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 I have the pleasure of introducing Dr. Samer Hattar as my guest on the Huberman Lab Podcast. Dr. Hattar is the chief of the section on light and circadian rhythms at the National Institute of Mental Health in Bethesda, Maryland. Dr. Hattar has many important discoveries to his name. He was one of a handful of groups that discovered the light sensing neurons in the eye that set the circadian clock. This was a fundamental discovery made in the early 2000s that has led to an enormous number of additional discoveries on how light regulates our sleep, our immune system, our mood, mental health, metabolism, feeding, and many other important processes. If ever there was somebody who understands how all of these processes interact and can inform best practices for our daily behaviors, it's Dr. Hattar. During our discussion today, Dr. Hattar answers questions that are absolutely essential for us to know about our health and well-being. For instance, how to align our sleep schedule with our activity schedule such as exercise and how to align light activity and exercise with our feeding rhythms. He presents a new model of how light activity and feeding rhythms converge to support optimal health and when those are not aligned correctly, how our mental and physical health can suffer. It's a discussion that is rich with scientific mechanism, made clearly, of course, so everybody can understand, as well as specific protocols to deal with shifts in day length, shifts in activity, and in order to optimize sleep, metabolism, and well-being of various kinds. I learned so much from Samar as I always do, he is an absolute wealth of knowledge on all things related to light and circadian rhythms, physiology, and neuroscience. I don't think you'll find anyone else as knowledgeable about these topics as Samar, and so I'm delighted that he joined us here on the podcast to share this information. 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 to bring zero cost to consumer information about science and science-related tools to the general public. And now my conversation with Dr. Samor Hattar. Samor, thanks for sitting down with me. My pleasure. Yeah, we go way back. So you are best known in scientific circles for your work on how light impacts mood, learning, feeding, hunger, sleep, and these sorts of topics. So just to kick the ball out onto the field, so to speak, how does light impact the way we feel? So when I get up in the morning, I have the opportunity to interact with light in certain ways or to avoid light in certain ways. I have the opportunity to interact with sunlight or with artificial light. Maybe you could just weighed us into what the relationship is between light and these things like mood and hunger, etc. Sure. So I mean, you do appreciate the effect of light for vision. So when you wake up in a beautiful area, beautiful ocean, light is essential. The sun rise, the sunset, blue sky, beautiful mountains. So that's your conscious perception of light. But light has a completely different aspect that is independent of conscious vision or image forming functions. And that's how it regulates many important functions in your body. I think the best that is well studied and well known is your circadian clock. And the word circadian comes from the word circa, which is approximate and DNA is day. So it's an approximate day. Why is it an approximate day? Because if I put you or any other human being who have a normal circadian clock in a constant conditions with no information about feeding time, about sleep time, about what time it is outside, you still have a daily rhythm, but it's not exactly 24 hours. So it will shift out of the solar day because it's not exactly 24 hours and hence the name circadian. So just to ask a quick question about that, when you say you have this to us about 24 hour rhythm, how does that rhythm show up in the tissues of our body? Great. So great question. So it shows up at every level that we know we study, it shows up at the level of the cell, it shows up at the level of the tissue and it shows up at your behavior. The most obvious for you is your sleep wake cycle. You sleep and your awake and sleep at the 24 hour rhythms. And if you measure the sleep wake cycle of a humans who are maintaining constant conditions, you will see that the period length of the sleep rhythm on average is more than 24 hours in humans is 24.2 hours. So you'll be drifting 0.2 hours every day out of the solar day if you don't get the sunlight. So the sunlight adjusts that approximate data and exact day. So now your behavior is adjusted to the light dark environment or the solar day. So if I understand correctly, if I were to go into a cave or I were to be in constant light, and I didn't close my eyes in constant light, that I would still sleep in one coherent bout. Yes. And I would still be awake from more or less one coherent bout maybe a nap. But the total duration of my day, so to speak, would be a little bit longer than 24 hours. But if I'm in in a condition like most people are where the sun goes up and the sun goes down and I have some understanding of that sunrise and sunset. You don't have to have the understanding, you don't have to have conscious understanding, you have the detection. So circadian photo entrainment is the word we use in training the circadian clock to the photo environment is completely subconscious. You're not aware of it. It's not like vision where or image forming where you actually know what you're looking at. So it's all hypotelamic. It's part of the brain that is not consciously driven. So you actually do not know when it happens or when it doesn't happen. And that what we'll get into when I tell you why light affects your mood and why sometimes people don't know how to deal with light to improve their mood, for example. So this is a subconscious vision. Yes. Okay. Before you tell us about how light impacts mood. I'm curious, what is the relevance of adjusting this clock from a little bit longer than 24 hours to 24 hours. I mean, it seems like a small difference 24 hours and 40 minutes or 24 hours. Like what what's what's the relevance? I mean, why should we care about that short difference? So let's do the math. If you shift out point two hours a day in five days, you're shifting out one hour. So you're literally one hour off in your social behavior in five days in 10 days, you're two hours off. And if you're an organism that is living in the wild, shifting out of the right phase of the cycle, you could either miss food or you could become food. So it's really essential for survival. I think it's one of the strongest aspect of survival for animals to have the anticipation and the adjustment to the solar cycle. And for humans as well, when you say animals, I'm assuming that applies to us. Yeah. I see. So even though it's just a short bit longer than 24, if you, if that accumulates over days, then you could find yourself very much out of phase with the rest of your, your species. Yeah. So let's say it's point two hours. So in five days is one hour in 25 days, it could be five or six hours. You could be in New York and you're feeling as if you traveled from New York to London. So you will be having jet lag in New York, even though you didn't do a jet lag travel. So it's very important for the adjustment. And if we have time, maybe we could talk about why this is important for seasonality because also it allows animals to anticipate the change in season and the more you're high in the north or the south, the more that these weather changes occur very harshly and you have to be ready for them. And that happens in us as well. We will definitely get into seasonality. Okay. So we've got this subconscious vision that aligns us with the turn of the earth. How does that work? What's the, what is the, the machinery that allows that to happen? And how does that machinery work? Yeah. So we know we knew that in mammals, including us, we are mammals humans that the eyes are required for this function. So if humans are born without eyes or the optic nerves are damaged, humans are not able to adjust to the solar cycle. So we know that the eyes are required. And since we thought we knew about the eyes a lot before 2000, we thought that before the year 2000, before the years 2000. Yes. We thought it's these photoreceptors in your retina that allow you to see. So in the human retina, there are two types of photoreceptors. They are called rods and cones because of their shapes. And these rods and cones simply take the photon energy, which light is made off. And they change it in a way to an electrical signal that allow us to build the image of the environment in our courtesies subconsciously consciously in this situation because this vision, right? This image forming vision, it's a, it's a visual cortex and association associative courtesies, which allow you to build conscious perception of the environment. However, people have found, including me with the work of David person and Ignatius prevention that there is a subset of ganglion cells. The ganglion cells are the cells that leave the retina, their axon, leave the retina and project to the brain. So these words are stored to only relay rod and cone information from the light environment to the brain. We found that a small subset of these ganglion cells are themselves photoreceptors that were completely mess in the retina. And these are the photoreceptors that relay light environment subconsciously to the areas in the brain that have and house the circadian clock or the circadian pacemaker, which adjust all the clocks in our bodies to the central brain clock that allows them to entrain to the 24 hour light dark cycle. Incredible. So in the year, as I recall, because I was a graduate student at the time in the year 2000, there was this landmark discovery made by you, you could prevent CO David person and others that these cells exist that can communicate day and night information to the brain. Yeah. And this very small subset of cells. Since then, I've heard, but maybe you can confirm or refute that this system that connects the eyes to the rest of the brain is actually the most ancient form of vision that this is probably the form of vision that some early version of human beings had before they had pattern vision before they could see colors and shapes and motion and all that. And that the same cells that perform this role are actually similar to insect eyes. I think I heard David person say once that we actually have a little bit of the fly eye in our eye. What's he talking about? Yeah. So it's really interesting actually because these same IPRGCs we discovered they contribute a little bit to image formation and now work from to finish meant specifically have proven that they do contribute to image forming functions. But they contribute to very limited aspect of image formation. So it fits your hypothesis that these are an ancient photoreceptors. The other thing that adds to that hypothesis is that they are expressed in cells that don't have any modification that make them look like photoreceptors. So the photoreceptors that I told you about that are important for vision image formation. They have very specialized structures that allow them to pack these structures with photo pigments. These are the photo detecting proteins. So they could detect a high sensitivity of photons that pass through them. These IPRGCs don't have these new photoreceptors don't have these specialized structures. So they just really need a lot of light at the time we thought they need a lot of light to be activated. So that's why we think they are ancient and that's why you think they adjust to ancient functions that are as important as regulating your body circadian clock to the solar environment to solar day or to the light. So you mentioned IPRGCs intrinsically photosensitive. So these are cells that connect the eye of the brain that behave like photoreceptors essentially. And then you mentioned melanobsin which is the actual pigment that converts the light into the electrical signal more or less. And my understanding is that melanobsin was identified first in frog melanophores. So does that mean that we have like little pieces of frog skin in our eyes? So honestly, David person say you have a fly in your eye because it sounds better. The more accurate I think is that you have a frog skin in your eyes. It's not as catchy. But really melanobsin really the name melanobsin is from melanocyte opsin. So it's melanobsin because it was found in the frog melanocytes. You know the frogs can change their color depending on light. And melanobsin drives this response. So when Ignacio prevents you first discovered these options in frogs. Luckily he was smart enough to see if they are expressed in the frog eye. They were expressing the frog eye and it what appears to be retinal ganglion cells which I told you the one that connect the eye to the brain. He had the insight to go and see if they are expressed in the monkey eye and he found that they are also expressing what appears to be retinal ganglion cells. And really that what opened the field wide open then David person did the seminal experiment where he went to the brain where the central oscillator the oscillator that drives her cadium rhythm in the brain called the supra-chasmatic nucleus that has been known for many years to receive retinal input. And he labeled the cells that project there and then he found that even if you destroy rods and cons you could get light responses from these cells. So you could imagine he nearly fainted when he saw that these cells can respond independent completely in the absence of rod and con input. I'll never forget reading those papers in 2000-2001. I was at the meeting in DC when Iggy showed Ignacio Iggy we call him Iggy showed this image of this basically what is frog, melana forest in the human eye. I want to get into how light actually can control circadian rhythms. But I think it's worth mentioning now that people who are pattern vision blind so people who cannot see and no conscious vision. But have eyes many of them still have these cells these melanobs and intrinsically photosensitive cells and can essentially match or in train as we say onto the light dark cycle. In fact they possibly have no problems in circadian photoentrainment they'll have a normal sleep week cycle but they're totally blind but they are totally image mind and what's really interesting is that. And this story I heard from track size learners I'll give him credit that some of these people who are image blind usually they get dry eyes and they give them a lot of pain and doctors used to think oh since they are image blind and they're getting dry eyes why don't you just remove their eyes they're not using them anymore. And the minute they would remove their eyes they start having cyclical sleep problems indicating that now they are not in training to the light dark cycle and are having cyclical jet lags when their clock shifts through the light dark cycle. That's really interesting and I hear from a number of blind people you know in my various aspects of my job and they a lot of them have issues with with sleep I think in part because they don't realize that they too need to see light at particular times of day or not. Absolutely. Well I think that's a perfect segue for us to talk about how light and viewing light can impact our sleep wake rhythms and then we will move into some of the other ways in which light can impact other forms of bodily function. Yeah so I love the way you set it up because one of the most interesting and difficult aspect of trying to educate people about light effect on subconscious vision is that it's subconscious. So we're all aware of what we think is intensity because we see the room but you know if you talk to people who know how to take photographs and stuff like that they know that the intensity is varies greatly but our system because we have to see the same way in very bright colors. We're not very good at estimating intensity consciously so when you try to tell people about intensity you really struggle because they think they know intensities but they really don't you mean light intense light intensity so so that the cones themselves have an incredible ability to adapt to different light conditions. And see at all different conditions otherwise it'll be a disaster you know if you don't change the the setting on your camera and you go from inside the room to the outside it becomes completely white you don't see anything so if your cones don't adapt to the environment. Then you're not going to be able to see in this room and in on the beach right. But the problem is your your IPRGC is the cells that we talked about they measure intensity pretty well they really know what intensity is they have a very good linear measurement of intensity they don't adapt as well they don't adapt actually that much to be honest. So that tells you that subconsciously the system is used to measuring light intensity in a natural environment because when you're on out in the natural environment you don't have you know industrialized lighting then you you know your system is functioning very well but now when we change these environments we could really mess up ourselves so you have to teach people how to understand intensity. And that's something that you have to explain to people and I think I love to do it myself I do it in what is called the lowest amount of light required to allow you to see comfortably so you have to do this as a fun experiment. Okay so explain to me how this goes and maybe we could break it up in the day into three or four parts so let's say assuming that most people wake up in the morning as opposed to night shift workers etc we could talk about later but wake up in the morning. So let's divide the day in the quarters what is what is the proper way to interact with light in the first part of the day. So I honestly think the easiest thing is waking up get as much light as you can. It's your eyes. Yeah it's really nice your system is primed if you're in train is primed to get light the sun should be out most animals in the world they actually seem to track the sun. The sun has a huge influence on life on earth is actually life on earth is because of sun so that's easy in the morning when you wake up you need light. Okay so what is the behavioral practice that you recommend does it let's say somebody is in a condition where there's a lot of cloud cover yeah is it important to get outside. So I have to tell you the cloudiest days going to be much more brighter than your room you could ask any photographer a cloudy day unless it's really dark dark clouds usually cloudy days have much more bright outside than inside the room even when you have good lighting inside the room. So I think in the outside is usually even when it's cloudy you're going to get enough intensity to help you adjust your cycle to the day night cycle. So how how long do you these are general rules of thumb but how long do you recommend people go out so if you do it daily you possibly need very if you do it daily because you remember this thing is going to happen on a daily matter so it's the clock is tracking it on a regular. Absolutely it's it's spot on counting is tracking. I would say 15 minutes if you don't do it daily you may want to increase it and we'll talk about when you travel what you could do but but yeah 15 minutes should be fun you do it more it doesn't hurt. And through a window I was my understanding is that through window it dramatically decreases the amount of light energy it depends on how you know how thick the windows are and how dark they are so it's but it's also nice to go outside and to feel the season sunglasses off. I don't use sunglasses. You have the Jordanian for pigment you know so yeah whereas my eyes are very sensitive right now so I will but I personally you know if I'm in the shade or if it's not incredibly bright I tried to especially in the morning but I'm also an early person so we have to differentiate between early and you wake up I wake up at 4 30 in the morning and it's not out yet so what do you do you turn on artificial lights I usually don't turn on artificial light because I know the sun is going to come up eventually but that's why I don't like the change in the timing that they do do you wait what do you do between 4 30 am and 7 am I mean I just got my computer I can't see so I get enough light but but in reality I mean as long as you let your body get the morning sunlight which I think is really to me and I there's no evidence but to me this is if you look at all animals plants this morning sunlight seems to be very important and I you know we don't have experiments to show it but I have got feeling that it has a huge impact on humans well Jamie Zyzer's lab at Stanford sleep I was shown that these early morning light flashes can adjust the total amount of sleep that one will get makes it easier to get it absolutely okay so and and can write also did this beautiful camping experiments that should maybe you can describe those because those are beautiful experiments he took these you know college students that had a late onset of sleep and late waking time and then he said let's go camping and just don't use any artificial light and you could go to sleep as as as late or as early as you want and wake up as late as early and he found a huge shift in their sleep pattern just by exposing them to the light dark cycle I mean so in it lasted and it lasted even after they came back two days of camping reset the circadian but it lasted yeah it's pretty amazing yeah it's really incredible okay so get bright light of some sort early in the day ideally sunlight even on a cloudy day it's going to be brighter than indoor light okay so then and the other thing that I would like to mention to people if you think it's very dim outside let's say it's very cloudy stay longer so remember intensity is only one component duration is also important because remember that the circadian system is not like the image system in the image system you have to change every second because you're looking at different objects you have to change your perception but for the circadian system is trying to figure out where am I in the day night cycle so the more you give them the information the better you are so if it's very bright you don't need a lot because it's clearly going to make you fire like crazy but if it's not bright stay longer stay for one hour you know have your coffee outside or something like that it's just going to help I think you said something extremely important which is that this circadian system is trying to figure out when you are in time exactly not where you are in so I said where you are in time when you are oh no no I wasn't correcting you I just meant that I think fundamentally that's the incredible thing about the system that you have this clock this 24 hour clock in your brain but it needs to be synchronized to the outside so could we go a little deeper into this circadian setting behavior and come up with some general rules of thumb so let's say it's a very bright day extremely bright no clouds suns out you said 10 minutes 15 minutes and I'll tell you if you're sensitive don't you don't even have to go in the sun you could be in the shade there's going to be so many photons out there in the shade is going to be perfect you don't even have to see the sun you don't have to have the sun you know it's great for vitamin D that's a different story you could do this for your skin and you know protect your skin that's not my area of expertise but for that effect on the circadian system as long as you're outside in the shade and it's sunny day 10 to 15 minutes should be amp amount and then let's let's say it's kind of overcast you know it's not particularly brighter there's you know solid cloud cover but you know the obviously the sun is out but it's not as bright how long do you think it would take to set the clock 10 to 15 should be sufficient stay for half a number say for 45 minutes if it's very dark cloud yes stay for longer OK and if for some reason one finds themselves very far north and it's very very dense cloud cover how long and at what point should somebody consider using an artificial light source to mimic the sunlight. Yeah honestly this is where we don't have a lot of information still because this is where we're going to discuss this maybe in more detail that if you put humans in artificial conditions the circadian system is very sensitive to light. But in reality in the real environment light also is affecting other aspects that are independent of the setting of the circadian base maker OK and these which we call the direct effect of light on mood for example so that is very hard to figure out what intensity you need to use and we haven't done enough experience because the system has been discovered just recently. But I would say if you use bright light in the morning and I mean it's hard for me to give numbers can get complicated. But yeah I mean if you're honestly if you're that far north and you're in the winter and you want to get make sure you don't use these light boxes I would suggest that personally but that's is. I use it's actually not designed for circadian setting but I have a 930 lux light pad that I bought and I bought it they're very affordable compared to the dawn simulating lights which are quite expensive frankly and I put it there and so I just basically when I wake up in the morning I use that until the sun comes out and then I make sure once the sun is out I go outside but I keep that thing on all day. And I don't know if that's good or bad is a good or bad I honestly I don't think being exposed to bright light in the days going to ever be bad because really if you're outside in the day unless you know the worst going to happen if the temperature is very high your body is going to say don't dehydrate and go to sleep so you could tell actually sometimes when it's very hot the more you get exposed to bright light the sleepier you feel in the afternoon which is counter intuitive. So you that's the product as you think against dehydration I think if you think about the human evolution from near the equator in them between noon and certain time in the afternoon it would have been very hard for you to maintain physiological homeostatic function being active at this very high temperature time so I think napping was away that's why I think it has a major function which is still napping was a way to somehow take you away from that dangerous zone of light. And maybe that's why people in the north they say in the winter we can't wake up in the morning because they don't have this long light so they sleep it more at night but in the summer they say we feel like we can go to sleep we have to put all these dark curtains. So I think you know venturing that up that much north up north has been came up with problem because evolution was used to a certain light environment that was completely changed with a human with other animals. I think that lived there longer they have come up with very interesting adaptation of actually measuring even very small changes in the light in the light intensities that still occur. So even if you're near the poles even though it's always light but there is a change in the light intensity across the day and I cycle so your system if it's linear and remember I told you that IPRGCs are incredibly linear can still measure all this is lower light than higher light. If the organism has that ability to do that see it's interesting I've spent so much time learning from you fortunately about these cells and yet I never really appreciate it until now how on the one hand they are tracking the amount of light to understand when we are in time relative to the 24 hour cycle. But also that you keep mentioning this this linear measurement of intensity that they really are trying to figure out when we are in time by measuring the intensity of light and of course the sun is the most intense source of light available to us. So okay so I think we've nailed down that first part of the day. Basically it's get 10 to 30 minutes depending on how bright it is and trying to do that as often as possible to give the system a regular. So you don't have to worry if you missed it one day you know stay longer if you want but if you're in a hurry and you want to do other stuff that's a greater command. So you're really jet lag without traveling absolutely simply by staying in being on your phone too much not getting the sunlight and you saw this during the pandemic lot of people mentioned that their sleep wake cycles suffer the bot. Because if you're not going out and if you're staying at home and you don't have big windows and you're waking late waking up late and then you're using very bright light to late at night your body is going to shift and now your day is going to start instead of like really when the sun comes up let's say at six o'clock in the morning it's going to start at 11 o'clock in the morning that's what your body is going to think is the beginning of the day. So then you're not going to be able to sleep at 10 o'clock at night because now that's really for your body is completely different timing and you could see this happen during the pandemic at a very high scale people get delayed in their sleep wake cycle a lot. There is this idea of chronotypes that we all each intrinsically have a best rhythm of either being a morning person you call yourself an early person or a night out or more of a kind of standard you know to bet around 10 30 up around seven type thing and the and I think there are now good data correct me if I'm wrong. From the National Institutes of Mental Health and elsewhere showing that the more we deviate from that intrinsic rhythm the more mental health issues and physical health issues start to crop up so there is great data on this and there is couple of things that complicate this the first is the people who usually are late they tell you that the society doesn't accommodate what let by late what do you mean people that wake up late and go to sleep late and wake up late they you they have an overwhelmingly higher level of depression and failures I mean clearly I mean the reason the people say sleep early wake up earlier better because human notice that people who wake up good sleep early and wake up early they do better in life they notice that they just perform better they perform but the question is is is that intrinsic to the system or is that society because society start things usually early only that's a hard question to discriminate against late rise in a way we discriminate right but the other explanation is can rights experiment these these late riser if they were truly chronotypically late why would they shift so easily when you put them in the like if you were really chronotypically late and there is a race relation between the light dark environment and your circadian clock then doing this camping experiment should not have cause much changes because it's not that you know you light is going to affect you in a certain way is that this is the relationship that your body decided that I'm a late sleeper late waking so I am honestly I'm still I'm unable to figure out how much of this late waking up is controlled by the light environment and how much is intrinsic I'm sure there are differences but are they as big as we see in the environment because you have people that go up sleep a seven p.m. and wake up at 1 a.m. these are clearly advanced face so people that go to sleep at 7 p.m. and wake up at 1 a.m. and feel good doing that I'm not so sure they feel good but a lot of the time you talk to people they say they are high achievers but they suffer because you know they wake they go to 7 p.m. wake up advanced face sleep syndrome they call it they call it a syndrome but you know but then you have people who would not be able to sleep till 5 a.m. and and not be able to wake up till 3 p.m. right and I'm not so sure that the circadian system is that variable in the human population I mean clearly there are maybe some genetic factors that make a small percentage of like everything with a bell shape but I think most of the time the light environment make play a role and once as you as we've talked about this is a long term effect of light once you get into rhythm and I don't mean it as a pun in reality once you get into rhythm it's hard to break out of that rhythm because if you start sleeping late and waking up late you're not getting the morning sunlight right and so you're just going to be late and if you like me waking up early you're getting the morning sunlight you're getting what size to set a I said his last name wrong. The one in Stanford who did that the Jamie's eyes yeah he actually worked for. Isle is a zi's are in size yeah there are a lot of ZZ's and eyes in those in their names yeah both phenomenal scientists yeah what what it seems to me is the case is that the only way to really know if you're meant to be an early bird as they call it an early person or a late person or somewhere in between is to get morning sunlight and figure out whether or not that makes you feel better and to understand to be educated about how to measure intensity how to measure I put it between quotation because you either get a measuring device but you cannot depend on I have on your eye to measure in because how do we do that because you keep coming back to this so I that tells me that's important it's obviously so there are apps like free apps like light meter where you can walk around and hold the button down and see how many locks. You know are in these are complicated because you have to point them to specific reason so so how how do people start to develop an intuitive sense of the measurement of intensity yeah I think at one point I posted on Instagram how I keep my nighttime at home and I found out that my night vision is very strong so I found that that I especially in the winter I only need candle light so I literally use these T lights and I put like 15 or 20 of them are romantic and it's so nice I could see it clearly doesn't affect my sense of your cat and my wife and wife just it's just great right but I don't expect people to have the same night vision as me so the simple I mean I tell people do the experiment so if you put three or four lights in your room switch to sit for 15 minutes switch to switch to off let's say you're using five and see after 15 minutes you will not recognize you switch these two off my feeling is that most people would need at least 10 times less light than they use at night to see the problem people use it because most of the time they didn't see the morning sunlight they are actually hungry for light without their knowledge so they come switch all these lights on but at the wrong time because they walk up late OK now now I understand so this morning light viewing goes way beyond absolutely setting your clock it's also a way to determine how much how little light you need later in the day and we and we're going to talk about this in a moment but how little light you get later in the day is a very strong determinant of things like when you wake up whether or not you wake up feeling refreshed et cetera let's let's not that's why yeah I'm going to break it on the screen and I'm going to tell you I think there is something else that people need to think about which is the tripartate model that this model incorporate three components which we talk about in details that allows us humans and all animals to incorporate the circadian clock and its the homeostatic drive and the direct effect of the environment which includes stress light all kind of stuff they have to be incorporated together if you think that's what I think right now if you think of one alone you will always miss something and when you think of them as a whole things really become clear it's actually quite amazing we will definitely want to hear about your tripartite theory and and go into detail about this homeostatic mechanisms I want to make sure that for people who are thinking now I'm sure about light and how it impacts them so the morning light viewing behavior I like to think we've tacked down clearly and thank you for that because there's so much information out there and I've tried to relay that information of course you're my primary source for all things circadian as well as Jamie and others of course and that walker but I think you've made that very very clear now let's say I've gotten my morning sunlight okay I made my bright artificial light and throughout the day you said to get a lot of light so I'm working at my desk maybe I'll I'll go out during the day a few times but I'm working at my computer I'm doing things is there anything about light viewing in the middle of the day that people should keep in mind or can they just sort of freestyle it depending on what they're doing most people are not you know in a dark room yeah throughout the day my gut feeling if you got your morning sunlight you walk from your car slowly or you walk to work you didn't wear sunglasses when the lights were still dim in the morning that you could freestyle it that even if you don't get a lot of light there is a way to just you know in the day you don't have to just worry about getting a lot of bright light but personally I like to do that so I go out at lunch and and have my lunch outside as well this reminds the body that here it is even brighter now but the evidence is that you could literally help your circadian clock by giving lights at dawn and dusk but again if you think of the tripartite model this may be important but circadian clock but is it important for your mood so that's where I think you need or the home you static drive so that's where you need to think about it so for the clock for entraining your clock you literally can't entrain it only by the dawn sunlight you actually don't need dawn on dusk and I appreciate that you're distinguishing between circadian effects and other effects of light you're being very precise which is appreciated until we hear about this tripartite model which we will cover for the sake of the discussion let's treat the light viewing behavior as what are the benefits or drawbacks of viewing light for all biological purposes not just circadian settings in the morning it's clearly going to set the clock and then during the day if I understand correctly the idea is to get as much bright light as you can because you're feeding it sounds like a sort of light hunger exactly I love this way to put it I think there is a weird light hunger considering that we're not photosynthetic organisms there is a weird light hunger in animals that they need to measure they need they need measure and I think that relates to the season the whole reproduction cycle of animals going to depend on the availability of food in the environment and if you don't know when the season is going to happen they don't have calendars it's going to be very hard to survive so I think that's why we have this light hunger that's a major hypothesis it's not being tested interesting so then afternoon and evening start to approach so I've had this weird experience maybe you can psychologically or biologically diagnose me now Sam or so where if I go into a movie in the afternoon like a matinee and I come out and it's dark I notice a significant drop in my mood and my ability to go to sleep whereas if I get some view of the light in the evening doesn't have to be the sunset although sunsets are nice but I get some light pulse in the afternoon that I have no trouble whatsoever and it happens in a daily on a single time to watch them more or less that's interesting and then you mentioned the camping experiment where when they went camping they're seeing the sunrise and the sunset so what should people do in the afternoon slash evening time in terms of their light viewing behavior I mean the best thing to do is to let the natural light creep in into darkness right that would be the best but clearly that would be inefficient you you want to go home you want to read you want to talk to your kids you want to talk to your family so I think you know it's nice to extend the day I don't think that's wrong if you somehow can block that light from affecting your circadian clock so should people use blue blockers in the evening I personally do not like any blockers that take a single wave length of light because again if you think of a holistic holistic approach yes the blue blockers going to prevent you from affecting your circadian clock very much but then your vision is going to be distorted because we always see in full spectrum the sun has this beautiful spectrum right and then when you start seeing without the blue things look yellow and it can't get really weird right I mean so I personally I've tried the blue blocker and I couldn't even wear them I thought they were just really horrendous to be honest well along the lines of blue blockers I think a lot of people mistakenly wear them all day long oh my god that would be very good a lot of people do that a lot of people do that they think that the blue light is bad I think that the concept of blue light being bad led to a lot of product development and a lot of people are just assuming that viewing blue light is what was giving them headaches when in fact it might have just been looking at screens at close distance so here is the problem right I mean the blue light got the bad reputation because people who gave a pure blue light showed that it goes a huge retinal damage but again if you're using blue light in its pure form it has a lot of energy because it's shorter wave length but we're talking about full spectrum light there are ways now where you could change the spectrum of the light and keep it white between day and night and change the content of the color without you noticing so you don't even have to affect your vision so how would you go about doing that so you just lower the level of the blue light you don't have to eliminate it so just dim the lights dim the blue but keep then increase the yellow but keep all the colors in a certain white so you know you could have different warmness of white and people know how to do this physicists know how to do this people who work with light know how to do this well maybe somebody in the wellness slash I don't like the word but biohacking or optical community will do this I think it's a really important I see so many people were really long I don't know why why they love well I think they're just uninformed I think frankly and to be honest it's easier right it's easier to explain to somebody if IPRGC's respond mostly to blue remove blue you'll be fine right but that's not as simple as that because they also receive road and coin input so you want to actually and you know we could go into details that's boring for your listeners but it also affects the adaptation properties of the whole retina so you don't want to do something so drastic that you take just one color of the spectrum it just seems very counterintuitive to me to be honest you've told me before as well that just because these intrinsically photosensitive circadian setting ganglion cells respond best to blue light if the light is bright enough because they also get input from other components of the eye it doesn't matter if you block the blues if you're looking at bright light at night you're going to disrupt your circadian absolutely and that's why I didn't want to go into the boring details but themselves the photo receptors have a wide range of responsiveness so they are most sensitive to blue light but that doesn't mean they don't respond to green light or to shorter than blue light they respond to very very wide spectrum with different sensitivities so unless you understand the system just removing 480 things going to do it in your brain so your home is a cave at night basically with some it's a nice cave with candles and you and your cat and your lovely wife I know who's also a phenomenal scientist in her own right she is and but you do keep your home quite dim to dark at night in fact I did go to meetings with some of my friends who work on this and they really struggled with me they said we could have broken our legs living in the same light environment that you do so I am an extreme but I measured it for myself and I asked Réjie my wife if she's okay with it she also liked the dimness both of us can see well in dim conditions and that helps us a lot but I think you have to measure it for yourself really have to do it's a very simple experiment just try to dim the light as much as you can I call it the minimum amount of light you require to see comfortably and that's how you want your environment at night this is what I think is the game changer if you reach to a level where it's just barely you're literally on the cusp of seeing uncomfortably versus seeing very comfortably you are going to be very much better than I don't like to make it completely dark I think complete darkness induce anxiety in humans to be honest so I don't like complete darkness kids don't like complete darkness they like a night light even nocturnal animals don't like complete darkness I mean we have studies in animals that are nocturnal that if you put them in complete darkness for several weeks they have severe anxiety and depression like effect so keep the light dim you know use red light that is very dim if you want to keep the room for sleeping red light that is very dim has very small effect on on on circadian clock and below 10 locks of red light literally doesn't affect sleep at all so there are ways to do it it just we need to educate the public and I feel like you literally need a whole lecture to just explain to the people how to deal with light because it's not as simple as people think well that's what we're doing here we're stepping through a piece by piece and the reason we're doing that is because it's not as simple as saying just block blue light or get a lot of light during the day and just put it in perspective tell it we only have three different cones in our retina that respond to three different colors we call them red cones for simplicity green cones and blue cones yet we have only three of these but we could see massive palette of colors so that tells you something if the system was just simply about a single color and it's just removing 480 or just blue is sufficient then we should only see in red yellow and blue we shouldn't see all these different hues of color but because the system is not that we see all these different colors and that's why it's important to remind people that the white light is made of many different colors it's actually like the rainbow that's why you see the rainbow it's made of many colors white light is never truly white it's made of a lot of different colors it's like the pink Floyd album cover exactly exactly so dim at night maybe dim red light ideally or candle light find that minimum required light level just make sure when you lower the light sit for at least 10 to 15 minutes let your system adapt because if you had it bright light and you switch it off surely you're going to suffer because your system didn't adapt it it was used to very bright light so you want to engage your rods which take a long time to dark adapt that's why I tell you just wait a little bit don't just switch it off it I don't see put it on put it off sit down wait for 10 minutes ideally 15 minutes and then see how you see and then once you do that you will notice that actually yeah I could see quite well even with much less light what do you do regarding screens? yeah that's that's the hardest thing again I mean there are beautiful programs that change the whole intensity and color of the screen these could help dim your screen at night to the lowest part I mean yes you won't see it when you wake up in the morning but then you can increase the intensity so try to decrease I mean just what we were talking about think of light intensity duration color and time of day you really have to keep these four things together right we've roomed together at a couple meetings from time to time no longer because one of us not to be named has a severe snoring issue that made the other one pseudo homicidal you can guess who that was but I've seen you check your phone after dark once or twice and you did it by sort of putting your phone away from you right and actually I'm sort of half joking but I and you dim it quite a bit I'm sort of half joking but it actually makes sense that you know if you shine a flashlight in your eye it's much brighter than you shine the light on the right direct lines so if you let's look on the side most of the lights is going to go this way and you're on the same screen so you okay so and as silly as that might seem to people listening I mean what it means is that getting bright light in your eyes at night is something that you really want to avoid but there is the reality then and even when I check sometimes if I you know if I have something and I check it so fast and switch it off so fast so I'm also aware of my degrees I'm also aware of the duration right so duration intensity color and time of day ideally I should not check iPhones and iPads I don't use iPad at night because it's hard to lower it enough because it's a huge but even my iPhone I try not to use it at night and like once it becomes a 30 or 9 I don't look at it at all unless it's world cup or euro cup in which case it is on 24 hours every but that's only every four years it's a big soccer fan alright this has been incredibly no pun illuminating let's talk about the relationship between light and some of these other non circadian or pseudo circadian effects and we will try and link those but you had a what I consider absolutely landmark beautiful paper published in nature a few years ago showing that if you disrupt the exposure to light or the timing of the exposure to light that there are dramatic effects on the stress system and on the learning and memory system we could talk about each of those separately or together what are the effects on stress and the effects on learning when light viewing behavior and sleep wake cycles are disrupted so just to remind you you know that but to remind you listeners that I was trained as a circadian biologist so I really was indoctrinated into thinking that light has to affect the clock which then cause all these different effects so that's that's what I believe that's my dogma that's what made me really happy and then Tara Legates and Cara Ultima joined the lab and said we started discussing a lot of data and we said what if there is a direct effect of light that we're missing independent of the circadian clock so this is not an easy question to ask to answer because as we've been talking all along light affects the circadian clock so how could you give light at different times of the day and not mess up the circadian clock? Luckily we came up with such a way and that's why it was important to do this experiment the way we did them and we proved that this light dark cycle does not disrupt the clock there is still a circadian rhythm and does not close sleep, does not go sleep deprivation and yet surprisingly if you give light at the wrong time of the day even without disrupting the circadian clock or without causing sleep deprivation as you mentioned you get a huge mood changes in the organisms and you get learning deficit so this really and at the time people have really hit us hard I mean it was really hard to publish this work and you would yeah well it came out in nature so in the end you prevailed but I want to make sure that I understand so you're saying that yes there are effects of light on the circadian rhythm, absolutely meaning sleep and wakefulness and they're timing however there are direct effects of light on mood that can be dissociated from the effects of sleep and waking so if I interpret that correctly that could mean that when we view light and how much light could make us feel happier or less happy or even depressed, stressed, learning etc Bingo and even if we're sleeping and waking up at the appropriate time Bingo I mean eventually because we're talking about the whole system eventually when you start having the other problems you also develop sleep problems but you're absolutely right and in fact now research from Diego Fernández in the lab have found that now we know that they actually require different brain regions so we don't only have a theory, we don't only have a light environment that showed they can be dissociated we know that they use completely different brain regions so the SCN that I told you about earlier the place where the central pacemaker is the one that received direct input from the retina through the IPRGC to adjust your circadian clock is not the area that receives the light input for mood regulation, it's a completely different brain region what's the brain region called? so the brain region we called it the peri-habenular nucleus I'm not so sure how good or bad the name but it doesn't matter it's the PHB and what's really amazing this region also received direct input from the IPRGC's but projects to areas in the brain that are known to regulate mood including the ventral medial prefrontal cortex which has been studied for many years to be impacted in a human depression so just by this amazing serendipity to find that a region that is so deep in the advanced brain like the prefrontal cortex is your executive brain one of the most elaborated in humans to see that they received input from this ancient photoreceptor was stunning to us and told us how much we didn't understand the importance of light on a human behavior so how does that finding informed daily protocols for you or for other people I realize you can't leap to always from one paper to daily protocols but if light indeed does control prefrontal cortex, executive function, learning, stress and mood and let's say I'm waking up and sleeping, what should I do differently? That's why we came up with the tripartate model because yes we could think about just adjusting the clock with lights in and being dark throughout the day but that may not be important for your whole physiological function so now if we include these other effects of light that's why I prefer to still get a lot of light in the day I don't want to be in very dim light condition throughout the day so even though it doesn't affect your clock as you beautifully said Andrew, it may affect your mood and learning and memory it may affect your alertness level which is going to allow you to learn better it may affect your homeostatic drive maybe your homeostatic factor will go higher so you could sleep earlier so it's important to think of light as stimulating all these brain regions which means it's producing more activity which in reality this is how people think of the homeostatic drive that the more active you are the more the homeostatic drive is built up the better you sleep so that's why we came up with the tripartate model because as a circadian biologist I only thought of light through the circadian clock affecting behavior as a sleep biologist they only thought of the homeostatic drive affecting sleep, affecting behavior and for people who study light for vision and other from they thought only of the environmental input but now if you put them all together you get with this tripartate model where it's really mind-boggling and it makes so much sense the organism doesn't want to depend on a single component but if you could incorporate these three together you could have a beautiful system that is well adapted so let me tell you the sleep wake cycle right so we know there is a homeostatic drive to affect sleep you've had beautiful talks about that which is basically the longer you're awake the more you want to be so that's your homeostatic drive we've talked about the circadian influence of sleep and the fact that light dark cycle affect the circadian system which eventually affect sleep so these two components are well understood now the third factor is your direct light or environmental input how much stress how much light you get from there also can highly impact sleep so even if you have a good circadian and homeostatic drive if you're getting light at the wrong time of the day or if you're being stressed and thinking other then your sleep is going to suffer so you have to think of the three together to have a beautiful sleep wake cycle and that's why we came up with the tripartate model the same thing happens with feeding I could beautifully put it to people your hunger your energy level is measured by the arquit nucleus your daily intake of food is again depending on the CN and light dark input we found that if food is not available there is yet a third input that is not depend on the SCN not depend on the arquit depending on a completely different brain regions so the animal can actually start looking or the human can start looking for food when it scars even at time when they are not supposed to be active so that's how the organism thing they have to evaluate multiple inputs for them to decide what is the best physiological outcome at that moment at that season I say so I want to get into arquit and feeding but just to keep make sure we can you know keep our hands around this tripartite model so if I understand correctly we've got the circadian influence then you've also got the drive to sleep actually one of the ways that I think that can be best understood is if somebody ever pulls an all-nighter they get tired around 11 or 12 or so and then very tired around 3 4 am but then even if you stay up sometimes right around 7 or 8 am your normal wake up time you start to feel alert again exactly and that's because the sleep drive is extremely strong but there's a circadian rhythm that drives wakefulness in the world exactly so that's two of the components before we get into the feeding component I want to talk about these direct effects of light on mood okay Diego Fernandez and this perihubbenular thing so let's just for the moment set aside the tripart of the tripartite model and just focus on what are the direct effects of light on mood and the way that I interpret what you said so far is that the protocol that emerges from this if one is trying to optimize their mood is yes see light view light I should say early in the day in order to set your circadian clock maybe also in the evening as well and of course avoid light at night get it as dim as possible however you said it's also a good idea to get as much bright light during the day as you safely can in order to improve your mood independently of regulating your sleep wake cycle and that's a hypothesis here's the problem where it's not going to be as satisfying as the circadian is that as you know this brain region has been discovered very recently the perihubbenular but we've known about it a long time but nobody knew what it did so when you're about the habinula but that's why the name is confusing it's actually not the habinula itself it's the perihubben it's near the habinula why don't you just call it the summer hot tar nucleus I should have I don't know why I don't know that maybe because if you do that it's not okay okay so for here ever after the perihubbenular nucleus we should probably call it the hot tar hot tar none this hot tar for Nana's version okay this is like nerdy science attribution stuff but I'm just going to call it the hot tar nucleus Wikipedia line it up okay so this structure is taking light an independent of sleep rhythms and circadian rhythms it's driving change isn't it how does it do that is this through the dopamine system the circadian rhythms system we still recently we haven't identified this region very well we don't know what light does to it we don't know how it interacts so this is an area that is ripe for discoveries and we're working on this right now but that's why I said it's not satisfying this is like the function of sleep why do we sleep? we know sleep is very important to us but we still don't have a satisfying function of why do we sleep right? we have to have the questions I think it's our good friend and colleague at University of Washington Russ Finn-Gelder who always says when somebody asks why the best answer is just to say I wasn't consulted at the design phase exactly right none of us really know no but the point is maybe I shouldn't have said why what is the function of sleep it's still very hard to know why would what is the reason organisms have to go offline for so long you know people assume it's for repair assume it's for learning and memory assume all kind of stuff but there is really no clear function for sleeping there is no clear function for sleeping I mean if you talk to people there are hypotheses I mean all we know is that if you don't sleep if your sleep is very fractured you get messed up and you could die even right? I mean it's really bad if you don't sleep but we don't know what is the function what is the what is that sleep have gone to organisms that couldn't have done with rest what if you just could rest without sleeping just sit down on rest well my lab is trying to figure out whether or not these non-sleep deep rest protocols can compensate for sleep in I mean obviously sleep is better but many people are not going getting the sleep that they need but okay so and if people are sensing that Sam or an I are about to start talking over each other and arguing that's always the goal when you talk right unlike other scientists I interact with when Sam and I get together it's considered a successful conversation if we get into a big fight and then go for a big meal where I pick the restaurant okay so let's talk about food and eating and appetite you had yet another yes I greatly admire your success in this way yet another incredible discovery showing that there are directs of direct excuse me effects of light on appetite and feeding behavior maybe you could just summarize those results and for and honestly that paper is the one that allowed us to come with the tripartite model because we were thinking completely wrong about it we wanted this experiment it be fun for your audience to hear why we started this experiment remember that when we discovered the IPRGC's we figured if they are the only really to entrain the circadian clock then you could kill them and have an animal opposite to the one that we spoke about earlier where instead of having no pattern vision and have circadian photo entrainment we could produce an animal that have pattern vision but no circadian photo entrainment circadian blind circadian blind but pattern cited and we succeeded in that the problem when you have these animals which I've told you many times already is that they don't adjust to the day night cycle so doing experiments on them become very complicated what is their behavior like if you don't have these cells are they awake and then asleep awake and they just drift like the humans we've talked about they think they're in Las Vegas they stay up later every night they come either they depend on their clock if it's a clock is shorter they come in earlier if their clock is longer they come in so they're really messed up they they really don't adjust to the if they were in the wild they'll be eliminated in a second right there is no way they'll survive so me and Diego started talking we're like what if we use non-light in training agent and what is the strong man light in training agent food so we thought that the light defective animals will have more sensitivity to food entrainment because as you know more than me this is an area that you've worked really well on for vision if your image blind you're hearing and some out of sensory get improved right the lack of vision improves your hearing and sensation but we found actually that if you don't have the light to system actually you're feeding the food ability to entrain the animal goes completely to the ground completely opposite to what we predicted so light viewing and feeding behavior are interacting in ways that support one another and that's why we came with the tripartite model we figured it's different than sensation of the environment when you sense with vision vision and hearing interact but your vision is a real full modality you want to see that's what vision want to do you want to hear that's what hearing want to do you want to sense that's what sensing want to do but for the circadian system light food all these in training agent they somehow have to interact to keep the coherent system you don't just assume if you remove light this one is going to be stronger no they need to know each others the light informs when the animals going to eat well what I like about this so much is that you know in the other in the world outside of science which I don't really exist in but that I see a lot of this kind of wellness you know stuff of this all this mind body integration stuff it's interesting people view the body more as a system right a system of organs that interact as opposed to the way that standard science and medical profession is like you work on the liver or your ear nose and throat or heart and lung or brain or that's a great way of thinking you know but the biology is integrated yeah I mean and so for somebody who's interested in affecting their eating behavior something that you are familiar with and that we will talk more about your experiences of in a moment how should they use light in order to adjust their eating behavior right so now that I've told you about all these interaction between the different inputs to the circadian clock just you think about it as an engineer what would be the best thing the best thing is to know when your food times happen in the day when should you get light and where is your circuit when is your circadian clock in your system right so if you eat at very specific times of the day that's another signal that is telling your body your clock you're in a certain time of the day so if you're having lunch at the correct time every day and you're getting bright light now you have two systems that are informing you clock your clock is going to be better so regular meal times regular mean times that fit your circadian clock so and in fact if you do that when when I started doing this and it helped me lose weight is that I'm exposing myself to the right amount of light dark cycle I'm eating at regular time it is amazing you will be not hungry let's say let's say you eat at noon you will not feel any hunger at 11.45 and then all of a sudden the hunger jumps this is clearly not an energy issue because it could not be that drastic right now and it's higher to eat is mainly driven by these these cues these hormone cues that are very exquisitely timed to sleep wake cycle but also to light. Exactly and you know in the wild you could imagine why energy level through the accurate is very good. It should explain to people what the arqueo it is because I don't think we've done that adequately the arqueo it nucleus is an area of the hypothalamus that drives hunger and feeding behavior and what we're talking about is the fact that it's taking cues from your viewing of light believe it or not is impacting your level of hunger and this is a non trivial way in which your timing of hunger and amount of hunger is regulated by when and how much light you view so let me ask you a couple practical. This is really before you ask me sorry Andrew I said we're going to fight but to me is the interesting thing to think about it in the wild when you didn't have the availability of food that we have the arqueo it plays a huge important role because if you're not if you weren't successful in getting food then the arque is going to tell you look you have to take risk and go get food because your energy level is very low and that's great that's tons of great research about that but I think what's missing is the fact in humans we're not getting to a situation most of us we're not getting to a situation where we have low energy levels most of the time actually we eat not because we want to because we are really have low energy but because we want to eat so I think that's why I feel that the timing is very important for us because we always have enough energy level for us to eat well I mean I enjoy eating so much that I'll eat just for the sensation of chewing I mean I enjoy the taste too and I enjoy the social aspects I'm sure are a part of it but I literally enjoyed the physical act of chewing absolutely which explains a lot. Okay so how regular are you or do you recommend people be about meal times because what I'm hearing is that light viewing behavior is pretty good a lot of light in the morning and throughout the day minimize it in the evening and at night generally speaking for sake of mood and circadian rhythm but for sake of regulating timing and quality I should also say a food intake because people clearly make better choices about food intake when they are anticipating a meal and they aren't constantly hungry and so the ability to regulate hunger for particular phases of the circadian cycle is quite valuable for all people not just people trying to lose weight but all people are we talking about down to the minute like I'm absolutely all right plus or so 12 noon is my normal lunch let's say plus or minus half an hour okay yeah so eat around between 11 30 and 12 30 if that's the time and it depends if you also do multiple meals remember three meals that's a decision that somebody came up with I don't know why nowadays people are fewer people are doing that I think yeah so in our friends such in pandas work right I mean so you could have two meals you could have very multiples meals that are distributed across your active time I agree with such in spandas work that try to avoid eating when your system is supposed to be relaxing when you're supposed to be at non active time so you know limit your eating to the active time of your cycle and that seemed to be and John Takahashi is doing some beautiful stuff on this that seemed to be incredibly important for aspect of the circadian and for health and for health yeah I mean such in we're referring to such in pandas work he wrote a beautiful book called the circadian code maybe Samar with with some luck you'll write a book as well meaning the world would be lucky to have that book but such in data really strongly pointed the fact that liver health brain health metabolic factors and endocrine factors in a very systems in organs all seem to benefit from having a period of each 24-hour day in which we are not eating anything and then eating it very regularly sometimes let's talk about eating in meal times and let's move a little bit away from the the science for the moment although we will return to it and talk a little bit more about your experience with eating in meal times so you're looking in good shape lately thank you I know you've been putting work into it yeah we talk a lot and you've been exercising and you've been eating well meaning quality food you just came back from Jordan where I'm assuming the food is amazing it's the food is amazing and honestly usually I gain a lot of weight in Jordan but this time I didn't gain any weight which was really nice so yeah you've you've been eating well but when I met you you were probably about a hundred pounds heavier than you are now 275 pounds I'm 219 that's crazy yeah you had a lot of vigor then and you have a lot of vigor now but I know that you undertook a very specific protocol in order to lose the weight based on your understanding of the circadian system and of light and appetite and mood maybe you could just tell us a little bit what that schedule looks like and we realized that this is not a prescriptive for everybody but you found what worked for you yeah maybe just to describe those honestly I followed my circadian cycle right have we what we've talked about right so I dimmed the light at night I slept at regular hours I ate my major food in breakfast and lunch when I'm really active and I'm really hungry and at night when I avoid dinner because my circadian system really shuts off at three I'm an early person like you could give me anything I would eat before three after three nothing appeals to me anymore my system is shut off what time are you going to sleep and what time are you waiting on so in my case is I should have put this I mean I go to sleep literally at 9 a 9 p.m. I mean I literally five minutes after 9 p.m. I'm completely out and I wake up between 430 and 5 a.m. so if I extended I go to 6 a.m. but very rarely defensive of how tired I was and that as I recall was an important set of changes for you to be able to regulate your food in time absolutely because then I'm having very big breakfast at and again for different people is different I have a big breakfast at 7 a.m. maximum so I have a big breakfast coffee and all the stuff then I have some simple snack around 10 then I have regularly lunch at noon or between noon to one then I have another snack at three and the hardest time to regulate the food is between 12 and three this is what I really feel hungry all this is dear equivalent of kind of late evening for most yes so for me it would probably be between 7 and 10 p.m. exactly exactly and then at night I'm completely not hungry but usually as you said the beauty of the enjoyment of food like when my wife kicks cook some really beautiful Indian food I eat but I'm not hungry and I notice if I eat with that I usually gain weight but if I regulate that at night I also lose weight so there is a combination of all these things that help you adjust these these the input of food the input of light the input of the clock and the drive to hungry yeah I appreciate you sharing that and I want to emphasize that some people are not hungry early in the day they might be late shifted people in which case eating later in the day will work well as long as they don't eat early in the morning that's just you have to work with your schedule with your active schedule yeah you and I've been talking about this offline for years I'm glad we're finally having this discussion publicly now but we're talking about really is finding your ideal sleep schedule exactly and finding your ideal eating schedule exactly and understanding how those two things interact and you know the nice thing as you said finding them out is going to help you to understand how they interact because we know from the tripartite model that they are all interconnected and for each person they going to be interconnected differently so for each person you would you know for me if I exercise at night I'm going to mess up my whole system believe me. So when do you exercise? Morning morning works great for me I mean it's amazing morning exercise for me works great if I tried one time because it was easier for me to exercise at night before I leave when the traffic is there from the night and I think that messed me up because I couldn't sleep well and I couldn't wake up well and that led to more changes in my food I gained weight again actually believe it or not even though I was exercising so I think this really makes me think that you have to think of the tripartite model to see where is the best times and what is the best interrelation between the different component as you have said between your meal times your light exposure and your sleep that works for you. Well thank you for that usually Sam is insulting me today he's complimenting me I'm going to compliment him right back by saying this is the first time that I've ever really understood how yes light can control sleep yes it can control mood yes it can impact feeding but that it's really about doing the self-exploration to align those in the way that works best in what I'm hearing tell me if I'm wrong but what I'm hearing is that once you understand what gives you the best sleep wake cycle then you should exercise during the period of time in which you feel most alert and if it works for your schedule ideally you would also eat during the time in which you feel most alert and then stop eating and stop light viewing behaviors you had towards sleep right. So the only thing I would say that complicates all of this and that's what makes me sad is your light exposure mine personally sorry the people's light exposure right this is what complicates it because you're not going to be able to figure all this out if you're shifting yourself out of your comfort zone by viewing by viewing light at the wrong time of the day. So let's say if you were under an idle natural conditions your person who would sleep later than me let's say we'll sleep at midnight and wake up at 8 a.m. let's say you don't eat anything till noon and as you said you eat late in the evening then this would be perfect for you but now see what happens if you now you include the light component now if you push your sleep from midnight to 4 a.m. now you're waking up in the morning and you're actually really not the morning you're working up sorry at noon instead of 8 o'clock and the time where you're not supposed to be hungry now you're going to start eating directly at noon or something like that or even delay it and now you're shifting your whole cycle and you don't know if this interaction between your sleep feeding and the light dark environment are still going to be maintained or not. And that's the problem that people have. So you know as I'm hearing this what I'm realizing is most of us probably me included are messing up at least one two or three of these components. But that the the the probe the way to figure out what's right for oneself is to start manipulating light exposure. And I'm going to be honest I'm biased because I believe that light is the stronger the strongest time giver and we a lot of people disagree some people think feeding is I always thought that light was the primary zeitgeber the primary light. Yeah a lot of people think it's food a lot of people even sometimes mentioned social interaction they read the literature. I agree with you. I I told you that I mean my understanding is that light is the most powerful driver of the things we're talking about. I think we need to regulate this first and everything else fits. And you know the nice thing is that your sleep or cycle and exercise tell you really bluntly if you're doing it right or not. Tell me more about that. I tell you more when I shifted my exercise. Honestly things fell apart like never before when you moved from exercising early in the morning. Yeah it completely fell apart for me. I didn't enjoy exercise at night. My paint tolerance for exercise wasn't as good. I'm talking with any equals one and I'm aware of this. I've never tested this empirically. But at least to me it really messed up everything. I started having problems because my body temperature will go up and that will affect my sleep. I possibly was running in the gym with a lot of lights. So maybe the light was a component. But for me exercising in the morning it's so much better for me. But a lot of people can't even think of exercising in the morning. So it depends on when you feel comfortable in your sleep or cycle and your exercise. I think that tells you if your system is in synchrony with one another. That's really interesting. You know I were good friends. Our friend Pat Dossett that we both know you know did nine years in the SEAL teams and he's one of these people says you know he's happy to go for a runner swim anytime between 4.30 a.m. and 6.00 a.m. And he'll train in the afternoon too because he's a SEAL team guy and they'll do whatever anytime. That's part of the phenotype. But he feels best doing that right? I'm a mid I like to exercise mid morning and I'm happy to skip eating until 12 or 1. Great. And I like to go to sleep around 11.30 12 because I'm a normal human being rather than you who goes to bed at 9.30. What about that actually? I've never asked him what time. So Pat ideal to sleep time. I've asked him this would be around 8.30 or 9. Except now. But he has yes. But he has two young children two years old and a newborn. And so the cycle is disrupted. That's known right? I mean the effect of child bearing and I think that we could talk about this that's more complicated but that's pretty pretty much. Yeah. I mean I think we need to come up with a new name for a chronotype because chronotype implies that it's just about sleep and wake up. Being an early bird or a night owl and what we're also talking about is how exercise and eating match on to those. And the phase relation between them. Right. And the phases between different components. As you said, because they interact because they interact. Right. And they don't have to be in the same phase like let's say my light and food could be very close to each other's your light and food could be different. Right. The phases don't have to be they can be plastic. So you have to find this for yourself. You may you may be a person who eats late at night exercises late at night or you may be a person who exercise early eat later. So it doesn't as long as the phase is good. That's what you that's what you have to find out. Okay. And if I understand correctly when you're talking about phase relationship, it means you want to lump exercise feeding and light for and sleep and sleep in a way that as a coherent and total system makes you feel really good. Temporally in a great order. Absolutely. Yeah. That's and I think that and I could tell you to me is literally getting exposed to some, you know, clearly in the morning, clearly at noon, I go out, I keep my windows in the office completely open, eating mostly in the early time of the day and exercising and literally at the end part of the day, I'm literally in a more thoughtful, vegetative state. Like I really can't like after five, I tell my students, if you want to tell me anything complicated, you're wasting your time. My brain just doesn't function. So even though I only sleep at night, but I'm really starting to shut off, ramp down. Really, I mean, it's, you know, I could send the email, talk about brainless stuff, but my power, my energy to do powerful stuff, really drop tremendously. So all my students who know me very well, they put the meetings with me early in the morning because they know this is when I'm so everything for me and for me, it's very tight. So it could be different. It's very clustered in the morning. It's all tied together. And literally the remaining part seems to be just, you know, vegetative state. Yeah, you and my Bulldog Costello who unfortunately passed away recently had that in. Yeah, I did not. Sam and Costello were good friends. Yeah, sorry to break it to you here. Yeah, he had a good long life and he went easy. But he had a circadian clock. The basically would just sleep around 24 hours a day. Minimal activity interspersed every third day or so. You do have this morning vigor. Yes. And that's I'm that I think other people are going to have more of an afternoon vigor. Do you think that this can change across the lifespan? It's the rumor is that teenagers naturally want to sleep in later and stay up later. Do you think that social rhythm or do you think that that's actually biological? Yeah, that's a tough question. I mean, it could be both. One thinks, well, that worries me is that it seems that if anything with age this morning, rigor gets stronger. You want people to become more of morning more and more. Why is that where you I think that's good? Because for me, I'm already very shifted morning. I don't want to be one of these seven PM to one AM sleepers at some point. Yeah. On the other hand, it's it's also kind of nice because it's quiet and you can get work on. Yeah, but honestly from 430 to 730 when my wife wake up, it can be very lonely. Yes, you achieve a lot, but it's quite outside. It's, you know, so I don't want to be at one AM. Let's put this. You can tell Samar is more social than I am. That's right. That is true. So we should touch on that actually. So your wife is, she follows a different schedule. Yeah. And so the social rhythm is important. I think what should we do? How should we conceptualize and how should we adjust ourselves according to the social rhythm? And I honestly love this this this hypothesis that people came up with and and Pat's kids reminded me of because kids are really going to disrupt your sleep week cycle. It seems like there is a crono attraction that usually people who attract each others have actually different sleep week schedule. And the idea being is that this allows them to take care of their kids throughout the day night cycle and several peaceful marriage and have a peaceful marriage anyway, right? So I mean, we didn't have kids me and Rachel. So maybe this is, but it seems like evolution, it makes sense that if you want to protect your protect your kids, you don't want everybody to be mourning rigor and then the kids don't have. So you want to distribute it across. I think it's a reasonable argument. I've heard that one of the reasons that people think that the clock is not exactly 24 hours but it's 24 hours plus or minus, you know, 20 minutes or so is because we believe that we evolved in clans or groups, villages, whatever that were about 100 to 200 people. And in order to have protection around the early morning hours when we're vulnerable to predation and in the late night hours that you would want some individuals of our species to be naturally more like night owls and some more like early people. So your theory of parenting is similar in that way. Right. The social rhythm is a powerful rhythm, no? Meaning, if I go out and I'm tired, let's say I'm tired like 930, I don't want to go out. I can't just say something about that. I think the social rhythm is powerful at the obvious levels like it affects your sleep, it affects how much you wake up or eat. But I'm not so sure as powerful as people think on the clock. Now eventually it will mess up the clock because now if you're doing a lot of social at night getting enough light eating at the wrong time of the day, eventually you're going to have an effect. But I don't think that's the social interactions themselves have been shown to affect your clock very strongly for some reason. That's good to know. Well, for people hearing this, they're probably getting the impression like I'm the night owl and then Samar is the one that's in bed at 9 and then wakes up at 4. But having attended many meetings with Samar, I can tell you that he's the party animal. So let's talk about that. I mean, let's talk about the fact that you're the party or who's up until two dancing at these at these various meetings, which I've seen. Yeah. Actually a good dancer I'm told. But what should we do when we do stay up very late for whatever reason? Could be because we have to take a midnight trip to the hospital, the unfortunate reason, or it could be because you're in the presence of people that you don't see very often and you go out for a really nice night out on the town and you get to sleep around 2.30 or 3 in the morning. How should one get back on schedule? Do you force yourself to then get up and view light at the normal time that you would get up in view light or do you allow yourself to sleep in? What's the optimal path? I would allow myself to sleep in and remember this is a long term effect. This is something that you live with for a long period. And remember, I told you about the experiments we did with the mood. These required two weeks of that light schedule to cause mood disturbances. So these don't happen just in a single day. So this is the way you justify staying out late everyone. Well, in the meetings you've seen me, I've done this for five or six days continuously. But what you didn't see that when I came back to my home, it took me two weeks as if I did a jet lag. So I really do suffer for two weeks after doing a six crazy night of staying up at night, drinking at the wrong time of the day. So it's not that I'm completely okay with it. When I go back, everything goes back. It takes me actually literally two weeks to recover from the circadian rhythm meeting that you've seen me party at some point. Which is kind of ironic. I know rhythm meeting people are totally disrupting the circadian cycle. But scientists are human beings too. So I think if you do it at very little occasions, I think you should not worry too much that this will have lasting impact. And the good news is that if you read, adjust your schedule, you could come back to it. The problem is when you maintain these wrong schedule for a prolonged team and becomes chronic prolonged periods of time, that's when you have the problems and accumulation of the problems. So when you have sleeping problem, you produce metabolic problem, when you have metabolic problems, you produce lack of exercise. And you could see how things can spiral out very quickly. And then it would be hard to come back to it. Well, certainly sleep disruption is both a symptom of and a cause of almost all mental health disorders. And certainly the metabolic syndromes that people are talking about nowadays and all of this, it all funnels back to light. This is what's so remarkable. And so we have these devices. And I use my phone and I use my computer. But do you think that the mere dimming of the screen or not interacting with screens after, you know, with it say 90 minutes or two hours before bedtime? According to what we're saying today, this should have a profound effect on all these things. And I really believe it does. And I, you know, again, I think Aspat has did these inventions where you get a pouch, where you put your phone in a pouch. So what Sam is referring to is our friend Pat, this former COT member that we, that who's also very impressive person in the landscape of business and family, et cetera, real a superhuman from a by any regard, has this habit of taking his phone and putting it into a sealed pouch in the evening. So it's basically, and in his world, and he sends you actually these, these sealed, you know, batches. And so that I think is a great idea because not only it will take away the light from you, but it also takes away the distraction because you want to repair and recover and sleep does that. And if you have your phone dinging all the time or, or the light flashing from it, it's you're just not getting enough sleep and you're causing yourself major problems. I'd never asked you this, but I realize now that I, I should have long ago, but I'll ask you now, why and how did you get into all this stuff? Yeah, I mean, honestly, I, first of all, I want to become a, you know, I wanted to study genetics and I knew I wanted to do PhD in genetics. But I only got accepted in one university at the time and I joined the Learning and Memory Lab. And I liked Learning and Memory at the beginning. I worked on the snails on Applesia, California, and started looking at Learning and Memory. But then the same lab was looking at these daily variation. I was really struck. Like you never think about it outside of science. It really struck me that organisms can measure day, biologically. That was very shocking to me. And I just really got attracted. And I wanted to see why does this happen? What is the effect of different times of day? And I just stuck with it. It just, it was mind blowing for me who was in medical school that I've never heard about it before. You know, it's really amazing medicine. I think still now, we are very good at looking at stuff spatially. But we're very bad at looking at temporal aspects. So we always like to see images, static images, spatially information. Take an X-ray, measure a temperature, measure a blood pressure. Exactly. But we don't think of temporal. And you know, you talk to John Hoganash right now and he's telling you the importance of Chrono medicine or Chrono pharmac, pharmac to it, whatever the word is. And it just, it really just getting the drugs at the right time of the day is going to be essential for our health. Do you think that's going to come from using better trackers? Like horror rings, whoops, traps, these kinds of things? I love the trackers, but I think there's even more exciting discoveries. Now you could take a single blood sample and measure many biological components and figure where you are in the circadian clock. Something that was very hard to do before. So if you have a marker to know where you are in the clock, you could actually understand more the effect of everything. Exercise, feeling, light input. What is the marker? So there are some papers from what's an amphilis Z and from a chemcramer where they measure multiple RNAs that are known to tell you what phase of the clock is or multiple proteins or biological reactions. And depending on a combination of factors, not a single factor, you could tell where you are in the circadian clock. So they could instead of just measuring temperature or melatonin, just one measurement. And melatonin specifically is also complicated by the fact that melatonin is affected by light. And you know, and temperature, your temperature and sleep can be easily dissociatable, right? When you travel across different times, when you sleep at different times in the temperature cycle. So having multiple components measured will give you a better determination of your circadian phase. And understanding your circadian phase in humans will tell you what is the effect of giving certain drugs at certain times of the circadian phase. So in the future, this is going to be studied at a much higher level when you can determine the phase in relation to all the other stuff. It's striking to me that in all animals, besides humans, if they deviate too much from the appropriate exposure to light and light dark cycle, they essentially don't mate and or die and or get killed off. But in humans, we are able to override that at least to some extent. But the ways in which we suffer appear to be things like obesity, metabolic syndromes, reproductive syndromes that are accompanied the other syndromes, you know, endocrine syndromes, and mood and depressive disorders. Is there any effort at the level of the nationally or laboratories that you're aware of to try and use light in order to improve mood and mental health? I mean, honestly, this is my mantra. This is the thing that I think people, because it's, I say, don't take a pill, take a photon. And not, I mean, you take pills. It's important. I'm just making it that really we have an opportunity right now with the incredible advances of LED. Lights of changing spectra of light of regulating intensities. And just to associate just for simple changes, you could really improve sleep or cycle productivity and still you could actually get more done because as we've talked about when you have all these messed up, now you have to sleep more, but your sleep is fragmented. It's not very good. And you can't focus. And you can focus. We don't have alertness when you need the alertness. So having all these, you could allow you to do even more, actually, at the end, done less. And that's the exciting part of it. One of the questions I get asked most often about is about ADHD. You know, I think there's a lot of self-prescribed as well as clinically prescribed ADHD. People are having a tremendously difficult time focusing and not just because they're sleepy. They just can't seem to anchor their attention. And there could be multiple reasons for this, but there are now several clinical trials ongoing using light to try and anchor people's attention and mood and well-being for sake of focus. And I think that while I love this saying that you mentioned, you know, take a photon, not a pill, and with due respect to the need for pharmacology for certain people, I think most people just haven't really dialed in their relationship to light in a way that allows them to rule out whether or not they need medication. Absolutely. That's the best way to put it. I can't add to that. Let's talk about jet lag. But not in the context of, okay, if somebody's traveling from Europe to Japan or from these, because that varies tremendously, right? I mean, there's as many different variations of travel as there are individuals out there and with goals and jobs, et cetera. But rather, let's talk about what are the two or three things that people can do to adjust their schedule quickly? Yesterday, I called you and said, look, I know somebody who's traveling six hours. I won't even mention in which direction because I don't want people to anchor to that example. And you described some very simple tools of viewing light a little bit earlier than normal, and getting on the local food schedule, et cetera, that would allow them to shift more quickly. And the reason I want to have this conversation is, yes, for the travelers and for the shift workers. But mostly because of the fact that you've proven again and again that people are disrupted in their circadian behavior at home. So what are the, aside from what we've already talked about, how can one adjust quickly to a new schedule? Like, let's say fall classes are starting. You start a new job where you have a baby or a puppy or whatever. What is the best way to shift the clock quickly? So it's very simple as we've talked yesterday. So imagine you're in the outside with no environmental, with no industrial light. If you, if your body thinks you're in early evening and you see a bright light, what does this tell you? Oh, wait, this is not early evening yet. It's still early afternoon or late afternoon. So I have to delay my clock to go back to late afternoon. So if you get light early in the evening, it delays your clock. So what does that mean that makes you want to go to sleep later? Yes, it delays your clock. So so you're in New York. Right. People in Italy have an advanced clock because they are six hours ahead of us. So if you're in New York and you get light early in the evening, you delay even further from Italy. So now you're delaying away from Italy. Now the same thing happens. Let's say you thought don't came up and you thought it's already done. But it was let's say three o'clock in the morning or four o'clock in the morning and then you get a bright light and you say, oh, wait a minute. Don't it's not up yet. So I should advance my clock or I'm at night, but I'm getting bright light. So I should run because don is already up. And then later in the night later in your night and actually just happens that the humans you get a temperature in the deer later in the night. Low temperature in your body after that might start advancing your clock. So if you want to go to Italy instead of getting light early in the evening, you want to get light after the temperature low. So you could advance your clock even before you go to Italy. And you're catching up to the Italians just by using light. It's as simple as that. So you could do it for every region. You could calculate how much they are advanced of you. You could know how much these light shifts happen per day. And you can calculate what you what you need to do. Very simple math to adjust either in direction of delaying. If you're going from New York to California, you want to delay your clock or advancing if you're going from New York to Italy. So in order to make that a visual and because a lot of people are listening to this not looking at it on video, we will put a zero cost downloadable figure of this on the Huberman Lab.com website related to this episode. But I think I can summarize it in in language as well. If I understand correctly what you're saying is if your typical wake up time is say 7 a.m. Then your low point in temperature probably occurs somewhere around 5 a.m. And if you light right or about around then it's going to essentially advance your clock. Yeah, because then you your buddy thinks, oh, it's seven o'clock so that's your clock by one to two hours. But if I were to view lights say at 3 a.m. then it would probably delay my clock. Yeah, okay. Yeah. So and then let's say I land in a new schedule. I want to adjust to new schedule. Let's say I didn't manage to do anything with my light viewing before I went and I didn't I didn't anticipate the trip. Suddenly I'm on a new schedule. Okay. I was told that one of the ways to help shift the clock and to avoid gastrointestinal issues is to eat on the local schedule. To start basically behaving like a local. Even though your circadian clock will take a little bit of time to catch up. Absolutely. But you have to remember the light right. So let's let's now that we explained it very simply. Let's take a very simple example right. New York to Italy. That's a simple example. New York time Italy time six hour difference right. So let's say you fly from New York at night. You reach Italy at eight o'clock in the morning. What is the time in your New York time? You although you reach six hours back six hours to an hour. So when you land Italy you want to avoid light like the plague. Yeah, you could eat but you really don't want to get a lot right. Because otherwise it's going to delay delay is going to send you to California instead of sending you to Italy. Right. And so this is such a key point. If anyone's confused about this we will put some diagrams up. But what Sam are saying is so crucial. Just because getting bright light in your eyes early in the day is really beneficial when you're at home. So you're going to have to travel to a new time zone. You have to take into account what your body thinks what. Excuse me. You have to take into account where your body thinks you are. And so if you're looking at the Italian sunrise having just flown from New York to Italy and you didn't prepare for that trip by waking up a little bit earlier in anticipation. Multiple days. And if you light it to a excuse me at six or seven a.m. Italian time beautiful Italian sunrise. You are going to delay your clock. You're going to basically throw yourself back to California. But you are in Italy. You're going to throw your biology back to California and you are going to be up in the middle of the Italian night. And you're going to be a miserable. I'll tell a brief and it took because I called Sam or in desperation a few years ago I traveled to Abu Dhabi. NYU Abu Dhabi to give a seminar. 12 hours out of phase. It's a 12 hour flip. And I thought I could just muscle it. I thought I'll get up just view sunlight when the sun comes up. And I fell apart mentally and physically. And Sam or came to my rescue. I called him. I said, I don't know what to do. And he said, go to the gym. Went at the local dawn. Work out. Eat. And then view sunlight starting the next day. And that basically got me on the schedule. So I used food and exercise to adjust myself because my light viewing activity was just completely out of whack. Yeah. I mean, and we talked about other details. So you have to calculate it. But you're absolutely right. I mean, it's, it's very important to avoid getting the wrong light information when you're trying to adjust your body. Because otherwise it shifts you to the other, to the other side. Absolutely right. Well, you are one of these people that has such vigor. And I think that's one of the things where having known you all these years, you have a tremendous capacity for work and for soccer and for arguing respectful arguing. And you know, sometimes, you know, getting worse with the age. Yeah. Well, we could talk about that offline. But I think a lot of your vigor and a lot of your ability to work hard and focus and really do so many things at an impressive level is because you think about these issues. And I think about when you're going to be optimal for focus, when you're going to be optimal for exercise, when and the when is the key. And I think a lot of people live in the landscape of feeling like there's something broken inside them because they can't focus or they can't. It's all subconscious. Right. Remember, it's all subconscious. These effects and you're absolutely right. Now, honestly, joking aside about age, I really agree with you that I think part of the reason I'm continuing to be able to do this that. I really think about it and I make sure that I keep everything aligned and that actually helps me a lot. Like I don't suffer in sleep. I don't suffer in waking up. I never use a timer to wake up. I mean, people say aren't you scared? Like you have to give a lecture at eight or seven thirty. I was like, there is no way I'm going to go beyond that. It just even if I try, I can't sleep beyond six a.m. in my regular times. It's just it's not going to happen by four thirty. My eyes are wide. I pay awake and I'm in bed. It's just system is so aligned. It works. A lot of times people will say, how come I go to sleep? I fall asleep fine. But then I wake up at three or four in the morning and can't fall back asleep. Is it possible that those people were supposed to go to bed at eight p.m.? It's possible. I mean, it is possible. It is also possible that sometimes people will wake up and go back to sleep. But yeah, I mean, it is possible or it's possible that their clock is completely misaligned that they are getting maybe in nap time at night when they are supposed and then they possibly feel so sleepy in the day. So there all these are possible combination. That's an interesting idea and considered. So I mean, what they think is their sleep, their body is so out of whack with the light. It's like a light art cycle that it's actually a nana or the weaker part of the sleep. I mean, you see this in when you travel to different times on before you adjust. You go to sleep really well, but two hours later, you're fully out. Two hours. If you were so tired and this is your regular sleep, there's no way you're going to wake up in two hours. Then you feel very sleepy later in the day or something like that. So it depends of how your whole system is aligned to the environment. That's a very interesting idea. I think that's going to resonate with a lot of people. I wake up every morning around three or four generally used bathroom and then I fall back asleep very, very deeply doesn't seem to disrupt my daytime wakefulness. And I think a lot of people obsess over that waking up and worry. There's something wrong provided they can go back to sleep. It's okay. If you can go use the bathroom, go back to sleep. That should not be a problem. Maybe some people when they go to use the bathroom, they use very bright light and then they get an alerting signal. So if you maybe that could be as simple as that that affects you. Maybe when you wake up, you put tons of light or you start reading your iPad. So there's all these combination that we still don't know about that could be affecting their sleep wake rhythms and their sleep maintenance. Do you use melatonin? Do you take melatonin? I don't need it to be honest. In my case, there is no reason to use it because I could guarantee you that by maybe eight o'clock my melatonin has already started to go up. And by the time I sleep, my melatonin is very high because I don't use a lot of lights after sunset and light inhibits melatonin. And life really blanches melatonin level. You hear this myth that the pineal gland calcifies as we get older. Do you know anything about that? I've heard about that, but I don't know what does. I mean, there is not very clear evidence that affects the sleep. I don't know much about it to be honest. The evidence that I've seen is that yes, there's some calcification around the pineal just because of where it sits in the brain. It's close to some bony structures, but I don't think there's any evidence that it has negative effects. I mean, if you still have, you could measure melatonin and that should tell you if it has any such an easy thing to do. I think this is more of an internet wellness thing that got outside the cage. You're absolutely right. Yeah. It sounds terrible calcification of the thing, right? The hard thing, right? Yeah, exactly. Let's talk about seasonality a little bit. I learned and I don't know if this is still true, but that most suicides occur in April in the spring. I think there's a poem that says April is the cruelest month. I think it is the poem begins. Are there data that suicides are more frequent? It's a particular times of year. And if so, is the spring that time of year? Yeah, I mean, a lot of people talk about this. And one of the hypothesis that is that the winter month that are very bad for moon, make people not wanting to do anything. And they get into such deep level of depression that when the sun comes up, they get actually the energy to act under depression, which sounds really terrible. It's terrible. So that's the idea that the lack of light throughout the winter caused them to go into such depression that they don't feel like doing anything. And when the light comes in with rigor in the spring, it gives them that after all the depression they suffer, it gives them that push to take that sad final act, I guess. What other seasonal effects have been demonstrated in humans? I mean, I think in humans it's not very clear because we don't think about seasonality. But if you start thinking about us, I think we go through major seasonal changes. I really do. I think our eating pattern change across the year, I could tell you that me thinking about this, there's a clear changes that happens to me across the year. Animals, this is really essential because for animals, they have to time their mating behavior was when they deliver their their progeny in the most abundant amount of food. And artificial light is causing major disruption because if you change the way these animals are receiving the light information, they either start mating much earlier or much later and their numbers window and they get into the dangers of really completely getting eliminated or extinct. Human birth rates are definitely going down. In the US, in the US, in particular, not others. But are there other effects of seasonality on humans that we're aware of? Honestly, you could see it, honestly, you could see it perfectly, I think, in Scandinavia. I mean, you could talk to people who live in, they get seasonal depression. What season depression is one, but actually when you start asking them questions, they tell you like in the winter, they barely could wake up, they barely have the energy before even depression, even people who don't get seasonal depression. They'll tell you our energy level is lower, our ability to go to work is is not the same. And in the summer, most people actually sleep very little. They tell you we really can we feel like we're manic, we have all this energy and not in a negative way in a funny way, right? I mean, but if you want to sleep, we have to put this curtain. I think in these situations, you could really appreciate the seasonality of a human. I think we kind of destroyed our seasonality because we don't get exposed to that much natural light. We have all this artificial light. But I think honestly, one of the things that is going to happen if they follow your recommendations about giving light at the same time, giving food, giving away, let's be clear, those are your recommendations. I mean, I'm just fair attribution. What I'm saying is that this is going to cause them to also experience some changes across the season because now they're going to see the sun differently. If you're going to go out in the morning in the summer, you're going to get the much bright. That's why I don't like the change in time. I know people think, oh, because you're biased, you because I think, wait, wait, wait, sorry, the change you're talking about daylight savings, daylight saving. It's such a bad idea because it disrupts that rhythm that you're having because I think your buddy, if you keep that rhythm, you will see the whole seasonality. And I look at it from a different aspect than other people. It really, and people say I'm biased because I'm a morning person. And it may be true. But there's situation conspiracy of morning people. But if you think about it, there is a situation where you're getting like perfectly well, and then all of a sudden they delayed by one hour because and then even though it's the summer, your buddy now, if you're still not adjusting, think, oh, wait, what happened? What kind of happened? Why do you bring in this up because I always thought, what's the big deal? One hour, right? One hour shift, you know, spring forward, just one hour. But this goes back to the beginning of our discussion. It's not just one hour. Because it's one hour across that one day, but there's this cumulative effect on the clock and these three elements of your tripartite model, right? And the homestatic sleep and the light direct effects on you. And when it's so close, it's sometimes hard to figure out how to adjust it perfectly because you know, we already sleep deprived in our society. And then you shift it by, you know, so it just it all accumulates and it has no benefit. Will you work at a major government organization, National Institute of Mental Health? Why don't we campaign for? No idea. I mean, it makes no sense. Why don't we go campaign? Yeah, I would love to. I mean, it makes no sense to have the summer light goes up at 9 p.m. The light goes down where I live in Baltimore at 9 p.m. And then all of a sudden, when you really want to see the light longer in the day, you now shift the other way. And it goes all of a six p.m. Why do you do these drastic changes? Well, let it blend across the whole season, you know, yes, later, earlier at night, but it's at least consistent. It goes in a very consistent manner. I just don't understand why they do this. It makes no sense. Well, I think that the reason they do it is because they don't understand the biology. Because one hour seems trivial unless you understand that the repercussions of that one hour shift. Because what's also clear now based on what you're saying is that that one hour shift is taking you out of alignment with the natural light dark cycle in exactly the wrong direction is pushing people to get even later in the summer when light is going to push you later anyway. It doesn't make sense. You put it beautifully. I just rambled and this is no, no, you made it you made it clear. I mean, it's like literally it made you it made people who are having problem having an advanced sleep rhythm because they are delayed. Now you give them this hour to make them even more delayed you push them even later in the day night cycle. It just doesn't make sense at all. I think 2022 should be the year that we abolish bad deal. I would say the day for me honestly. Well, it's in. Well, also if it has a positive effect on the what is essentially an epidemic of mental health issues and other issues related to improper interactions with light. That I think is a well worth while cause and we can explore so for once we're going to fight with some with another group common battles with one of them. I mean, the circadian people honestly to give them credit have been trying for years to abolish daylight saving the problem is they all go to sleep at 9 p.m. and wake up at 4 a.m. So we never see them. No, the circadian community has done an amazing job of figuring out what we need. Right. And then the challenge of course is making sure that people get what they need. Right. And making sure that at a societal level we're not involving ourselves into the wrong. And the biggest problem is that the late waking people they think that really and I'm going to try to put it in a better way now. They think oh, because you're a morning person you want to see the sun early so you want me to suffer it dropping late. But that's not the case because what happens is when they shift it back after the daylight saving now they're going to make you suffer really badly because now it's going to be earlier in the fall. In the fall when there's not enough light if they keep it the same way so try to convince them that actually this at the end because it more trouble when you need the light for your late schedule in the fall when they shift it back then they say keep it daylight saving all the time and that has been proven that is very bad. Like people have done studies that literally two areas close to each others and areas that work the whole year on daylight saving has much more problems even in cancer rates and depression so you don't want to do that. So that's what trying to convince people that you need to prevent that switch and you don't need daylight saving at all. That's where the problem happens. Interesting I had not thought about that but yes you late risers the in the fall when they when that's the fall back as they say spring forward fall back you dial back the clock it's really compounding the problem that all exists. And it's really nice if you think you keep it consistent in the spring you get the long you know when you get the equinox and then the days start going up and then even in the summer start going down and then the fall you get the other equinox and go back so it's very symmetrical right it goes into short day longer long and short day again but now you're getting these bumps in both sides of the spring and fall why would you do that something that is beautifully symmetrical beautifully smooth. You're putting bumps into it well and we're not just beautiful because it's there but but evolved I mean essentially this is the seasonality is the most of the year even apart from the exact equator every part of the earth have seasonality. I want to briefly touch on something which is individual and genetic variation in sensitivity to light so not chronotype but first of all a very basic question. Do people with light eyes light colored eyes have are they more sensitive to light than people with darker pigmented eyes I mean honestly it makes sense they will be more because if you think of my dark pupil it's blocking more light so if you have light pupil. Yes for vision it may not be very obvious but for something that is measuring the amount of light you're getting more light than me so you're probably need less light to be effective as somebody who's darker and that maybe could explain why sometimes lighter people say I don't want to go into very bright conditions because it's really bright. I can't I can't even be at a cafe without one of these reflective tables like a metal table unless I have very dark sunglasses so bright it's painful. Some people like you we've sat outside and meals and you're like fine I assume it was kind of Jordanian toughness you know it's really the pupil blocks more light so I think it is possible that it's as simple as the pupil blocking more light can have sensitivity but your question is also goes deeper are there more sensitivity differences on. And my understanding would be I would think that it may be depends on how effective your cells are in responding to light how how healthy your IPRGCs are so I would but there's not many studies to show that what is really clear that is happening is that patients with bipolar they seem to have different sensitivities to light so it seems that at least people who have. Psychological changes they may have differences to the sensitive lights so. Where are those differences in a particular direction i don't remember the exact we can look at yeah yeah yeah i you know i and people have heard me say this ad nauseam to the point where they actually roll their eyes but you know that these are the only two pieces of brain i'm pointing to my eyes folks that are outside the cranial vault they are two pieces of brain that it basically inform the brain about. Whether or not to be alert or sleep but you can imagine that those two little pieces of brain that we call eyes would have genetic variations of course i color is genetically modular is that determined. That there would be genetic variations based on whether or not your ancestry evolved near the equator further from the equator right I mean you see more blue eyes and Scandinavia I mean it's the lack of light that said you need more less inhibition because there's not enough light right so that's not the way to. So yeah i totally agree with you i mean i think this is an area that will be studied later and will be empirically determined the problem we have in this field right now which i think is the biggest problem is we don't have a way to measure the IPRGC sensitivities in humans so. We still like it's easy to measure your rot corn function if you go to an optometrist they measure all the details right contrast it and look at the chart you look countless now and chart you look at the letters at the DMV yeah but for the none subconscious we still don't have a good measuring systems to figure out what is Andrew sensitivity what is Sam or sensitivity what is this person sensitivity and I think. We're starting to work on something like that to hopefully develop these techniques but till we develop them it's going to be very hard to figure out if there is a sensitivity difference how do they relate and on men and women you know dark and unlight and all that you know normal versus psychologically affect and stuff like that fascinating and every time. And every time you talk I learned so much it's like a in the best way the best sense of the term it's like it's a waterfall of knowledge as a final question I have a question about sensitivity of a whole other kind and that's the sensitivity to spicy food now the reason i'm asking this question what seemingly out of the blue is that I made the mistake once of having Sam or cook for me. And I said not too spicy and he said okay not too spicy yeah she said okay not too spicy and it almost killed me I was like two or three days so you know a lot about biology outside the visual system light etc you've been around a while. Are there known genetic or inherited of any kind sensitivities to spicy food to things like red peppers and capsaicin because what you call mild my friend almost put me into the hospital I think this is similar to you swimming in the ocean and I need to get developed the big true true I like cold water swims and say that's not a fan but that's not change it's not going to change that's my village before I met Raysia I was like you and. And once I started eating lot of spicy food I lost touch of house spicy my food is so I nearly killed you and I apologize I forgive you so basically you're saying is that marriage tough in you out tough in me exactly maybe that's maybe that's the solution yeah. Sam or this has been an amazing march through the importance of light not just for regulating sleep and wakefulness but also for food timing the interactions with mood the interactions with exercise I'm certain that people are going to start thinking about how to change the relationship with light as a way to anchor everything that they do and that's important to their health. And I just on behalf of all of them and just directly from me as your friend and as a colleague for many years now I just want to say thank you for the incredible work you're doing and for sharing with us. Thank you so much and actually now thinking about all of this and you said I should write a book I should write a book and call it the tripartite model I think that would put all these components together would be very interesting to do at some point you should write a book. You should write they'll probably try and change the title to like food mood and you know something because but you can put in little print on the tripart model or whatever but regardless of what it's called I you absolutely should write a book and and so if you'd like. Sam or to write a book or if you'd like to learn more about him let's talk a little bit about where people can find you your laboratories at the National Institutes of Mental Health. He is head of the chronobiology unit all these things that I've mentioned earlier but you are active on Twitter and Instagram right so what is your Twitter handle it's at summer at the and we will provide a link for that in the show notes sorry that yes at the Twitter at summer at the same for Instagram and Samar has been coaxed on Instagram so he does post from time to time mostly pictures of food that is incredibly spicy. But also information about chronobiology he comes on for an Instagram live every once in a while with me and so definitely give him a follow there and on Twitter and and I'm sure that he'll be happy to answer questions and entertain any and all discussions about chronobiology absolutely yeah unlike yeah great thank you Samar awesome thank you for joining me for my conversation with doctor Samar ha tar I hope you found it as interesting and informative as I did if you're enjoying this podcast and we're learning from it please subscribe to our YouTube channel in addition please leave us comments and feedback in the comments section on YouTube a great thing to do there would be to make suggestions about future topics you'd like us to cover or future guests you'd like me to host on the human lab podcast in addition please subscribe to our podcast on apple and Spotify and on Apple. You can leave us up to a five star review please also check out the sponsors that we mentioned at the beginning of the podcast that's a terrific way to support us and we have a Patreon it's patreon dot com slash Andrew Huberman and there you can support the podcast at any level that you like for those of you that are interested in supporting scientific research. You can support the research in my laboratory on stress on sleep and human performance and other related topics by going to Huberman lab dot Stanford dot edu slash giving and there you can make a tax deductible donation at any level that you like if you're not already following us on Instagram please follow us at Huberman lab on Instagram and also on Twitter both those places I teach neuroscience and offer information that's not always covered on the Huberman lab podcast and last but I'm sure that you can see that I'm not going to do that. And last but certainly not least thank you for your interest in science.