

## Optimizing Workspace for Productivity, Focus, & Creativity | Huberman Lab Podcast #57

In this episode, I discuss ways to set up your workspace to optimize productivity, focus and creativity. I discuss how to adjust light, physically arrange your work environment, and leverage body posture to enhance productivity. Additionally, I explore how to shift your work environment for particular types of tasks. Moreover, I review the role of body movement in the workspace. I also discuss sound-based tools that can either enhance or diminish cognitive functioning (the ability to focus on deep work). I describe a particular frequency of binaural beats that studies show can be used to enhance memory and recall. This episode covers quality peer-reviewed findings practical tools anyone can use, regardless of budget, in order to optimize their workspace to achieve heightened levels of productivity, increased alertness and focus, and creativity.

#HubermanLab #Neuroscience #Productivity

Thank you to our sponsors:

LMNT - <https://www.drinkLMNT.com/huberman>

AG1 (Athletic Greens) - <https://www.athleticgreens.com/huberman>

Theragun - <https://theragun.com/huberman>

Our Patreon page:

<https://www.patreon.com/andrewhuberman>

Supplements from Thorne:

<http://www.thorne.com/u/huberman>

Social & Website

Instagram - <https://www.instagram.com/hubermanlab>

Twitter - <https://twitter.com/hubermanlab>

Facebook - <https://www.facebook.com/hubermanlab>

Website - <https://hubermanlab.com>

Newsletter - <https://hubermanlab.com/neural-network>

Links:

The Influence of Ceiling Height: <https://bit.ly/3gcB31K>

Heating, Ventilation, & AC Noise During Mental Work: <https://bit.ly/3rbG69c>

Office Noise & Employee Concentration: <https://bit.ly/3AMoJPa>

Effects of a Workplace Sit-Stand Desk Intervention on Health & Productivity:  
<https://bit.ly/3reelwF>

Effects of Binaural & Monaural Beats on Attention: <https://bit.ly/3IN2Wda>

40-Hz Binaural Beats Enhance Training to Mitigate the Attentional Blink:  
<https://go.nature.com/35BVrYh>

#### Timestamps:

00:00:00 Arranging Environment for Focus

00:02:40 LMNT, AG1 (Athletic Greens), Theragun

00:07:55 How to Increase Focus

00:10:02 Lighting Your Work in Phase 1

00:16:00 Lighting Your Work in Phase 2

00:19:45 Lighting Your Work in Phase 3

00:24:17 Where to Look While You Work

00:28:02 Arranging Your Environment

00:31:24 Body Posture

00:34:22 How Long to Do Deep Work

00:36:50 Set the Right Visual Window Size

00:42:15 45 min / 5 min Rule

00:44:23 The Cathedral Effect: Analytic vs Creative Work

00:55:50 Leveraging Background Noise

01:02:20 Binaural Beats for Work

01:06:38 The Best Binaural Frequency for Work

01:11:17 How Binaural Beats Increase Focus

01:13:56 Minimizing Interruptions

01:20:01 Sit or Stand, or Both?

01:25:18 Movement in the Workspace

01:31:00 Summary & Shifting Work Environments

01:39:36 Zero-Cost Support, Sponsors, Patreon, Instagram, Twitter, Thorne

Please note that The Huberman Lab Podcast is distinct from Dr. Huberman's teaching

and research roles at Stanford University School of Medicine. The information provided in this show is not medical advice, nor should it be taken or applied as a replacement for medical advice. The Huberman Lab Podcast, its employees, guests and affiliates assume no liability for the application of the information discussed.

Title Card Photo Credit: Mike Blabac - <https://www.blabacphoto.com>

- 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. Today, we're going to talk all about how to optimize your workspace for maximum productivity. Indeed, that means to heighten levels of focus, to increase levels of creativity, to improve your ability to task switch. And this could be for sake of school or for work, creative endeavors, personal endeavors, this really extends to everybody. Most often when we hear about how to focus or how to get the most out of our work sessions, we hear about the biology and the psychology of that. We hear about dopamine and we hear about serotonin and we hear about caffeine. And indeed, those are topics that I've covered a lot on The Huberman Lab Podcast. Today, we will touch on each of those, but we are mainly going to focus on how we arrange our physical environment and indeed how we arrange ourselves in that physical environment, in order to bring out the best in our neurobiology. That is how to put ourselves into a heightened state of focus by virtue of things, as simple as where we place our screen, relative to our eyes at a given time of day. Believe it or not, there's excellent research on this, and there's excellent research for instance, on whether or not you should or should not listen to music, whether or not you should use things like binaural beats, and if so, what frequency of binaural beats. We are going to cover all of that, and by the end, you'll have a checklist of things that you can do to optimize your workspace on any budget. I will mention various products and apps that some of you might find useful for optimizing your workspace. But I want to emphasize at the outset that none of those that I mentioned are any products or apps that we have a financial relationship to. And more importantly, you don't need them. I'm going to explain how for zero cost, you can arrange your workspace in ways that makes you maximally productive, maximally focus and allows you to adapt your workspace to different environments, whether or not you're traveling, working with others, working alone, et cetera. Just to give you a little hint of where we are going, I will mention a zero cost app

that will deliver binaural beats at a particular frequency that peer-reviewed research has shown can enhance certain types of learning and memory. However, peer-reviewed research also shows that it can diminish performance in other types of tasks. So stay tuned, we'll go into all the details so that you can optimize your workspace for zero cost and get the most out of your efforts and endeavors. Before we begin, I'd like to emphasize that this podcast is separate from my teaching and research roles at Stanford. It is however, part of my desire and effort

00:02:40 LMNT, AG1 (Athletic Greens), Theragun

to bring zero cost to consumer information about science and science related tools to the general public. In keeping with that theme, I'd like to thank the sponsors of today's podcast. Our first sponsor is LMNT. LMNT is an electrolyte drink that has everything you need and none of the things you don't. And when we say everything you need, the main one is salt. Now, salt, aka sodium has kind of a bad rap. We've all heard that too much salt is bad for us. However, if you look into the research on salt, and in fact, if you go to one of the highest level, peer-reviewed scientific publications, Science Magazine, you can find a review article in science some years ago that shows that most of what we think and understand about the science of salt is completely wrong. And in fact, salt does a number of things that's extremely important. For instance, our neurons, which signal to one another through electricity and through chemical signaling, critically rely on having enough sodium in order to generate what we call action potentials or electrical firing of neurons. If your sodium levels are too low, your neurons simply won't work. One of the main deficits from being dehydrated is lack of sodium, not just lack of water. Getting sufficient sodium does a number of things that's very important, it can raise your blood volume, it can help you retain water in a healthy way, not excess amounts. It allows neurons to fire for sake of thinking, for sake of athletic performance, and so on. Other electrolytes that are in LMNT are things like magnesium and potassium, which are also essential for neuronal function, and indeed all organ function. LMNT has a lot of salt, some magnesium and some potassium, so unless you're somebody who really has chronic hypertension, elevating your level of salt intake can often be beneficial. You should check with your doctor, but indeed it can often be beneficial. LMNT contains a science-backed electrolyte ratio of a 1,000 milligrams, that's one gram of sodium, 200 milligrams of potassium and 60 milligrams of magnesium. It tastes delicious, I happen to

like the raspberry or citrus flavors, in fact, I like all of the flavors. Put in some water, you can make it as dense, meaning as high concentration as you like. So some people will put it in eight ounces of water. I like mine in about 16 ounces of water and I'll drink that before and after exercise. And I usually will have another one throughout the day, just sip on it as I'm doing work and so forth. If you'd like to try LMNT, you can go to [drinklmnt.com/huberman](https://drinklmnt.com/huberman), spelled [drinklmnt.com/huberman](https://drinklmnt.com/huberman) to claim a free LMNT sample pack, you only cover the cost of shipping. Again, that's [drinklmnt.com/huberman](https://drinklmnt.com/huberman) to claim a free sample pack. Today's episode is also brought to us by Athletic Greens, now referred to as AG1. I started taking AG1 way back in 2012, and so I'm delighted that they're sponsoring the podcast. The reason I started taking AG1 and the reason I still take AG1 once or twice a day is that it helps me meet all of my foundational vitamin, mineral and probiotic needs. And when people ask me, what's the one supplement I should take, if they were to only take one supplement, I always recommend AG1. For the simple reason that the vitamins, the minerals and the probiotic support metabolic health, they support endocrine health, they support brain health and the probiotics and prebiotics in there in particular, support the so-called gut-brain axis. There is now a plethora of data supporting the fact that when we have a healthy gut microbiome, that has little microbes that live in our gut, that are good for us, our gut signals to our brain and our brain signals back to our gut, in ways that support our immune system, our digestion, even our mood. They can even support healthy levels of dopamine signaling, an important molecule for motivation and high levels of mood or positive mood. If you'd like to try Athletic Greens, you can go to [athleticgreens.com/huberman](https://athleticgreens.com/huberman) to claim a special offer. They'll give you five free travel packs plus a year supply of vitamin D3 K2. Vitamin D3 K2 has been shown to be important for metabolic health, endocrine health and K2 in particular for heart health and regulating appropriate amounts of calcium in your bones. Again, go to [athleticgreens.com/huberman](https://athleticgreens.com/huberman) to claim the special offer. Today's episode is also brought to us by Theragun. Theragun is a handheld percussive device that releases deep muscle tension. I was first introduced to Theragun on a shark diving trip. We were way out in the Pacific, filming great white sharks for my laboratory where we study fear, and everyone was diving all day, carrying what are called Pelican cases, which aren't actual pelicans with wings, but cases for these cameras. They're very heavy, removing things all day, we're working really hard, and we got really sore. I got particularly sore from all that physical labor. Someone brought a Theragun along, I'd never seen one of these things before or tried one and I spent the rest of the trip trying to get as much time

with the Theragun as I could, at least when I was on board the boat. With Theragun, you can get what is effectively a deep tissue massage to any area of your body, and you can just do that for minutes or hours for as long as you like, it's really wonderful. If you have someone else there, who's willing to use the Theragun on hard to reach places like your back, that's even better. Whether or not you want to treat muscle tension from working out and injury or just deal with daily stress from everyday life, there's really no substitute for the Theragun. You know, professional massage is wonderful, but a professional massage of course involves going to a masseuse, it's quite expensive often, et cetera. If you're interested in getting a Theragun, they start at only \$199. You can go to [Theragun.com/huberman](https://theragun.com/huberman) right now to get your Gen 4 Theragun today.

00:07:55 How to Increase Focus

You have a 30-day money back guarantee, that's [Theragun.com/huberman](https://theragun.com/huberman). Let's talk about workspace optimization. This is a topic that's intrigued me for a very long time because my undergraduate advisor, my graduate advisor and my postdoc advisor had many things in common, including being great scientists, being kind people and terrific mentors, but they had another thing in common, which always perplexed me, which is that their offices were a complete disaster. They had mountains of books, mountains of papers, mountains of all sorts of stuff. And yet all of them were extremely productive and could remain extremely focused in that incredibly cluttered environment. Now I'm somebody who doesn't like clutter, I find it very hard to focus in cluttered environments. And indeed there's tremendous variation among people as to whether or not they can remain focused or whether or not they struggle to focus in physically cluttered environments. There's no right or wrong to this, but the question we should ask ourselves is why were they all able to be so focused? And it turns out that the reason they were able to be so focused is that they all captured one single and yet fundamental variable of workspace optimization. And we'll talk about what that variable is. In fact, where you're to talk about what all the variables of optimizing a workspace are things like vision, things like light, things like noise in the room, whether or not you listen to music or not, whether or not you use noise canceling headphones or not. We're going to talk about all of that and we're going to do that in a way that you can optimize your workspace, regardless of whether or not you are at home, whether or not you're on the road, et cetera. Because the last thing I would ever want to do is to create a situation

where you find the optimal workspace, and then you are a slave to that optimal workspace. That's just not the way the world works. What you want to do or my goal for you rather, is that you will have a short checklist of things that you can look to, anytime you sit down to do work, and you can think about the underlying variables that impact your brain and your body and allow your brain and body to get into the optimal state in order to learn, in order to be productive and indeed to move through your work bouts in a very relaxed

00:10:02 Lighting Your Work in Phase 1

and pleasurable way while maintaining focus and while pursuing any of the number of things that you're doing. The first variable we want to think about in terms of workspace optimization is vision and light. On a previous episode of The Huberman Lab Podcast, devoted all to habits, I talked about the importance of dividing your 24 hour day into three different phases. And for those of you that haven't heard that episode, I'm just going to briefly summarize what I described. From the time you wake up in the morning until about six or seven or eight, sometimes nine hours later, your brain is in a unique state. It is in a state of high levels of dopamine, a neuromodulator, and high levels of epinephrin, as well as hormones like cortisol and so forth. Without going into the biology of those things, they set your brain into a state of high alertness. And this is true, whether or not you indulge in caffeine or not. I know some of you say, oh, I really don't wake up until the afternoon, I'm much more alert and focused in the afternoon. We will talk about that phase of the 24 hour day in a moment. But that early part of the day is a time of day in which for sake of workspace optimization, being in a brightly lit environment can lend itself to optimal work throughout the day, not just during that early phase. And so while on many episodes of this podcast, I've also emphasized the importance of getting morning sunlight in your eyes within 30 to 60 minutes of waking, not as often, but now, and again, I will also mention that it's important to light your daytime environment as brightly as you safely can. So if you are going to be doing work in this early, what I call phase one portion of your day, you want to have as much light and indeed as much overhead light shining on you as safely possible. And of course you don't want it so bright that it's glaring and you have to squint, et cetera, but you want as much light as is safely possible. And you can do that a couple of simple ways. One is if do own or you're in an environment, we have overhead lights, turn on those overhead

lights. What's special about overhead lights for setting alertness is that the neurons in our eyes, which are called melanopsin ganglion cells, that's the fancy name. Melanopsin ganglion cells are mainly enriched in the lower half of our retinas in our eyes and view the upper visual field. Those neurons send little wires to an area of our hypothalamus, right above the roof of our mouth, that creates a state of alertness. Now, early in the day, we want to be as alert as possible. And this phase one of our circadian cycle is when we are best at doing analytic detailed type work. So we're going to go into other aspects of workspace optimization that are important for phase one, but during phase one, again, within zero to about eight or nine hours after waking, bright lights in your environment, in particular overhead lights, are going to facilitate focus, they're going to facilitate further release of things like dopamine and norepinephrine and healthy amounts of cortisol. And we want that to happen early in the day for a variety of reasons. For instance, we don't want that cortisol peak to happen too late in the day. That's actually associated with depression and insomnia and a number of things that we just don't want. So one of the things that I've done for my workspace is to make sure that when I wake up in the morning, I do go get my sunlight. If the sun isn't out, I turn on as many bright artificial lights as I can manage or tolerate, and then I go get my sunlight exposure. But once I set out to do some work that all the overhead lights in that room are on, as well as lights in front of me. And that's again to stimulate heightened levels of focus and further release of these neuromodulators that I mentioned before, dopamine, norepinephrine and epinephrine. Now the way that one could do that could be a very low cost way of having, for instance, a desk lamp and those overhead lights. If you're somebody that wants to take this to the next level, you can purchase a ring light, which is, I think those are mainly made for people doing selfie type videos, for Instagram posts and things of that sort. Ring lights can be pretty cost-effective, and yet they're very bright and they have the sort of bright blue light that is going to optimally stimulate those melanopsin ganglion cells. So some people I know will have a blue light or a bright LED on their desk in front of them. And indeed I have one of these, I don't use a ring light, I use a light pad. The particular light pad I use, I bought on Amazon. I can mention the brand, but again, I have no financial affiliation to them, this is the Artograph Lightpad is designed for drawing. And it says on it 930 lux, Lux is just a measure of brightness. So I place that on the desk in front of me and I turn it on essentially throughout this phase one of the day. Even if I walk away from the desk, I tend to keep it on, it doesn't consume that much energy. And in that way, I'm constantly being bombarded with photons that keep my levels of



alertness up because the early part of the day is when I do the majority of that focused work. Again, you don't need the light pad, you can use a ring light, or you can simply use any kind of other lights that you might happen to have artificial lights. For those of you that can place your desk near a window, and even better to open the window, that would be really fantastic. I don't have access to that. Why would I say open the window? Well, it turns out that sunlight is going to be the best stimulus for waking up your brain and body through this melanopsin hypothalamus system. And by looking at sunlight through a window, it's 50 times less effective than if that window were to be open, mostly because those windows filter out a lot of the wavelengths of blue light that are essential for stimulating the eyes and this wake-up signal. So all of this has rests on the premise that we need to be alert in order to do our work, in particular focused work. And I've talked about before in the Habits episode, and I'm saying again now, that first phase of the day, that first seven or eight or nine hours of the day is really the time in which our neurochemistry is primed for getting the most amount of focused kind of challenging work done where a lot of precision and detail is required. So you want to brightly light your work environment during that first phase, again, from the time you wake up, try and get sunlight, but then even if you're going to get exercise or do other things, you want to get as much bright light in your eyes

#### 00:16:00 Lighting Your Work in Phase 2

as you safely can and then you want to light your work environment. Now in the afternoon, starting at about nine and continuing until about 16 hours after waking, you want to start dimming the lights in that environment. Now you don't want to make it dark because you don't want to get sleepy at two o'clock in the afternoon, unless you're going to take a brief nap, which I do and is perfectly fine, as long as it doesn't interfere with your nighttime sleep. But the idea is that in this so-called phase two of the 24 hour cycle from about nine to 16 hours after waking, you want to bring the level of lights down a bit. And when I say down, I literally mean down. Having lights that are in front of you is fine, but overhead lights at that time are not going to be optimal for the sorts of neurochemical states that your brain wants to be in. The states that I'm referring to are a shift from the dopamine and norepinephrine that's highest early in the day to increases in things like serotonin and other neuromodulators that put your brain into a state that's better for creative endeavors or for more abstract thinking. Now, as we'll soon see, there are other

things you can do to improve creative thinking and abstract thinking. And in fact, there are things you can do to improve analytic thing, and we will talk about those, things that are distinct from light, but right now we're just focusing on light. So what I recommend doing, and what I personally do is I will turn off overhead lights in the afternoon. It's not completely dim, it's not completely dark, but I will start to reduce the amount of overhead light and just simply keep the light pad on and whatever other lamps I happen to be using. Now, one thing we haven't talked about is screen brightness. This is highly individual, people have different retinal sensitivities. What I mean by that is everybody differs in terms of how bright they can tolerate their visual environment and their screen. And whether or not you are sensitive to light or not, will depend on a lot of factors. Some of it is eye color, indeed people with darker color eyes generally can tolerate more bright light than others. I have green eyes, I am very, very sensitive to light. If I'm outdoors at a cafe or something, and the table has any kind of reflective properties and it's a sunny day, I can barely see the person across the table from me, unless I'm wearing sunglasses. Some people, other members of my family for instance, have dark brown eyes and can just sit there and have a conversation without the need for sunglasses at all. So that's, there's tremendous variation there, one or the other isn't healthy or advantageous necessarily, just understand that you never want to be in an environment where it's painful to maintain looking at whatever it is that you're looking at. If something's painful to look at, it could be damaging to your eyes, so you do want to protect your eyes. Now, in this second phase of the day, since most of us are working indoors, but even if you're working outdoors, you want to try and get the amount of light reduced overall, but in particular, that overhead light, and you also want to start reducing the amount of blue light that you're being exposed to. So somewhere around four or 5:00 pm, which for me is about 12 hours after I've been awake or 14 hours after I've been awake, I will turn off that light pad and start to transition the lights in my environment to more yellows and reds. Now, I can't always do this, I have friends that actually have converted their entire homes from blue light early in the day to red light late in the day, that's really cool and fantastic, I haven't done that. There's a cost to doing that and it is optimal in terms of optimizing productivity and sleep and so forth, but it's not feasible for a lot of people. But what I do is I simply switch to using yellow lamps. I will turn off that LED in the later afternoon, again, around four or 5:00 pm, and I tend to wake up around 6:00 am or so, I'll turn those off. And what I'll try and do also is I'll try and dim the screen that I'm working on so that I can still manage to see everything that I need to see, but it's

quite a bit dimmer than it was early in the day.

### 00:19:45 Lighting Your Work in Phase 3

So that's phase two of the day, and that's how we want to think about light. And then I'll just mention, because I know there are people who are working in the middle of the night, there's phase three, which is about 17 to 24 hours after waking. And I realize that for shift workers or for people that are pulling all nighters or for students, oftentimes you need to be awake and studying in the middle of the night. I, myself am somebody who for years would pull anywhere from five to 10 all-nighters per year. I still pull an all nighter now, and again, because of deadlines and so forth. I don't recommend it, if you can avoid it, great, but many people just simply have to do this for sake of shift work or because of impending deadlines or procrastination or all of the above. If you are going to be doing work in that third phase of your circadian cycle, you really want to limit the amount of bright light that you're getting in your eyes to just the amount that allows you to do the work that you're doing. Because if you get light in your eyes, that's any brighter than that, you're going to severely deplete your melatonin levels. You're going to severely shift your circadian clock and it's effectively like traveling to another time zone. So if you stay up from 3:00 am until 6:00 am or 2:00 am until 4:00 am working on a term paper or something of that sort, and you're getting bright light in your eyes, you are effectively flying six hours to a different time zone, or at least that's what your body registers it as. And it can really throw your sleep and your metabolism and a number of other things out of whack. Now there's an exception to this, which is if you really want to be awake, it can often be beneficial to flipping on all the lights in the room and keeping them really bright. One of the hardest things to do is to stay up all night studying when you're in a dim environment. So you have to determine the trade off between whether or not you want to shift your clock or whether or not you want to get the work done. And I would say the ideal situation is to sleep at night and to do your work during the day and in the afternoon, but if you do have to be awake in the middle of the night, do understand that you want to dim those lights overall. You would not want to use that LED, you would not want to have overhead lights on, unless you're really struggling to stay awake, in which case you want to get as many bright lights on as possible. So there are a couple of tricks to all-nighters, I don't really want people pulling all-nighters unless they have to, but there are a few things that you can do without taking stimulants in order to stay up all

night, that can be beneficial that maximize on your biology. One of them that's a little less commonly known is you can drink 32 ounces of water and commit to not going to the bathroom for 90 minutes, at least. It turns out that there is a circuit that goes from your bladder, literally neurons that go from your bladder to your brainstem and when you have to urinate, it makes you very alert. And as many of you have probably experienced, this is actually what wakes us up in the middle of the night when we have to use the bathroom is this circuit for alertness that goes from full bladder, it's signaled by the bladder being full to the brainstem. And this is the circuit that is disrupted in kids that have bedwetting issues. And there are a number of cognitive behavioral approaches to that, sometimes bedwetting in very young kids is because the circuit hasn't developed yet. Most adults fortunately are not bedwetting, but you can increase the amount of alertness in your system and remain awake in the middle of the night, by drinking a little bit more water than you normally would and then refraining from going to the restroom, that certainly will lend itself to alertness. You know how difficult it is to fall asleep when you have to use the restroom for instance. So that's one tool. The other thing is again, to flip on as many bright lights in the environment as possible. And then of course, people will rely on stimulants like caffeine or even more aggressive stimulants. That's not something I necessarily recommend, you'll each have to determine that for you. But if you do in fact, have to use all-nighters for any reason, you can maximize this bladder to brain approach and the right light approach. So that more or less covers how bright to keep your overall environment and how bright to keep your screen. If you really want to get nerdy about this, there is a free app called Light Meter where you can start measuring how many lux, how many photons are in a given environment. It's actually measuring reflectance of photons and so on, if you can look up what a Lux Meter does, if you like, I don't necessarily recommend doing that. I don't want to set a critical threshold by which, for instance, we say, once your environment is more than 1,500 lux, then it's too bright or not bright enough, et cetera. Everyone has different retinal sensitivities, everyone will find that different levels of brightness will cause them to be alert, different levels of dimness, if you will, in the room will cause them to feel sleepy. You really want to just modulate across the 24 hour cycle where it's very bright, as bright as safely can be early in the day so that you are alert. You can do your focus detailed work in that first phase, and then in the afternoon, as you move into more creative type works or abstract thinking, or working with other people in kind of a brainstorming mode

## 00:24:17 Where to Look While You Work

that you would shift to dimmer lights, yellow lights, eliminate the blue lights as much as possible. Now that's light, but there's another aspect of vision that has been shown to be critically important for how alert we are going to be and how well we can maintain that alertness. And that has to do with where our visual focus is in a given environment. So I'm not talking about overall brightness, what I'm referring to now is simply where you place your phone or your tablet or computer screen or book, whatever it is that you happen to be looking at. There's a very underappreciated and yet incredible aspect of our neurology that has to do with the relationship between where we look and our level of alertness. And it works in a very logical way, we have clusters of neurons in our brain stem and those clusters of neurons control our eyelid muscles and they control our eye movements up and down into the sides. And indeed, if you were to look at an eyeball, I looked at a lot of eyeballs in my lab and I teach neural anatomy, so we do this from time to time, we would see that there are six muscles attached to your eyeball. Now four of them are located at the top, the bottom and the two sides of your eyeball, sort of at the 12 o'clock, six o'clock, three o'clock and nine o'clock of your eyeball. And those muscles can move your eye in the socket from side to side and up and down. And then we also have some muscles that can actually pull the eyeballs at angles. So we have different muscles that can move the eyes at different angles as well, and that's why we can look up into the side or down into the side, not just from side to side or up or down. Now, the neurons that control those muscles have a very interesting feature, which is that when we are looking down toward the ground or anywhere below, basically the central region of our face, the neurons that control that eye movement are intimately related to areas of the brainstem that release certain types of neuromodulators and neurotransmitters. And they activate areas of the brain that are associated with calm and indeed, even with sleepiness and there's an active inhibition or prevention of neurons that increase alertness. Now the opposite is also true, we have neurons that place our eyes into an upward gaze above the sort of level of our nose and up above our forehead. Literally looking up while keeping the head stationary, or if you tilt your head back and you look up, these neurons are still active. Those neurons don't just control the position of the eyes and cause them to move up, they also trigger the activation of brain circuits that are associated with alertness. Now, this is a fundamental feature of the way that our eyes and brain are wired together and how they relate to what we call autonomic arousal. And

there are a bunch of details there. We will actually have a guest in a few weeks who has learned to exploit these neurons and the fact that they control these different states of calm or alertness in order to generate hypnotic states, to place people into very atypical states in which they are both very alert and very calm. We'll save that for a future episode. But the important thing to understand is when you are looking down below the level of your nose, you are essentially decelerating your alertness. You're reducing your amount of alertness, it might be subtle, but it's happening. Whereas when you look straight ahead or in particular, when you look up, you're increasing your level of alertness. Now this has some obvious implications. When we get sleepy, our eyelids tend to close and we tend to nod down, when we're wide awake, we tend to be wide-eyed, we don't tend to blink as often. And we tend to be chin up and kind of on vigilance and alertness. So this has a evolutionary, or at least an adaptive component to it.

#### 00:28:02 Arranging Your Environment

This can be exploited, and indeed it's been researched in terms of how it can be used to optimize work environments. Contrary to what most people do, which is to look down at their laptop, tablet, or phone, if you want to be alert and you want to maintain the maximum amount of focus for whatever it is that you're reading or doing, you want that screen or whatever it is that you're looking at to at least be at eye level and ideally slightly above it. Now, I haven't seen many workspaces that take advantage of this very hardwired neuro-biological fact. So what should you do with this information? Well, if you're somebody who sits down to do work and starts to feel sleepy, or simply unfocused, unable to attend to whatever it is that you're doing, I highly recommend that you take your laptop or tablet. I do hope that most people aren't doing serious work on their phones because it's such a small visual window, and we can talk about why that's an issue later. And the idea would be to place that screen of your tablet or your laptop or other computer, and try and get it elevated at least to nose level, your nose level, or even higher. Now I realize that can be complicated to do, I've long, just used a stack of books, or I'll sometimes take a box and turn upside down and set it there. I do use a mixed standing-seated desk, I'll talk about that in a few minutes. There are a number of different ways that you could do this, you could wall mount a monitor. I think many people are working with laptops, it's a little bit harder to do that with a laptop, some people though will configure a second screen. You have to decide what's right for you in

your budget. But again, in addition to having a brightly lit room, to be able to focus and attend to whatever it is you're working on, you want to have that screen positioned high in your visual environment. Now you wouldn't want it on the ceiling necessarily, I know that would be pretty cool, but you do want it above you. Now, there are a couple solutions to this that don't involve a wall mount or stacking books or boxes. For instance, you could be one of those people that likes to lie in bed or on the sofa and get your screen up above you by putting pillows on your knees. I used to actually do a lot of my writing and work in the middle of the night, I don't do this anymore and I don't recommend it, but I used to do a lot of work from bed. Now I no longer bring electronics for work into the bedroom. I just really try and keep the bedroom for sleeping or whatever else. But in terms of lying down on the couch, it is somewhat easier to get that screen up above you, you can kind of slide underneath that screen and get typing, but there's a problem with that. And we'll talk about this a little bit more in a moment, but it turns out that your posture, literally the position of your body relative to gravity, also has important implications for how alert you are. So ideally you would be standing or seated. I would say the ideal would be standing, second best will be seated and your screen will be either directly in front of you or slightly above you. Or if you wanted to get really fancy, you could create a situation where it was above you and slightly tilted toward you so that you actually had to maintain kind of proper neck posture. This accomplishes a number of things. In addition to making you more alert, you also get away from the so-called text neck. You know, people are starting to look more like C's nowadays, the shape of the letter C because we're constantly looking down. I do every once in a while, see somebody who's texting in public with it at eye level, it always looks a little odd that they're doing that, but I always admire their posture at the same time, so we shouldn't give them a hard time. So this is another feature that you can arrange into your physical workspace.

#### 00:31:24 Body Posture

Again, whether or not you're seated or you're standing throughout the day, try and get that screen elevated. Now with reference to posture, there are beautiful data illustrating that when we are standing up, those same neurons in our brainstem, locus coeruleus neurons, which release I should mention things like norepinephrin and epinephrin, those neurons become active when we are standing. They become even more active when we

are ambulatory, when we are moving and we will talk about treadmilling and cycling at your desk and so forth in a little bit. But when you sit, they become a little less active and when you lie down and indeed, any time that you start to get your feet up above your waist or your head tilted back, those neurons fire less and neurons in your brain that are involved in calming, and indeed putting you to sleep, start increasing their level of firing. It's a really beautiful system. So beautiful, in fact, that there are studies that show that as you adjust the angle of the body back, you actually get a sort of dose-dependent increase in sleepiness and calmness and a dose-dependent decrease in alertness. And so, as we were all told to sit up straight or even better, just stand up straight, and now I'm also telling you to get that visual thing that you're attending to, screen or otherwise, up in front of you, or ideally above you, those things combine to generate maximum alertness. So you can think about how you might work this into various aspects of your homework environment or office work environment. But as I describe this, many of you are probably thinking what I'm thinking, which is, gosh, most of what we do is in complete opposite direction to all of this neurobiologically grounded advice. Most of us are looking down at our laptop while seated, or we are lying down, which is going to make us more sleepy, or we are positioning our computers in front of us, but we really aren't an environment that's bright enough and so on and so forth. So as you can tell, we're starting to layer in the various things that you can do, first brightness in the room, second, get that screen up and try and put yourself into a posture for work that lends itself or promotes alertness if indeed, you want to be alert for that work. If your goal is to take a nap, get your feet elevated about 10 to 15 degrees above your head, maybe put a pillow underneath it, lie down and take a nap, but that's not what we're talking about today, we're talking about workspace optimization. And I suppose you could also exploit that all-nighter trick that I talked about earlier, I actually did this, when I was an undergraduate, I was a little bit masochistic in this way. I would drink coffee and water at fairly high volume. I wasn't forced drinking or anything like that, but I actually wouldn't allow myself to get up and use the bathroom except on a timer. So I think the longest ever went was three and a half hours. It was kind of excruciating, I actually don't think that's necessarily a healthy advice, but again, you can use slight, I mentioned slight over consumption of fluids in order to generate alertness. That was just me really trying to get as much work done as I could, I had a very, very demanding class schedule and it was just the only way that I could get work done. If I was getting up every few minutes, use the restroom, I found it hard to re-engage in that work



## 00:34:22 How Long to Do Deep Work

and maintain focus, which is what I just want to briefly mention now. I talked about this in the episode on focus, but one thing that is completely unreasonable and that you should never ask yourself to do is to sit down or stand up and immediately focus on something, unless you're stressed about what you're looking at, or you're very, very excited by it. If you're very stressed about some sort of information or a deadline, or you're very, very excited about something, you'll find that you can focus instantly just within a moment. And that's because of the deployment of neurochemicals like dopamine and norepinephrine that bring about our levels of alertness. However, most of us, including myself, will go to begin to work out and we'll find that our mind doesn't quite engage at the level of depth and focus that we would like right off the bat. I've timed this and other studies have timed this in a more rigorous way, mine is just what we call anecdotal, but so I've timed it for myself, but there are studies that have looked at this. And the data point to the fact that even at our most heightened levels of focus, most people can only maintain focus before switching tasks for about three minutes, which is depressingly short period of time. However, you can extend that period of time, and I've talked about that in the episode on focus, but more importantly, when you sit down to start a work about of any kind, any kind expect that it would take about six minutes for you to engage these neural circuits, you wouldn't expect yourself to walk into the gym and do a PR lift or start running and do your best sprint, or just head out the door without warming up at all. A little walk jog at first, or a few warm up sets, I mean, we expect that, we are not surprised that we need that. And yet we sort of expect that our brain should be able to lock on and do work in a very focused way immediately. And that's just a ridiculous assumption, it's an unfair assumption, I should say. So assume that it will take about six minutes to engage in your work about and that those neurochemical systems will take some time to rev up and engage. The other things that I'm describing about lighting and screen positioning and posture, those will also help maximize your focus and will limit that ramp up time into a focus state. And I think what you'll find is that as you maximize your workspace, the time the latency, as we say to get into that focus will start to shorten. It will especially start to shorten if you use tools to limit distraction, we will talk about distraction, but things like Freedom, which is an app, a free app that allows you to lock yourself out of the internet or turning off your phone for instance. But even if you're

doing work on your phone or that involves

00:36:50 Set the Right Visual Window Size

your phone or the internet, as many of us including myself do, expect there to be a ramp up time for you to focus. There's another aspect of our vision that's absolutely critical for optimizing our workspace. And that has to do with this really interesting feature of our visual pathways in that it has two major channels. Those two major channels have names, although you don't have to remember the names. The first one is the so-called parvocellular channel, which is involved in looking at things at specific points in space and at high resolution or detail. And then there's the so-called magnocellular channel, that's involved in looking at big swaths of visual space and at lower resolution. So you can think of the parvocellular system as kind of a high pixel density, think about your most modern smartphone, the recent smartphone with the best, best camera. And think about the magnocellular system as being lower resolution, kind of an older smartphone, lower pixels, et cetera. You might ask, why would you want a system that's low resolution. Well, the low resolution system is better at things like detecting motion and not so much at detail and vice versa. Now, again, you don't have to remember the names, what you do have to remember, however, is that you're going to create the maximum amount of alertness in your system. The maximum amount of ability to focus when your system is in that parvocellular mode, when you're bringing your eyes to a common point, what we call a vergence eye movement, V-E-R-G-E-N-C-E. I've said this before on the podcast, and people said, virgin eye movement, no, vergence eye movement. As in convergence, bringing your eyes to a single point in space, will create a narrower aperture of a visual window, meaning your visual world actually shrinks at least perceptually. Whereas when you relax your eyes and dilate your gaze, you can do this now by whatever environment you're in, trying and see without moving your head off to the side, above, below you, as broadly as possible, maybe can dilate your gaze so much that you can see yourself, your body in that visual environment. You'll notice that your resolution of vision isn't nearly as high as when you do that vergence eye movement. Vergence eye movements are incredibly powerful for creating heightened states of alertness and focus. And indeed they create heightened states of cognition, of thinking, and that's because your brain follows your vision in terms of focus. When we say I can't focus, what we often are experiencing is an ability, and inability, excuse me,

to not focus visually. Whereas when we are in a very focused state, we are in a state often where we can focus visually. Now we can also do this with our auditory system or to touch et cetera, but right now we're just talking about the visual system. Now, in terms of workspace optimization, what this means is we never really want to be looking at a square or rectangle or target area for our work that is too far beyond our ears. How far is too far? Really, you want to try and keep the blinders on, or I should say the invisible blinders so that whatever you're looking at falls within the region of visual space in front of you, that is present if you were to cup your hands and put them right next to your eyes. Now this is a rough estimation, but I'm doing this now, for those of you that are watching on YouTube, I'm doing this now, I'm trying to simulate like a horse with blinders on, for those of you who are listening, just imagine me looking silly with my hands cupped near my eyes. But if we are to, for instance, look at a screen that's very, very big and we're too close to it, or even if we're standing back from it, it's going to be hard for us to attend to everything within that screen space. So this is actually support for the idea of using a phone or a tablet or a laptop. My laptop is about 15 inches in diameter, I think is the one that I have, some are 13, some are 17. Some of you like to use big monitors, make sure that whatever it is that you're looking at, if you want to remain focused, it doesn't extend too far beyond where your eyes are, the size of your head that is, so just think blinders on a horse. And actually that's the reason they put blinders on a horse so that they're not looking off into the periphery. Horses, unlike humans don't have the same shaped pupil, they don't have a visual system that's organized in quite the same way, they mostly see in Panorama, in magnocellular vision. And so those blinders are designed to keep their visual focus straight ahead, so they physically restrict it. Now, some people will actually go to lengths to further restrict their visual focus. They will do things like putting on a hoodie or wearing a hat for instance, to restrict their visual window. And indeed that works quite well, but as we'll talk about in a moment when you really restrict your visual window, down to a very, very narrow portion of visual space, that actually changes the types of information that you are best at processing. And we'll talk about that in terms of something that's called the cathedral effect in a few moments, but for now here's the principle, make sure that whatever you're looking at is directly in front of you and doesn't extend too far out to the side. Once you get out to say six or 12 or certainly 18 inches on side of your eyes, you are dilating your gaze by definition, you're dilating your gaze, it's completely subconscious, and it becomes very hard to maintain attention. Now, the caveat to this is that if you are going to look at a narrow

space, a narrow window for any period of time, whether or not it's a book or a laptop or a tablet or a phone, those vergence eye movements not only create alertness, but they also require energy. And they also can fatigue the eyes because there's a process called accommodation whereby the shape of your eye literally has to change so that the lens can move so that you can focus at that location. Accommodation's an incredible process, but it is as demanding one, and that's the reason

00:42:15 45 min / 5 min Rule

that your eyes get tired when you focus on something for too long. So here's a principle extracted from the ophthalmology and neuroscience literature that you can adopt. For every 45 minutes in which you are focusing on something like a phone or a tablet or a book page or your computer, you want to get into magnocellular panoramic vision for at least five minutes. And the way that I suggest to do this is actually to take a walk, ideally outside. We're going to talk about ambulation, about movement and about how that can maintain alertness throughout the day. So for every 45 minutes or so, try and get five minutes of relaxing your eyes. This is something that's not often done, especially in today's homeschooling and where kids are going to school by Zoom and adults are working by Zoom, this is a serious problem. People are getting eye fatigue, they're getting headaches. Indeed, some people are getting migraines, they're having all sorts of issues, neck pain. Much of that, if not all of that, in some cases can be alleviated by this 45 to five rule. For every 45 minutes of focused work that you do, get five minutes where you get outside, or if you have to be indoors where you can dilate your gaze. Now some of you may be saying, well, that spits in the face of your 90 minute rule. You've told us before that we should focus for 90 minutes. I would still want you to take breaks within those 90 minutes, if you're looking at a narrow piece of visual world, meaning at a phone or a laptop or so forth, and again, the best way to do this would be to go outside, just relax your eyes, look off into the distance. Looking at a horizon will automatically trigger this panoramic gaze, which is very relaxing to the eyes and will allow you to go back into a focused work about. The one thing you absolutely do not want to do is to go outside and check your phone, because if you're outside checking your phone or you're taking a break and checking your phone, you're still in that vergence eye movement. So this is very, very important because vergence eye movements increase focus and attention, and you can exploit that to increase focus and attention when you want to, but you

absolutely need to relax the system, again for every 45 minutes in which you've been in that focused mode,

#### 00:44:23 The Cathedral Effect: Analytic vs Creative Work

you want to get at least five minutes of panoramic vision. If you can take a 15 minute walk, even better. Next, I'd like to talk about an aspect of workspace optimization that can actually bias whether or not our brain and nervous system are better suited for detailed analytic work or more abstract work. In fact, there's a way that you can arrange your work environment, or I should say there's a way that you can place yourself into certain environments that will allow abstract thinking, creative thinking, and indeed expansive thinking to emerge. There are other environments that you can put yourself in that will make your brain shift towards more analytic work, toward more detailed and precise types of work. Now, I just briefly want to mention something that was covered again on the Habits episode that I did a few weeks ago, but again, you don't need to see that episode in order to digest this information. It goes back to this issue of three phases within the circadian 24 hour cycle. Phase one, which as I mentioned is about zero to eight hours after waking, phase two, nine to 16 hours after waking, and phase three 17 to 24 hours after waking. Phase one, being ideal for analytic precise, detailed types of work, phase two, better suited for most people for creative, kind of abstract thinking, expansive thinking, brainstorming, et cetera. There are some exceptions to that, but most people follow that pattern because of the different neuromodulators and hormones and so forth that are released into the brain and body at those different phases. What I'm about to tell you is a way in which you can use your physical environment to further shift your brain and nervous system into a mode that's either prime for analytic or abstract and creative thinking. What I'm about to describe is called the cathedral effect. The cathedral effect has been discussed well really, for many, many decades, maybe even hundreds of years, but formally has been discussed since the early 2000s in which it seemed that people who were in high ceilinged environments, hence the phrase cathedral, would shift their thinking and their ideas to more abstract and creative lofty type thinking. So literally higher ceiling, loftier thinking, higher aspirations that this was observed in terms of the language that they use, but also the sorts of ideas that they would generate. And conversely, that people that were in lower ceilinged environments would be more oriented toward using a language that was more restricted, literally more

detailed, analytic about things in their immediate space. Now this seems kind of wild on the one hand, but actually if we go back to our understanding of the neurobiology of the visual system and the way that our brain and body is evolved in different environments, it actually makes a lot of sense. We don't have time to go into a long lecture about evolutionary neurobiology, but we have to remember that our nervous system has a number of features that are adapted to different environments. And indeed, we are able to go from big open prairies or mountaintops or large cathedrals or concert halls into small environments and everything scales with it. When we're outdoors in a big, expensive space, our vision tends to go long, we tend to be in panoramic, magnocellular vision. Our hearing tends to extend long, even if we're having a conversation with somebody, we tend to also be attending somewhat to the screech of hawks off in the distance or to the rush of a river. Whereas when we were in small spaces, everything, our vision, our hearing, and indeed even our physical movements become more restrained. Even if we can still extend our hands out as far as we want. What do I mean by that? Let's say you're in an elevator, that's a small space compared to outside on a field. This has been measured over and over again. The size or the amplitude of people's spontaneous movements actually scales down in smaller environments, even if they aren't completely restricted from extending their limbs all the way, whereas when we are outdoors, we feel a natural impulse to move further away from our body, our torso with our limbs, this just feels like more appropriate behavior. And when I say appropriate, I don't mean in any kind of social context necessarily. There's actually a reason for this, the visual system and the so-called vestibular motor system are intimately linked. And I can just tell you briefly one way in which you can test this and observe this and even use this, it's a little off topic from today's episode, but let's say you have a certain amount of flexibility. You can extend your arms off like wings is what I'm doing for those of you that are listening, not watching off to your side with arms straight, and you reach a maximum positioning of flexibility. You can do a quick experiment where you sit still, you would bring your arms in for a moment. You can put them on your knees, if you like, or in front of you, and you can move your eyes very far off into the periphery of your visual field. So you actually, I'm going to do this now. It looks kind of silly, but moving my eyes without moving my head off into the periphery, all the way to the right, then all the way to the left, all the way up all the way down, but especially all the way to the left, almost looking over my shoulder without turning my head all the way to my right. And you will find that you actually can extend your arms further back

subsequent to that. And that's not magic, it has to do with the ways in which your cerebellum, which actually means mini brain and your eyes, your visual system are connected, and the way in which your cerebellum controls some of the spindles and other aspects of the neuromuscular architecture of your nervous system, 'cause your nerves control your muscles and allow those muscles to move further out. So for those of you that lack flexibility, you can actually explore your visual system for this. Now that's again, a bit of a tangent, but it's a fun one that relates back to this so-called cathedral effect. The cathedral effect is a way in which our thinking becomes more restricted and restrained in tighter, smaller, more confined visual environments. Or if the ceiling is higher, we are in expansive space with a lot of distance above us or space above us and out to the sides, maybe even out on a field, our thinking goes into these more broad abstract and kind of loftier future thinking in particular. This has actually been measured. There's a really nice paper, I will post a link to this. The authors are Joan Meyers-Levy and Rui, and then in parentheses Juliet Zhu, I'm going to assume that they go by Juliet. The title of the paper is "The Influence of Ceiling Height: "The Effect of Priming "on the Type of Processing People Use." And I won't go into all the details of this paper, but what's really cool about this paper is they looked with very rigorous statistics and they have a fair number of subjects and everything about this paper looks solid to me. The difference in cognitive processing, and abstract thinking and detailed analytic work that people are able to perform in environments that have a 10 foot ceiling versus an eight foot ceiling, which is not that much of a difference, there's just two foot difference there. And what they found were significant effects whereby high ceilings, activate concepts related to abstraction, whereas low ceilings prime confinement related concepts, but, or promote the kind of detailed thinking that lends itself well to sort of spreadsheet type work or accounting type work. Whereas abstract creative work was supported by these higher ceilings. And the way they analyze this was really interesting. Again, we don't have time to go into all the details, but they ask people to sort of generate word sets of related to particular topics like sports. And so people will talk about soccer, football, baseball, golf, et cetera, and talk about some of the equipment and other things. And then they had a kind of a challenge, a cognitive challenge whereby people had to link different concepts along different dimensions so that you depart from the dimension of sport and you start thinking about sports that involve teams or sports that involve a ball, et cetera. And so in the same conditions you can, except for the fact that the ceiling height is different eight feet or 10 feet, what one finds is that the kinds of language and

the kinds of associations that people start to create are vastly different. And there're actually two experiments in this study, you're welcome to go look at it, so it wasn't just about sports, there were some other things that were analyzed as well. And in the references of this paper, it also points to other examples of the cathedral effect, which I find very interesting because as a vision scientist and someone who spends his life thinking about and indeed talking about the nervous system, we know that our cognition follows our vision. For low vision or blind people will follow mostly their hearing and to some extent their touch. But for most people who are sighted, as most people are cited, our cognition follows our visual environment. So what does this mean for workspace optimization? Well, most of us have a fixed ceiling level in our home, but you might have rooms in which the ceiling is higher and rooms in which the ceiling is lower. If that were the case, I recommend if you want to do creative work during phase two, the nine to 16 hours of your circadian cycle, nine to 16 hours after waking that is, that you do that in the high ceiling room, or maybe even outdoors out on a deck or on a patio. Cause the highest ceiling of courses is the sky. Whereas if you're going to do detailed analytic work I would suggest doing that during phase one of the day. But even if you're going to do it during phase two of the day, for whatever reason, scheduling or other sorts of constraints that you do that in the lower ceiling environment. Now, if you are interested in controlling the height of your visual world, but you don't have control over the ceiling height of the environment that you're in, there's another way to do that. And I used to observe this in the cafes, in and around Stanford, and the Bay area where you would see somebody who, despite the weather would be in a hoodie, maybe with a baseball cap or other form of hat or some sort of blinder above their eyebrows, which is actually another way of just lowering the ceiling height very, very low and restricting your visual field. Not unlike blinders that we talked about before that one would put on a horse or one would put on themselves by restricting their visual angle of focus to directly in front of them, but not too far out beyond the sides of their head. So these cathedral effects, I think can be leveraged toward doing particular types of work best. And again, the lower the ceiling or the lower your visual environment, the more that one tends to do where I should say performs detailed analytic work accurately. And the more that one's thinking is oriented towards detailed sort of correct answer type work. Whereas when the ceiling is higher or there's no ceiling, the more that the brain and the rest of the processing that we call cognitive processing, is related to abstract reasoning, brainstorming, and indeed can pull from broader swaths of memory resources, because really what abstract



reasoning is, is it's taking the existing elements and maneuvering them, arranging them into novel ways. So you can think about like notes on a piano, playing a particular song, learning scales, that's very analytic. There's a correct answer that you're trying to arrive at or generate, whereas writing music or writing poetry or generating new material of any kind, involves taking existing elements, right? You're not going to use words that you don't have committed to your memory or that you're not aware of, and arranging them in novel ways. So I think the cathedral effect can be leveraged. And again, you don't need to move into a different home or build a slanted roof and work at one side of the room at one part of the day and the other side of the room at the other, although if that's the way you want to swing it, that's great, most of us don't have that flexibility, but it's very clear that the height of the ceiling of the visual environment that we're in,

#### 00:55:50 Leveraging Background Noise

has a profound effect on the types of cognitive processes that we are able to engage. Now, I'd like to shift our attention to the auditory environment or the noise in the room or the music in the room or the music or noise in the headphones, because it turns out that there is a lot of quality scientific data out there that speaks to whether or not listening to particular sounds can enhance our cognition. And indeed the answer is yes, but there are very particular types of things to listen to under very particular types of conditions that allow one to do that. First off, I want to say that people vary tremendously in the extent to which they can tolerate background noise for work. In fact, individuals will vary tremendously from one day to the next, or even within the same day in the extent to which they can tolerate background noise. I've experienced this myself, there been times in which I've been working at home and I felt like for whatever reason, I just could not engage in focus. And what worked to generate more focus for me was to go to a cafe or to a library or someplace where there's actually more commotion, more people moving about, maybe even more noise, maybe even music in the room. And we have to all be in touch with when we want more background noise, or when we want less background noise, there is no hard and fast rule. If you look across the literature for studies that involve complete silence or white noise or binaural beats, or music or classical music or rock and roll, you can find results to support any type of environment as being more beneficial. However, as we'll talk about in a moment, there are a few types of environments to really avoid and a few types of sounds that really can enhance the

cognition and your ability to focus in your workspace environment across the board, that really seemed to work for all people. Let's talk about background noise to avoid. And here we're talking about background noise to avoid because it actually can cause some pretty severe deficits in cognition. There's a paper first author, Jordan Love, cool name, last author Alexander Francis. The, the title of the paper has to do with "Psychophysiological responses to potentially annoying "heating, ventilation and air conditioning noise "during mentally demanding work," which is a mouthful. But basically what this paper identifies is a large dataset in which workplace and environmental noise, mostly the humming of air conditioners that's very loud or the humming of heaters, that's very loud and ongoing, just incessant doesn't let up, can really increase mental fatigue and can vastly decrease cognitive performance. And if you're interested in looking at the cognitive performance data that authors are Banbury & Berry 2005, that paper is the one that supports the fact that cognitive performance is worse when there's just the hum of an air conditioner in the background or the hum of a heater and otherwise complete silence. There's also evidence which I discussed on the episode about hearing, which is that in young children, white noise can cause some impairments in the development of the auditory system. Now I don't want parents to freak out and if you're exposed to white noise, as it as a sleep aid as a child, which I know many of you were, don't freak out, but it turns out that white noise, especially if it's loud, white noise can cause some disruption in the auditory maps, the representation of different frequencies of sound in the brain that can lead to some deficits in auditory and even language processing. So we really have to be careful about long-term exposure, extended exposure to white noise, or kind of an air conditioning noise that's really at a high level. I wouldn't worry if it's in the background and shutting off and turning on again, as the thermostat kicks off and on, but really try and avoid work in loud fan filled or ventilation generating or heat generating environments, because it really can cause damage to the auditory system long-term and as we described, it can impair cognitive performance and overall increase fatigue. I think we've all experienced that when you're in a room and there's some ongoing background noise and all of a sudden it stops and you just feel this enormous relief [sighs]. And the reason for this is that our auditory system has a parallel to our visual system. In our visual system, that light entering the eyes triggers the activation of those melanopsin cells, which triggers activation of the hypothalamus, a particular area of the hypothalamus, which generates alertness, generates the release, even of cortisol, a stress hormone. In the auditory system, when there's ongoing sound, your auditory

system hears that, even if you're not paying attention to it, if you're paying attention to something else, it's still registers. Those little hair cells, as they're called in your inner ear are fluttering, the eardrum is beating and in concert to that sound frequency. And there's a brainstem mechanism that generates alertness and a kind of vigilant. So when you have a sound that's ongoing in the background, it shuts off, all of a sudden you experienced that peace, which is the turning off of those brainstem circuits that are associated with vigilance, the locus coeruleus, which we talked about earlier, which release epinephrin and norepinephrine and generate the heightened state of alertness in your brain and body, those neurons then can turn off and you experience that as relaxation. So does that mean that we shouldn't listen to white noise or pink noise or brown noise while we're working? Certainly a lot of people do. In fact, if you want to know what white noise, pink noise and brown noise are, they're just different constellations of auditory frequencies that are played together. Most of us think of white noise as the [shushing] on a screen, all the black and white pixels going all around, like they call it visual snow, but pink noise has certain sound frequencies, notched out, taken out, brown noise has others. It has different frequencies that are included at higher amplitude, et cetera. You can look this stuff up on YouTube, if you want, you to just put brown noise. None of it sounds terrific, it doesn't sound like music. It's literally just noise, mixed frequencies in no particular arrangement. There is some evidence that playing white noise in the background or on headphones or pink noise or brown noise can facilitate cognition, but it's mainly through an increase in this overall alertness as a consequence of areas like locus coeruleus and other brainstem areas that are associated with autonomic arousal from that noise. So it's a lot like the air conditioner effect. And I think done in a restricted way, meaning not for hours and hours, but maybe if your focus is waning and you're having a hard time engaging in work, you might put on some brown noise or white noise or pink noise and work that way for 45 minutes or so before you go to your panoramic vision walk and get some sunlight, that should be fine. There's really no reason to suspect, however,

01:02:20 Binaural Beats for Work

that those particular patterns of noise are going to optimize particular mental functions. So what I'd like to turn to next are particular patterns of sounds that indeed have been shown in peer-reviewed studies to optimize certain types of mental processing, because

you can incorporate these into your optimized workspace environment, through headphones or through speakers, whatever mechanism that you want, in order to get more out of your work efforts. If you were to search for apps or go online and try and find sounds that can improve thinking or change your emotions. You're generally going to find three types. One are called isochronic tones, these are tones usually of a common frequency. So it might be a beep and then a pause, and then beep of the same frequency, and then beep, forgive my terrible beeping. I don't know what good beeping would sound like, but contrast isochronic tones with monaural beats. Monaural beats would be repetitive, almost percussive like beats delivered to just one ear, [vocalizing], this kind of thing. You can find apps that can deliver monaural beats, you can find also apps that deliver so-called binaural beats. You can also find YouTube scripts or channels that will deliver binaural beats. Binaural beats as the name suggests, are beats delivered to the two ears, one pattern of kind of percussive beat to one ear and a different pattern, or at least a pattern that's out of phase, that's not synchronized, delivered to the other ear. So on one ear you hear, [vocalizing] and in the other ear, you've got [vocalizing]. And what happens is because of the way that the auditory system converges in the brainstem and generates what are called interaural time differences, I'll explain what that means in a moment, interaural time differences, the difference between the two patterns of beats that are heard by each of the two different ears, leads to a third pattern that the brain entrains to, and kind of maps onto and generates particular types of brainwaves. So without going into a lot of detail, interaural time differences are the ways in which if you were to hear something off to your right, like I just snapped my finger just to the right of my right ear, that a signal arrives in my right ear before that's sound signal, those sound waves arrive in my left ear. So there's an interaural between ears, time difference. And there's a brainstem area in which signals from one ear and signals from the other ear converge, and there's literally a math done by your nervous system that says this signal arrived before the other signal. And the difference between those signals is the interaural time difference. So if I were to snap my fingers on both sides on my left and on my right side of the exact same time, and they arrive at the same time, the interaural time difference is zero. Whereas if one goes first on the right and then the left, I'm terrible at snapping on the left, it's a weak snap, but it was there, then there's a delay and the interaural time difference has a particular value. Okay, you get it, it's almost ridiculously simple. Binaural beats have been generated in ways that create a particular pattern of interaural time differences that

then cascades up to the rest of the brain and puts the forebrain and other areas of the brain that are involved in cognition and action into a particular rhythm. And some of the rhythms or waves of brain activity are ones that you may have heard of, things like alpha waves or theta waves or gamma waves. Now I don't like to get too attached to particular brain waves as excellent for particular kinds of thinking. This is something that was really popular in the 90s and 2000s, when ways of measuring brain activity, noninvasively with electrodes on the outside, enabled people to identify the indeed alpha brain waves are associated with alertness states. And some are other brainwaves that are kind of larger amplitudes, slow waves like delta waves are associated with kind of sleepiness or relaxation, but in general, the way that the brain works is that different brain waves are generated in different structures at different times. And those combine to give us a sense of happiness or give us a sense of focus or give us a sense of creativity. Nonetheless, if you look across the board at the studies of binaural beats and you ask what sorts of binaural beats appear to be useful for people to enhance

#### 01:06:38 The Best Binaural Frequency for Work

their brain function for particular kinds of tasks, we arrive at some very interesting answers. So we'll review what those are now. The frequency of binaural beats that appears to bring about improved cognitive functioning at the level of memory, improved reaction times and improved verbal recall, seems to be 40 Hertz. Now, is it exactly 40 Hertz? We don't know, but if one wants to look up a great reference on this, they reference Colzato, C-O-L-Z-A-T-O et al 2017 describes and here, I'm quoting, so this is a direct quote. "The present findings are in line "with those of a recent study, which also found "faster reaction times in participants "that listen to binaural beats at 40 Hertz." And you can find many examples of this in the literature where binaural beats have about 40 Hertz or exactly 40 Hertz, in some cases, somehow brought the brain into a state that made it optimal for learning, for memory and for certain types of recall, including verbal recall, math learning, et cetera. So for those of you that are interested in binaural beats, there are a number of free apps out there. I'm not going to recommend any in particular, just have to search for one that you happen to like. One thing that you will find is that many of those apps super-imposed binaural beats onto raindrops or ocean sounds or that rather they superimpose ocean sounds and raindrops onto the binaural beats, that does not appear to be as effective as pure binaural beats. There has been an

exploration of lower frequency binaural beats. So for instance, seven Hertz, which is theta binaural beats done for 30 minutes with an overlay of rain sound or rain sounds only that's been analyzed and believe it or not, that showed immediate recall memory was significantly decreased. So that's a negative effect of binaural beats on memory. So the idea that binaural beats are just great for us across the board, I think is wrong. It does appear that the higher frequency binaural beats as one moves up toward 40 Hertz are going to be the most beneficial. There are instances in which for instance, 15 Hertz binaural beats increased response accuracy on a spatial verbal memory task. This is a complicated working memory task. Working memory is the kind of memory of remembering a phone number. So if I say for instance, 4932931, and you have to remember that number, keeping it online is what we call your working memory. It's likely that you would forget that two or three days later. You can get improvements in working memory with 15 Hertz binaural beats, whereas the other control conditions, five Hertz and 10 Hertz binaural beats, all decreased accuracy of working memory. However, when I looked at the literature and I examined a number of different studies, what I always seem to come back to was that 40 Hertz or so plus or minus five Hertz seemed to be optimal for generating improvements in cognition, in math performance, and even in various types of memory recall, and even in musical performance. You might wonder, well, how can people do musical performance, they're listening to binaural beats. Here's another surprise, many of the studies that I looked at didn't have people listening to binaural beats while they were doing the tasks, the memory task, or the music learning, et cetera, they would do it beforehand for 30 minutes. There were instances in which people were listening to binaural beats during the task. But if you decide to employ binaural beats, I recommend this 40 Hertz as a great place to start. I don't recommend doing it for all of your work bouts. I think there's a good reason to believe that you can attenuate to it. But if you are going to try it, you might try it both ways. You might try listening to binaural beats for about 30 minutes while doing something else and then maybe eating lunch or something of that sort, or taking a walk and then going into the work about. Because remember the moment that you start listening to these binaural beats, the brain doesn't immediately switch into a particular pattern of oscillation or brain waves, it takes some time. Neural circuits, again, take time to engage. The only neural circuits that are going to engage instantly are going to be the ones that are of a sort of reflexive sort, like you step on a sharp object and you have to retract your limb, or you suddenly are stressed by a distressing text message, or you're suddenly delighted about

a delightful text message. But when it comes to shifting your whole brain state toward optimizing work, it takes a little bit of time. So again, 40 Hertz binaural beats, many, many apps, many YouTube scripts out there, probably other resources for binaural beats, hopefully zero cost, so you can access those without any need to shell out any money. If you find one that you particularly like, maybe put in the comment section, so other people can find it, YouTube would be the best place to do that. Feel free to put a link or just a description, that will be wonderful. And again, you don't need to listen to binaural beats

### 01:11:17 How Binaural Beats Increase Focus

at the exact same time that you're doing the work, although that could also enhance your productivity. Some of you out there might be craving a little bit more mechanism by which binaural beats can influence things like focus or reduced reaction time. This has actually been explored, this 40 Hertz binaural beats pattern seems to have an effect on what's called striatal dopamine. We have dopamine as a neuromodulator of course, involved in many things in motivation, it's actually involved in adaptation to light in the retina. Something that most people don't know, but it's involved in movement, which is why people with Parkinson's who have a depletion of dopamine neurons actually have movement deficits and so on. But striatal dopamine is closely related to motivation and focus. And 40 Hertz binaural beats appears to increase striatal dopamine release. And this has actually been measured indirectly by what we call spontaneous blink rate. Now I've been accused on various Instagram posts, and even on this podcast of being a non-blinker, let's call it, or a minimal blinker. And as an important aside, there is no evidence whatsoever that people that don't blink very much are sociopaths or lie. Also, you will hear that people who blink a lot are sociopaths and are lying. There's absolutely no evidence that blink frequency correlates with anything except alertness. Now longer blinks are associated with less alertness. As we get tired, we tend to blink longer and longer until we take the long blink that is sleep. I guess the long blink would be death, but the longish blink would be sleep. But it turns out that the more firing of striatal dopamine neurons that's occurring, the more frequently we blink. And so it is associated with a resetting of our visual window, that's what happens when we blink and there's a whole relationship between blinking and time perception that we covered in the episode on time perception. But here's the bottom line for sake of this discussion. 40 Hertz

binaural beats appears to increase spontaneous blink rates because it increases dopamine transmission in the brainstem and in the striatum in several locations in fact. And so the way in which these binaural beats set a rhythm in the brain, recruits dopamine release. That dopamine release leads to heightened levels of motivation and focus, why motivation and focus? Well, dopamine is actually the substrate by which epinephrin is made. Dopamine, the molecule is actually converted into epinephrin adrenaline and they work together like close cousins, dopamine and epinephrin in order to put us on a path of movement or if we are doing work, of mental movement toward a goal. So that's a little bit of mechanistic meat to explain at least part of the reason why 40 Hertz binaural beats

#### 01:13:56 Minimizing Interruptions

can enhance our focus, reduce our reaction times and improve indeed learning and memory. Next I'd like to talk about the role of movement in optimizing our workspace and whether or not standing, sitting, lying down, treadmilling or even believe it or not, cycling, can enhance our work output and performance. Before we do that, I want to touch on two aspects of optimizing workspace that will come up at some point in your work or school life. Alas, there isn't a lot of science around this, but I think they are worth mentioning. And I think I can offer a little bit of advice in terms of how to navigate these in a way that would be beneficial to you. The first one is interruptions. If you go online and you ask about how to avoid interruptions, people will say, okay, well, if you have kids at home or even if you don't or at work, you'll have a light, like a recording light with recording is on we're, we're busy now, or have a sign on the door that says bother only in a case of emergency or find to knock or don't knock at all. I've used a different policy throughout the years. I am somebody who works pretty hard to control my time and focus, but of course, as a laboratory director, I have people coming by and who want to talk about things. And of course we have phones and we have computers and people's opportunity to reach us. Interruptions really are deadly to our ability to generate focus. And it's not just about the distraction that occurs of say a minute or two minutes or five minutes when we were interrupted, it's also about the additional time to get those brain circuits to re-engage to a mode of focus. So it's really kind of a double whammy. Now, none of us, including myself want to be harsh or cruel or shut off from the world and oftentimes interruptions bring incredible insights and people are providing support and



very useful things that are essential to my workday and presumably to your workday in school day as well. But there's a simple method that I learned from my graduate advisor that works very, very well. Again, no peer review data to support it, this is just my experience, but this is somebody who had immense powers of focus, had a very, very demanding life, a long commute to children, extensive laboratory, et cetera. And what she would do was if I came by and asked a question, or if anyone came by and asked a question, she would acknowledge their presence, but would not shift her body toward them. So she purposely did not position her computer facing the door, which I think is a deadly or I should say, deadly to focus a way of positioning your workspace. So her computer was facing the wall, the door was perpendicular to that. And I would come by and I say, I have a question. She would say yes, so she would acknowledge my presence, but she wouldn't actually orient her body toward me, which told me that this conversation was not going to last very long. And no matter how long I stood there or what I asked, she would never orient toward me, which generally kept these conversations very, very short. We had other designated meetings where we would be face-to-face. The other approach, which I confess colleagues of mine have used before, not necessarily at Stanford, but elsewhere is to simply say no to everything that somebody requests or comes by. So if someone would knock on the door, they would just shout no through the door, or if someone said, can I bother you for a second? They would say, no, or if someone said, I have something I want to tell you, they would just say no. And they would just continue doing this until the person went away. That was actually very effective, these were some of the most productive people I know, not always the kindest, but some of them were very kind. The other approach that I've seen and actually this is an approach that was used by someone who has been a guest on The Huberman Lab Podcast, someone who's immensely productive was that he, so I'm constraining who this might be by saying he, he actually, despite having the option to have a very large office, would place himself in a workspace that was literally a coat closet, cleared out with a desk, small lamp, completely dark. So this violates everything that I've talked about before or prior to this, everything about high ceilings, bright light, et cetera, and would work, still works underneath a desk lamp in a completely dark closet, minimal ventilation. This is my definition of hell. And yet is one of the most productive people on the planet. Also very, very hard to find, I actually know where his closet is, turns out he has several of them that he migrates from in order to avoid distractions. So I mentioned these as kind of extremes, I think that most of us exist on the other extreme.

And that's why I mentioned it, which is that most of us like some social engagement and a welcome, or at least set our work environment in a way that welcomes interruption and we have to be very, very careful about this. Now in the digital realm, I already mentioned a few of the things that we can do as practical tools to limit interruptions. One is use the program Freedom, the other would be to simply turn off the wifi. If you do need to be online and navigating, you're doing research of any kind, that's not going to be possible. Turning off one's phone, I've at times, put my phone on airplane mode, if that didn't work, I've locked it in a safe, I've done that, I'd left in the car outside. It all depends on one's levels of self-discipline, which as you probably know, from your own experience, tends to kind of wax and wane. Sometimes we are better at avoiding these distractions than others. So if you find yourself in a place where it's very hard to reduce those distractions, you may need you to go to more elaborate lanes. I will say that a graduate student in my lab who was immensely productive and focused, had the habit of coming in each day, she would take her phone, I don't know if she turned it on, or off or not, and she would just place it in a door, excuse me, in a drawer and would then go start doing experiments. We do experiments all day at 10 courses, engage in discussions avidly with the rest of us, and then would take her phone out at the end of the day and leave. And I don't think that behavior was not correlated with her immense productivity. I think the ability to untether ourselves from the phone is going to be the way in which many of us are either going to succeed or fail in our various pursuits. I'm somebody who engages on with the phone on a regular basis throughout the day for various reasons, but I do try and have large swaths of the day in which it's either on airplane mode or it's completely physically separated from me. When I'm in large swaths, I might do every other hour with the phone on airplane mode

01:20:01 Sit or Stand, or Both?

or even a two or three hour about where I just am simply not engaged with the phone at all. So is it better to sit or is it better to stand when doing work, at least as it relates to focus and productivity? And the answer is both. There've been a number of systematic studies exploring what are called sit-stand desks. So these are desks that can be set to a height that makes standing the best practice, and then they can be lowered to a height that makes sitting the best practice or the easiest practice I should say. And it turns out that just sitting is terrible for us and there's an enormous number of studies out there that

have pointed the fact that people who sit for five or six or seven hours a day doing work, have all sorts of issues related to sleep, neck pain, cognition suffers, their number of cardiovascular effects, even digestion, there may even actually be some almost pressure effects on the pelvic floor and things of that sort, depending on the chairs that one uses. But that people who stand are in a slightly better situation where many of those health metrics improve, but that people that do a combination of sitting and standing at the same desk throughout the day, or move from one desk to another, if they don't have a combination sit-stand desk, that's going to be best. The good news is it's very easy to convert a sit desk into a stand desk, you can just stack some boxes, I've done this at times or stack books. There are also some pedestals and things that you can purchase if that's your preference in order to set your computer at a particular height. And of course there are desks that have motors and they're ones that have cranks, and there are all sorts of variations, both in terms of the types and whether or not they have motors as well as the cost to these things. So they can go from very low cost, like placing boxes or books to create a standing desk, to very high cost in some cases. Now what's interesting, if you look at a scientific literature, is that people who decreased their sitting time by about half each day. So they took, let's say they were working for seven hours a day, three and a half hours of that day, they decide to stand, and it's not even clear that it matters that they do all those three hours in one about, or they divide that up into shorter bouts of a half an hour, and then sit for half an hour, et cetera, alternating back and forth showed incredibly significant effects on reduced neck and shoulder pain, increase in subjective health, vitality in a work-related environments. And perhaps most importantly, for sake of today's discussion improvement in cognitive conditioning and the ability to embrace new tasks and cognitive performance. There are several studies that if one wanted to explore, they could explore this in more detail. I'll put a link to this as well. The article that I'm referring to is called "Effects of a Workplace Sit-Stand Desk Intervention on Health and Productivity." And I like this paper because many of the papers out there focus on the effects of sit-stand desks on health in trying to get people to burn more calories, improve their posture, relieve neck pain, slumped over, et cetera, but not on productivity. And this particular paper focuses also on the metrics of productivity, it has its own study and also references a number of important studies. What does this mean for you and me? Well, I've long used a standing desk or some variation thereof. What this means is that we should probably spend about half of our work time standing and about half of it sitting, but not all sitting or not all standing. If you

had to do all one or the other, standing is going to be better than sitting. What happens if we just stand? Well, that can also generate some postural issues in terms of stabilization and fatigue. I have a good friend who's in the movement and physical rehabilitation and physiology space, his name is Kelly Starrett, he's very impressive in all those domains, and he always says, we weren't designed to sit all day, but we also weren't designed to stand all day. And I think that's true, if we were to look back at our species over tens or hundreds of thousands of years, we would find that indeed, we did sit down, we did lie down. It wasn't that we were standing all day long. That said, almost everybody, at least in the U.S., is not getting sufficient cardiovascular exercise or movement throughout the day. And standing at one's desk can improve some of those health metrics, and again, can improve productivity, probably because of those postural effects that I talked about earlier, that when we lie down, there tends to be less alertness in our brainstem, if you will and there's less activation of those brainstem circuits involved in alertness. And indeed that circuits that involve a kind of a calming effect on the body, get activated. And as we become upright, standing or sitting, but especially standing, then those brainstem circuits for alertness kick on, which are going to make it easier to remain focused. If you are going to start standing for half of your work time, you will notice that it takes a few days to adapt. You'll notice a lot of shifting from side to side, definitely want to wear comfortable shoes. Some people do this on a wooden floor, other people feel uncomfortable unless they're on carpet. You have to figure out what works for you, but it can take a little bit of time to adapt. After say after now, about 10 years of working at a sit-stand desk, I find I can't sit for too long before I want to stand. And my standing bouts can be anywhere from 30 minutes to two hours, although two hours would be a little bit long. And then I catch myself kind of leaning on the desk off to the side. So again, the idea is to stand, but not be leaning on the desk, obviously, if you're typing or you're writing,

#### 01:25:18 Movement in the Workspace

there'll be some leaning involved, but that's what the literature support. There is also a literature on whether or not physical movement under your desk, meaning treadmilling or in fact, there are now bicycles that allow people to peddle. It's kind of a unicycle like thing, although not a unicycle under the desk, can be beneficial for workplace performance. So let's take a look at what those data say. The study that I'm referring to

has a first author, Frod Sham, F-R-O-D S-H-A-M, Frod Sham et al. This is a research article published in plus one, and the title of the article is, "Does Type of Active Workstation Matter: "A Randomized Comparison of Cognitive and Typing Performance "Between Rest, Cycling and Treadmill, Active Workstation." It's amazing that people do this science, I think it's great. Where else would we get peer-reviewed data on these types of questions? First things first, there were no significant differences between cycling or treadmill workstations on any cognitive or typing outcomes. So it does not seem to matter whether or not people are treadmilling under the desk. So these would be stationary treadmills, it's like a little conveyor that people are walking on. Sometimes very slowly, I'm guessing some people walk more quickly, the New Yorkers probably treadmill quicker. The California's probably treadmill a little slower, I'm in Californian, so I can make that quote unquote joke, but nonetheless, there were no significant differences between that and a cycling station where people are sitting and peddling as they type away or as they work, or as they're on phone calls, et cetera. So it really doesn't seem to matter. So if you're going to embrace these active workstations, as they're called, just decide what you would prefer to use. It doesn't seem to matter in terms of outcomes. Now, this study involved looking at 137 young adults. They had multiple sessions where they at first completed cognitive and typing tests, these tests have different names, and you're welcome to look those up if you like, as well as flanker tasks, so these are tasks of attention and things of that sort. And then they either engaged in treadmill or cycling and then there was a comparison. And the statistics were run, and basically what they found was there was a statistically significant improvement in attention and cognitive control scores during any kind of active session, as opposed to just a mere seated session. So they compared seated to cycling to treadmilling. However, verbal memory scores actually got worse during active sessions. So I'll repeat that, treadmilling or the cycling workstations, improved attention and cognitive control scores as compared to people that were just seated and working. However, verbal memory scores got worse during the active sessions, and again, just to repeat, there was no difference between cycling and treadmill workstations. So this is interesting, I suggest that as the author say that active workstations, whether walking or cycling are not only useful to improve caloric output and physical activity, circulation and so on, but particularly when completing tasks like cognitive tasks or tasks that require focus that do not require verbal memory recall. Now why verbal memory recall was negatively impacted, we don't know, it could be because people were breathing a little bit harder. It could be that there's something

about walking and talking that seems incompatible in the nervous system, although I'm not aware of that. I know a number of people who can walk and talk at the same time, but if you are going to explore these treadmills or you're going to explore these cycling stations, you probably wouldn't want to do that for highly verbal work, maybe more for mathematical work or for analytic work or even creative work. But anything that involves very precise or detailed verbal recall, sitting or standing seems to be the better option. And if you're wondering why cycling or treadmilling would enhance various aspects of cognition, we can speculate. I've talked before about this, but anytime we are generating forward movement through our own actions, our own efforts, typically, if we are outside, we're not on a treadmill or we're out on a bicycle or running, or even on a motorcycle or in a car, we have what's called optic flow. And that optic flow is known to quiet certain areas of the brain that are associated with vigilance and indeed fear. This is the basis of things like EMDR, eye movement desensitization reprocessing. However, the mere act of engaging what are called our central pattern generators, the neurons in our brain stem and in our spinal cord that engage repetitive movements also can reduce some of the areas of the brain that are associated with anxiety and vigilance. So one pure speculation, but nonetheless grounded speculation would be that treadmilling or cycling at a desk would reduce anxiety that would allow performance to improve. The other, what I think is more likely explanation is that anytime we are in ambulation, we recruit the release of neuromodulators like epinephrin dopamine and things of that sort, that further increase overall levels of alertness. I think that's the more likely explanation because it's hard to imagine how just a reduction in anxiety could lead to these improvements in cognition in a direct way. Whereas the subjects in the study, I just mentioned on average experienced an increase in cognitive performance merely by movement. And this does not include any optic flow because it's stationary, the treadmill or the cycle is stationary. And so we can rule out that optic flow, and that points to the idea that when we are in movement, we recruit neuromodulators associated with the so-called reticular activating system, the striatal system and so forth, that would place the brain into some pattern. We don't know, we only can speculate some pattern, perhaps it's gamma waves or some other wave pattern

01:31:00 Summary & Shifting Work Environments

that would engage heightened levels of focus and attention. Nonetheless, treadmilling,

cycling at a desk, does improve cognition. So we've been discussing workspace optimization with the understanding that you're not always going to work in the same place every day. What I've tried to do is give you a set of high potency tools that can improve your focus and cognition, and to place that within a framework for particular kinds of work. Let's just review some of the basic elements of what we've covered today. First of all, in the first part of your day, that zero to nine hours after waking, you want bright lights, especially overhead lights, as bright as you can keep them without feeling uncomfortable, or certainly not without feeling any pain in your eyes or elsewhere in your body. Bright lights will make for the maximum state of alertness. In addition, try and place, whatever it is that you're focusing on directly in front of you, but not have it extend too far out to either side of your eyes, try and generate a fairly restricted visual window as we call it. And if you can, try and place whatever it is you're focusing on at least at nose level or above, that it might take some engineering or some ingenuity and creativity in order to figure out how to do that, but that's going to be most beneficial. Try and avoid reclining, try and avoid sitting, try and stand for at least half of your work day. That's a good goal, and it may take some time to work up to that goal. In addition, if you're going to use sound as a stimulus for increasing focus and alertness, trying to avoid exposure to white noise, pink noise or brown noise for extended periods of time, for more than an hour or so, that might actually be damaging to the auditory system. And at the very least, is kind of stressful, even though you might not notice it, it's kind of a background level of anxiety and stress that is not going to serve you well. Rather, if you're going to pursue particular types of sound frequencies consider using 40 Hertz binaural beats, not monaural beats, but 40 Hertz binaural beats done during a particular work about or for 30 minutes prior to that work about. I would not rely on binaural beats all the time, every day, I think that could cause them to lose their potency, just because of the way the auditory system attenuates. And actually you've experienced that attenuation, the mere fact that you can go into an environment where there's an air conditioner, blowing, blowing, blowing, and then it stops, and you feel that relaxation, but you weren't thinking about the air conditioner before, it tells you that your auditory system had kind of attenuated to it and yet it was still impacting your system. You were sensing it, we would say, but not perceiving it. There are other things that you can do to improve your workspace optimization such as standing for half the day, as I mentioned before, but if you're interested in this or you feel like it suits you to treadmill, find a stationary treadmill that you can walk on. I've never tried this before, maybe after this episode, given what

I've read in the peer-reviewed research, and it's pretty compelling, that treadmilling seems like an interesting way to increase alertness and cognitive performance. I'm not sure that I would do the cycling method because I can't imagine just cycling and typing at the same time, that sort feels like, like I actually can do the rub here, tell me pat your head kind of thing. But it still feels like a little bit of a sort of a cognitive motor collision for me for whatever reason, but that's just my bias. I do know how to ride a bicycle, but anyway, you pick your preference. Some other things that you could do in order to improve your workplace performance would be to consider the cathedral effect. If you're going to do analytic work for any part of the day, phase one or phase two, as I described them, but really in any time of day, that detailed analytic work for which there is a correct answer, learning scales of music, learning mathematics, trying to figure out the solution to a problem where there is indeed a solution. It could be an interpersonal problem as well, then try and get into an environment with a relatively low ceiling. If you don't have access to a low ceiling environment, you might consider using a brimmed hat or even a hoodie, or even just facing down, or even putting your hand above your eyes, as you will, at the level of your eyebrows. In other words, lower the ceiling, that's the basis of the cathedral effects on analytic performance. In contrast, if you're interested in doing brainstorming, creative work, you're writing new things, you're creating new things of any kind, artwork, consider getting into a high ceiling or no ceiling environment, or if you're wearing a brimmed hat or you're wearing a hoodie, maybe peel that back. Again, the data within the peer reviewed literature are there to support these sorts of practices. And if you'd like to start layering these protocols, by all means, please do that. There's no reason why you couldn't do one or just two of these protocols. There's no reason why, for instance, you couldn't use binaural beats and try and get into a low ceiling environment to do detailed work a couple times a week, but you could also employ all of these. Now, of course, there are an enormous number of other things that you can do to improve work performance and productivity, and I've talked about those in previous episodes, in particular, in the episode on focus and the episode on motivation, there are supplements you can take that can increase dopamine, for instance. There are tools that you can use to increase your focus, for instance, focusing your visual attention on one location for 30 to 60 seconds prior to entering a focused work about, this has been shown again and again. The work from Emily Bell, that's at NYU in the episode on focus, I cited a number of studies where this has actually been tested and deployed in various schools. Having kids do a focus task where they look at a particular visual target for 30



to 60 seconds, then doing some mathematics and seeing pretty impressive improvement in focus and attention, even in people that have attention deficit, hyperactivity disorder and so on. So there's no reason why you can't and shouldn't combine the sort of practical workspace optimization solutions that we talked about today with the kind of neural optimization solutions that we talked about in the episode on focus and the episode on ADHD and the episode on motivation. By all means, layer those together, that's how you're going to achieve the optimal focus bouts, that's how you're going to achieve the optimal creativity bouts. I do want to acknowledge again, the fact that I realized people are showing up to this challenge of workspace optimization with different budgets, with different constraints. Some people have kids at home, there are a lot of interruption, some people do not. Nonetheless, I hope that the information I was able to provide today will allow you to make subtle or maybe even drastic rearrangements in your workspace environment. There's one other point related to that, that I did not cover and that I'd like to cover just briefly, which is that there's nothing to say that you have to always work in the same location all the time. You can move from house to cafe if that works for you, you can move from office to home, you can also move from different locations within your home. I have a brief anecdote about this. I used to attend a lot of scientific meetings when a lot of scientific meetings were in person, and there were always a few individuals that seem to stay engaged throughout these very long meetings. And we're talking seven, eight hour day, sometimes evening sessions, and sometimes these meetings would go on for, four or five or even six days. These are long meetings and the quality of talks vary tremendously, and I always notice the individuals that manage to stay engaged and awake for the entire meeting. And I noticed that people that could maintain high levels of alertness in this one conference room had a habit of moving to a different seat after each session, sometimes even between talks. And I actually discussed this with one of my colleagues who was doing this, I said, is this conscious, are you always moving from place to place? And he said, yeah, if I just stay in one place and I just look from this one particular visual angle of the screen, I find after one or two talks, regardless of how interesting the talks are, that I start take on of draft, my mind isn't as engaged and indeed, sometimes can fall asleep. And so I started this practice of moving from space to space, or I should say, seat to seat within an auditorium and it works quite well. And I think it works quite well because again, of the relationship between our visual system driving the majority of our cognition, our visual system drives our thinking and that novel visual environments are going to lend

themselves to heightened levels of alertness. Now, you don't want things to be so novel and scary or threatening or anxiety-provoking or loud that they draw your attention away from your work. But I think this is part of the reason why turning on music or moving to an office or a cafe or an outdoor environment from an indoor environment or vice versa, maybe even within a single day, can bring about more heightened levels of productivity. I'd also like to acknowledge that what I covered today is most certainly not exhaustive for all the types of workspace optimization tools that one could create. For that reason, I'd love for you to suggest any of your workspace optimization tools that you found useful. Please put those in the comment section on YouTube, that would be the best place than other people can see them. Also read through those, and perhaps in a future episode,

01:39:36 Zero-Cost Support, Sponsors, Patreon, Instagram, Twitter, Thorne

I'll call about some of the ones that I've tried on the basis of your suggestions. If you're learning from, and are enjoying this podcast, please subscribe to our YouTube channel. That's a terrific zero cost way to support us. Also on YouTube, you can put comments in the comment section, so give us feedback. You can make suggestions for future guests that you'd like us to host on The Huberman Lab Podcast. And in general, you can ask questions. We do eventually read all the comments and they do influence our future content. Please also subscribe on Apple and/or Spotify. And on Apple, you have the opportunity to leave us up to a five star review. Please also check out the sponsors mentioned at the beginning of this podcast episode, that's the best way to support the podcast. We also have a Patreon, it's [patreon.com/andrewhuberman](https://patreon.com/andrewhuberman), and there you can support the podcast at any level that you like. We also have an Instagram and a Twitter account, it's Huberman Lab, and there I teach neuroscience and neuroscience related tools. Oftentimes that information and those tools overlap with themes on the podcast, but sometimes they are distinct from themes and topics covered on the podcast. So please follow us on Instagram and Twitter. This episode, we didn't talk too much about supplements, but on many previous episodes of The Huberman Lab Podcast, we talk about supplementation and while supplementation isn't required or great for everybody, some people do derive tremendous benefit from supplements. We talked about supplements for focus, for sleep, for creativity, all sorts of things. If you'd like to see the supplements that I take, you can go to Thorne, that's [T-H-O-R-N-E.com/U/Huberman](https://T-H-O-R-N-E.com/U/Huberman), there, you can see the supplements that I take, you can get 20% off those supplements.

And if you navigate deeper into the Thorne site, through that portal, Thorne [thorne.com/u/huberman](https://thorne.com/u/huberman), you can also get 20% off. Any of the other supplements that Thorne makes. The reason we partner with Thorne is because one of the major issues in the supplement industry is that many of the supplements out there don't contain sufficient quantity, or they contain too much of a given supplement. And the quality of the ingredients can vary tremendously. With Thorne supplements, there is immense stringency in terms of the quality of the ingredients and the precision of the amounts of those ingredients that they include in each product. Once again, thank you for joining me for this discussion about the science and peer-reviewed literature on workspace optimization. I hope some, if not, all of the tools will be beneficial for you, and as always thank you for your interest in science.