttle back when you might want to kick up your adrenaline a bit if you're suffering from low energy because you're just kind of feeling down and a little bit under activated well then the practices of ice baths and intense breathing etc could be very beneficial so might fasting but if you're feeling exhausted and burnt out so drained and stressed well then fasting or doing a lot of cold exposure or doing a lot of intense exercise is driving you further and further into chronic stress so because I don't have a saliva test or a blood test or God forbid an ear wax test to measure your cortisol as we're engaging in this discussion together you have to gauge for yourself whether or not you are in a state of under activated and need more epinephrine and cortisol or whether or not you are over activated in terms of cortisol and epinephrine and you need ways to buffer those ashwagandha maybe it should be a warm mellow bath not an ice bath so one has to learn how to regulate these hormones with behavior with nutrition perhaps with supplementation and then of course their prescription drugs and I always leave these to the end because I'm not a medical doctor I'm not prescribing anything I'm a professor I'm professing a number of things that you can decide for yourselves what to do with or not but of course there are prescription drugs that can increase cortisol or decrease cortisol in cases like Cushing syndrome which if you have that diagnosed you should talk to a physician you should talk ideally to a endocrinologist but to a physician of some sort board certified physician there are drugs that can be used to treat injury like corticosterones that you can inject to reduce inflammation injury but they are cortisol so they're going to bias you towards more stress in other domains remember cortisol can cross the cross the blood brain barriers are going to be more prone to psychological stress I also want to mention again that I think there's great benefit to having a practice that perhaps you do every other day but if you can't maybe every third day or every other day of deliberately increasing your adrenaline in your body while learning to stay calm in the mind so that you learn to separate the brain body experience you know we hear so much about how beneficial it is to unify the brain and body that we're all out of touch with our brain and bodies I particularly dislike claims like that or statements like that because there's great power as we learn today in having your body activated by some sort of stimulus cold water or even psychological stress but learning to stay calm in your mind I should just remind you that most of the negative effects on your life and on the lives of others are due to people perhaps you I hope not being unable to regulate their mind when they have high levels of adrenaline in their body either because they read something in a text or a comment section of course that never happens to me but it may happen to you of course it happens to me but the idea is to stay calm in your mind so that then you can regulate your action right and so I think that there are these practices that one can develop over time that are really straightforward and zero cost right you could find any number of ways to increase your adrenaline and stay calm and we tend to focus on things like exercise as the way that we get our energy up but today again I'm talking about deliberately increasing adrenaline while staying calm mentally because that has great utility when the adrenaline hits through unwanted events through things that we didn't seek out so the ability to regulate adrenaline cortisol is about inducing them deliberately when you want to push back on infection potential infection from bacteria viruses it's about pulling back on adrenaline and cortisol maybe through the use of supplementation but certainly through proper use of light and sleep and mental tools that we talked about as well when they are chronically elevated it's about training your system not just to be unified at brain and body which sounds great until you're stressed and then that's terrible it's really about having a deliberate dissociation between the adrenaline response from the adrenals and the adrenaline response from the brain stem so once again we've covered a ton of material I hope right now you're thinking am I in a state of chronic stress am I under activated or could I afford to increase my levels of adrenaline cortisol to improve my relationship to my immune system and to energy, neural energy if you like the information that you heard today and you want to remember it well then at the end of this episode perhaps you go do something to increase your level of adrenaline and now you know what some of those things are because it will help you retain the information or you could apply that to anything else that you learn or experience of course and I hope that you'll think about some of the ways in which cortisol and adrenaline are not good or bad that stress isn't good or bad but short term stress is healthy alertness and energy is healthy even if it puts you at the edge of agitation that's an opportunity to learn how to control these hormones better and I hope that if you're in a state of chronic stress that you'll do things to start tamping down some of that stress and that you realize that your nervous system and your hormone system are linked but they're linked in ways that you can control that we don't have to be slaves to our hormones and certainly not the hormones that cause us stress we can learn to control those both to the benefit of our body and benefit of mind if you're learning from this podcast and you like the information that you're learning please subscribe on YouTube that really helps us and in addition if you could hit the notification button that will let you know when we release new episodes now we release them every Monday morning but in addition to that we are starting to release short clips now and again as well as some special content so hit the subscribe button please and hit the notifications button if you haven't already subscribed on Apple and or Spotify please do that you can certainly subscribe to all three if you like and on Apple you can give us a five star review as well as leave us a review on YouTube is the place to leave us comments and feedback as well as suggestions for future episodes we do read all the comments and I know many of you are anxiously awaiting particular topics and episodes and we will eventually get to them all I'm not going anywhere and we do want to be thorough about every topic today we rounded out the discussion about hormones we aren't going to continue with that topic any longer we are moving to a new topic segment for an entire month or so if you know of other people that you think could benefit from the information on this podcast or that you think would enjoy listening to it please forward it along to them we'd really appreciate that another great way to support us is to check out our sponsors that we mention at the beginning of the podcast we also have a Patreon it's patreon dot com slash Andrew Huberman there you can support the podcast at any level that you like I should mention that I will be answering some questions that come up frequently in the comment section on YouTube in Instagram lives every once in a while I am on Twitter at Huberman Lab I'm on Instagram also at Huberman Lab and on Instagram from time to time coming up I'm going to be discussing answers to your common questions in these Instagram lives and I will make sure that they're recorded so you can check those out please follow our Instagram if you are not already doing that and check out our Twitter if you're on Twitter I covered a lot of different types of tools today behavioral tools etc but I did mention supplements for those of you that are interested in supplements we've partnered with Thorn THORNE because we believe them to have the highest levels of stringency and quality in terms of supplement production in terms of amounts of supplements in their different formulations etc. if you want to check out the supplements that I take and you want to get a discount on Thorn supplements you can go to Thorn THORNE dot com slash the letter you slash Huberman and you can get 20% off any of the supplements that I take or any of the supplements that sort that Thorn sells for that matter that's Thorn dot com slash you slash Huberman to get 20% off anything that Thorn makes. Thank you for joining me for what I hope was an informative discussion and an actionable discussion about how to increase energy and the immune system by way of cortisol and adrenaline epinephrine I really appreciate your willingness to learn new topics as well as to embrace and think about new tools and whether or not they're right for you and as always thank you for your interest in science