



**Transcript of “Daniel Pardi: Date Rape Drugs,
Napping, & Jet Lag - #208”**

Bulletproof Radio podcast #208



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Dave: Hey it's Dave Asprey with Bulletproof Radio. Today's cool fact of the day is that the record for the longest period without sleep is 18 days 21 hours and 40 minutes and that occurred during this rocking chair marathon. The person who holds the record has hallucinations, paranoia, blurred vision, slurred speech and memory and concentration lapses. I know a lot of people who have those things but they're usually at burning man so I'm not sure how related rocking chairs and burning man are but there might be a relation.

Today's guest is Dan Pardi who is an entrepreneur and a researcher and he's looked at how to facilitate health behaviors in people and created this really cool thing called the loop model to sustain health behaviors so that you can maintain health and vibrance in our modern world. He works as a researcher with a psychiatry and behavioral sciences department at Stanford in the neurology and endocrinology departments at Leiden University in the Netherlands. In other words he's like academically got some serious credentials and has developed a model that's really useful to the things that Bulletproof people care about all the time. Dan welcome to the show.

Dan: Thank you so much. It's great to be on.

Dave: You also worked for naval special warfare to help elite fighters have vigilance when they're fighting people or not fighting people. You have gone beyond just looking at sleep or health to looking at performance when life and death are on the line which is the other reason I want to chat with you. What was that like when you jumped in there worked with these elite warrior types?

Dan: It's a huge honor for sure. Going in there I don't have a military background but I try to think about what their situation was like without knowing much about it. I know that they're training wants to prepare them as best they can for battle then they're going to be in a condition of battle where they're not going to be able plan all the time. They're going to have extended missions where they have to maintain vigilance for over 100 hours at a time and then there's the condition of coming home and then having to ... what do you after you've been in

battle and how do you sleep if you're basically been maintaining a hyper vigilance state for a long period of time.

There are basically 3 pretty distinct conditions but these guys end up dedicating their lives to our country. Even if they are still alive when they get back oftentimes they have real serious metabolic issues and sleep problems that can last the rest of their lives. Anyway, it was a really interesting situation. I worked with Navy Seals and also swift-boat operators which support Navy Seals while they're operating. I go in there and I tell what are the determinants of good sleep and therefore what are the determinant of vigilant or alertness.

They understand what those things are so that when they have the opportunity to create the conditions or to respond to the conditions that facilitate alertness and good sleep and they can actually take advantage of that. That's the general intro to that work that I've been doing.

Dave: Have you ever done any work with Mark Divine or Kirk Parsley?

Dan: Not Mark Divine but I got connected with the seals through Doc Parsley.

Dave: Doc Parsley is a friend and for people listening Mark's been on the show. The thing that helps me remember Mark's name is he's the only guy I know who can kill you and has a porn star name. He's an elite Navy Seal commander guy. It's really interesting when you look at what's possible when you're doing at that level so I figured that people who are listening who are connected into that community of how do you make people sleep would probably understand those names. You have worked with them. What are the tricks to hacking sleep for people who are so stressed that people maybe shooting at them at any time? How do you do that?

Dan: I also work with high functioning organizations to help them with his similar issue. The Seals are tough they are not always in a place where they can act upon the things that will get them a good sleep. Then you have to know "If you can't do everything that ordinarily would, what would you then?" A lot of their training tries to inure them to the effects of sleep loss which can happen. What that means is that you don't get

enough sleep on a regular basis and you basically become toughened to the effect. You see this with a surgeon who's performed surgery at night thousands of times. Over time they actually have less of an emotional toll of say "I'm not getting the sleep that I need but I've been in this situation 1000 times and I can perform well." That thing can happen.

When you don't get the full amount of sleep that your body would want, you can train yourself to have less of an emotional response to that. However, the objective impairment that does take place will still ... You can't train yourself to not experience the objective impairment. What ends up happening is these guys can perform well on less sleep because they've done it before and they know that they can but they're also more likely to do things like engage in friendly fire and make decisions that are uncharacteristic of themselves if they're really sleep deprived for long periods of time. You want them to be tough to the effects of sleep loss but you also want them to be sensitive enough to know when they're putting themselves or their team in a dangerous situation.

Dave: When I was developing the Bulletproof diet I went through this period it was after my son was born and I said "I'm going to do this ridiculous experiment. I'm going to eat 4000 or 4500 calories a day and I'm going to maximally sleep 5 hours a night. If I'm just going to wake up when I'm going to wake up like at a set time and if I go to sleep at 4 in the morning and I wake up and I only get 3 hours of sleep that's just what I'm going to have for the day and I'm not going to take naps and all that stuff." I figured I was doing this because if I got very little sleep and I eat way to many calories and I stopped exercising I should gain weight.

I was planning to gain 3 pounds when the calories in and calories out so I should gain 20 pounds and I'll be like "Where's the 17 pounds? The math is wrong here." What I did was I got a ton of energy and I was using [Bulletproof coffee](#) with like 8 spoons of butter and whatever I could to pound the calories in and I end up doing this for about 2 years. I maintain muscle mass, got a little bit leaner and overall had this experience. I believe that I stress condition myself for sleep because during that time I also got to fly. I'll fly to Singapore or wherever and I'll get on stage 2 hours after I land. I'll deliver a kickass presentation.

Sometimes I use modafinil during the first half of it but a lot of times I didn't. I'm not using modafinil now. I haven't used modafinil in the past going on a good year and a half maybe almost 2 years because I don't need it anymore. I might be tired but I can still kick ass. Consider me maybe a sleep condition as some of these guys that you train but when I started that if I was an average person, what percentage of the sleep deprivation burden comes from my body's own fear of being tired versus the actual physical impairment?

Dan: That's a really interesting question. In fact my research was looking at something just like your question but related to food intake. It's really interesting stuff. I'll tell you about the experiment and we'll use that as a launching point to go further on the topic. I took 50 subjects and I gave them a baseline examination where I looked at a variety of things related to cognition. Reaction time, mood, memory and that was baseline. A week later the intervention was that they got more or less sleep than usual. Then they came back the next day, the day after the sleep loss or normal sleep and they did the exact same experiments that they did the week before. I look to see how did their mental performance change if they had more or less sleep.

What I also did was I used intentional misdirection. In the middle of the test I gave them a break and that break I put out a variety of different foods. I said "I'm going to have you watch these 2 TED videos and you came in and fasted you didn't have anything to eat so but then the last experiment you need to actually have some food in your system. It's better to be closer to full than still hungry." That's all I said but I said the exact same thing to everybody. The food choices were basically ostensibly healthy or not so healthy so you had gummy bears and you had almonds.

Dave: Gummy Bears are low fat so those were the healthy choice, right?

Dan: Exactly. As you know people's opinions about food vary drastically. They were agave, gummy bear so some people might say "Isn't agave supposed to be healthy?" Actually they're good for me. Some people if they believe that fat is bad for you might look at the almonds and say "Those are high fat. They're not good for me." What I really cared about

was how did people eat based off of their own perceptions of the food. I had them at the end of the study rate all of the food choices. Then what I did is I looked for associations between reaction time which is a measure of objective alertness and how well and what they actually ate and I found some pretty interesting things.

That subjective sleepiness which is basically how sleepy you feel had differential effects than objective sleepiness which is a reaction time. Not in all cases there were some overlap but when people feel sleepy they ended up eating more calories in total. They ended up selecting more foods that they rated as less healthy and then as the investigators we also decided to draw a line down the middle and we said “These 4 foods are actually bad foods and these 4 foods are good foods.” We then said “How much did people eat based off of the investigator rating of these foods?” Anyhow, it was very interesting.

When people feel sleep they ate more foods they rated as less healthy and when they had objective impairments of sleepiness so when they had slow reaction time they ended up eating more calorically dense foods and these were all statistically significant findings. I think your question was, how much of the effects of sleep loss or just the emotional toll? It’s a good question and it’s probably conditional on what exact situation we’re talking about. They do differentiate so just by feeling sleepy ... I mean these people they weren’t in terms of their reaction time objectively they are performing fine but they felt sleepy and they were making different choices. That’s a pretty interesting finding.

Dave: I believe there is some value for people. Maybe that’s the function of going to college is just staying up really late and drinking too much beer and then somehow managing stumble into class the next morning and not fail. There’s something that you can do just to reduce the stress. I look at my experiences taking modafinil most of the time for 8 years. I actually talked this through with my wife Dr. Lana and one of her theories is that when you take modafinil for even a few months that it does show the body I don’t mean show you but it shows like the nervous system and the parts of you that you normally see that you’re not going to die if you’re tired and you have to get up and do what you’re going to do.

It just lowers that stress thing and so lack of sleep conditioning is rough on your body. It can give you cancer and things like that if you do it a lot but if you do it enough to be able to function on a little or a lot of sleep and maybe that's a life skill that's worth having.

Dan: It's a really good point and we see that with nurses and anybody that does shift work. They have to learn how to perform when they're not getting optimal conditions for good sleep and mental performance and they do. Not all the time actually you see a higher risk of accidents. We'll talk about some of the stuff today I'm sure but the mind changes in a variety of interesting ways when you're sleep deprived. Some people can perform let's say a majority to all of the task just fine but the more complex those tasks get, the more sleep deprived you are there's also individual variability some people can withstand sleep loss much better than others.

If you look at objective decrements of performance over let's say 60 hours they experience very, very little and that has to do with genotypes around period genes other genes that are involved with circadian rhythms that kind of impact of sleep loss. I bet that Seals for example are probably selected. They have a certain genotype that perform very well under sleep deprivation. That doesn't mean that they need sleep less than others across all the different domains of the value of sleep but that means they can perform better where other people once they've had a full day of wakefulness their performance drops off precipitously as soon as it's nighttime.

Dave: I love talking with doctors and having one in the house makes it really helpful. I was talking with Dr. Lana about what do you do when you're working the night shift in the ER and one of the things you eat and you eat calorically dense foods because now we know at least that willpower in the brain is tied with blood glucose levels and I would argue or ketone levels because when people drink [brain octane oil](#) and get ketones and sugar at the same time they get more, there's an edge there. What changes in your research when people are eating calorically dense nutritious foods?

Dan: I didn't look at the effect of the meal on the mental performance. I'm going to analyze that later because I did have one part of the test happened after the food intake but I was more interested in looking at how reaction time influenced or didn't influence what people chose to eat and how much they ate. That was basically the primary variable of interest. Unfortunately the research that's looking into diet and sleep are not that good. There needs to be more research there.

Generally carbohydrate seem to have an favorable effect on sleep. The reason being probably is that there are neurons in the brain called hypocretin neurons. Those neurons are responsive to circulating levels of glucose and those neurons are inhibited by glucose. A really good way to think about what these neurons do is they sit at the center of the wake network and they tell all the other awake network neurons when to be on. If you are sleepy then having glucose in your system is going to make you feel sleepier.

If you have good alertness and you've gotten good sleep regularly having carbohydrates in the system can actually make you feel more calm. In the evening the only studies the few studies that I have seen on nutrition ... I mean the data is all over the place but a carbohydrate meal in the evening can help to reduce sleep onset so people can fall asleep a little bit faster. Does it have much of an effect on sleep quality? Not really, nothing substantial.

Dave: It may be individually variable too for the individuals sleep quality thing. I've had a few clients where they do the trick I wrote about in the Bulletproof diet about using a tablespoon of raw honey. Are you familiar with that raw honey versus regular honey idea?

Dan: Tell me a little bit more about.

Dave: I came across this fan and I wish I can remember who it was who sent me this book randomly called The Honey Revolution. I'm like "Really? You're sending me a book on like how to have sugar. Oh come on!" But I read the book and I apologize if I got the name like the honey something but it had just tons of tons of references. The most interesting ones in the book was that if you took about a tablespoon sometimes a little less

sometimes a little more of only raw not cooked honey maybe 15 minutes, a few minutes before bed then it would raise your blood glucose for at least 6 hours because that kind of honey is 22% more likely to liver glycogen which serves as a fuel source more for the brain versus muscle glycogen.

When you did this study it would improve sleep quality. I've been taking with Seth Roberts from Quantified Self and he had also noticed this. Funny if I have desert I sleep better thing. I'm experimenting "Wow it's kind of cool. I'll put it in the book and site the places where it came from." Is there validity based on what you know about the stuff to that idea? Is it a hypocretin thing or is there there's also talk about being serotonin modulated? Any thoughts?

Dan: Blood glucose levels are regulated in a very complex fashion over the course of a 24 hour period and I wish I knew it a little bit better to describe it probably efficiently. Our hormones change over the course of the night as you know. At different points of the day for example our cortisol levels are low in the evening and they're higher in the morning. That will change over the course of an evening and one of the reasons that it does that is to actually maintain adequate blood glucose levels throughout the night.

There's other hormones that will actually respond in a similar way. We have growth hormone levels are very high in the first part of the night. They correspond with levels of slow wave sleep which turns out to be restorative aspects of sleep. Anyway, there's this intricate dance and balance over the course of an evening with different types of sleep that are occurring and different hormones that are released and the stabilization of blood glucose levels that take place during what is typically a fast. We don't eat at night usually. Actually when we do it's problematic. That is one of the ways where that the body will regulate blood glucose levels.

In the morning when cortisol levels are high, part of that is to actually keep an adequate amount of blood glucose in the blood to support the regular functions that it does. Anyway, it's a very complex dance. I don't know that you need to like be loading carbohydrates in order to induce

that effect. Our blood glucose levels stay fairly stable unless you have hypoglycemia issues for over 24 hours. I don't know anything about that but I'll look into it. Thanks.

Dave: It's a question that there's few guys I would even think about asking because it's jut out there a little bit. The effect was really noticeable so I'm writing about it. It's a quick experiment and I've tried honey before bed for a week and if blood glucose doesn't go crazy and you sleep better think well okay. Stop it for a week and start it again and it's probably now placebo and if it is then own it.

Dan: It sounds like a very low risk experiment.

Dave: Let's talk about persistent insomnia and inflammation. Are you on top of the correlations there? It looks like you might have done a paper on that.

Dan: I didn't write a paper on insomnia and inflammation but ...

Dave: Maybe you just sent me one then.

Dan: Maybe. I'm interested in insomnia. I was in Switzerland and I had a good fortune of sitting down at a table with the dean of the neurology department at Harvard it was a conference and we were chatting about insomnia. His name is Cliff Saper and he's like "Insomnia is much more of an anxiety disorder than it is a sleep disorder." There are different types of insomnia the kind of organic insomnia is very rare but that is where you have a problem with some center involved in sleep initiation or sleep maintenance. It means that you cannot go or stay asleep and that's a real big problem.

For most people most of the time a lot of us experience insomnia at some point in our lives and it has to do often with some stressor and sometimes it's actually just mental engagement. You've got this idea and you're absolutely manic about it and you can't stop thinking about it and shut off the machine and that happens a lot as well. Either way you have this hyperactivity that is taking place in terms of cortical activity and you can't shut it down. It overwhelms the pressure of sleep that has

built up naturally over the course of the day. What's really interesting is that some work by Eric Nofzinger.

This is a typical experience. People who have chronic insomnia. They go to a sleep specialist. They do a PSG or overnight sleep study and the doctor tells them "Everything is normal and all of your sleep architecture looks totally normal. You fell asleep a little bit more slowly. It took you longer to fall asleep than an average person by a little bit but it took 25 minutes instead of 9 so your fine." The person will look at the doctor and be like "You are a fraud. I hate you. You don't know what you're talking about. I was up all night." That's why I think that this work by Dr. Nofzinger was really, really interesting.

He did fMRI in people who have insomnia. What he found is that brain activity so you can detect with more fidelity different types of brain activity with fMRI that you can with normal PSG. What he found is that there was areas in the brain that looked like they were awake even though the rest of the brain was asleep and he called it this hyperfrontality. These areas that are processing thought it was like they were awake. They were not demonstrating normal characteristic behavior as sleep but the rest of the brain was asleep. Because that area was hyperactive at night it led to hypofrontality during the day which meant like sluggishness and slow thinking and fatigue.

That's a pretty common experience of people that have chronic insomnia is that they feel that they're awake even though they're asleep and part of that is because their brain is processing and thinking and they feel that they're awake. That even though they can't sleep ever or they have a hard time doing it, they have this alertness that is there persistently. It's a tough situation. There a lot of things that are driving it. Anyway, you asked about inflammation and insomnia. I haven't explored the connection there but inflammation seems to break everything in our body.

I certainly would not be surprised if there was an association. There are centers of the brain in the hypothalamus that are most active at night. They initiate to facilitate sleep onset. If those areas were to become inflamed like we see with other areas of the hypothalamus so we know

that areas of the hypothalamus can become inflamed then usually what you have is inhibited function. While I don't know anything specific about the connection there, I wouldn't be surprised if there was one.

Dave: There's a couple of studies I've come across that say that there's one and certainly you would expect if you have less growth hormone and your other circadian disruption things happen that inflammation would be one of the things that would happen. There's another thing that's come up lately the potential that narcolepsy might be an autoimmune condition which I would absolutely say makes sense to me based on a lot of the narcoleptics that I've talked with over the years. They seem to have all these other problems. What do you think about your immune system and sleep? Is there a connection there that people can use to hack their sleep or people with allergies actually be paying extra attention to their sleep?

Dan: Narcolepsy is a disorder that I studied for about 8 years. I worked for a pharmaceutical company that had a drug for narcolepsy. That drug is sodium oxybate. That's where my love for sleep started. I knew nothing about it beforehand and I would go to the APSS conference, Associated Professional Sleep Societies and soon it became one of the hardest choice I have to make all year was like which session do I want to attend. They were all so interesting. It was all such a window into how sleep provides this incredible window to understand how the body and mind work. Narcolepsy has been the darling of sleep research because as I was mentioning earlier these hypocretin neurons those are the neurons that are actually go missing with narcolepsy.

Probably due to autoimmune attack, autoimmune disorders can be very hard to pin down because the conditions of autoimmunity that end up causing the damage at a certain site the markers can be gone by the time that the condition manifest itself clinically months later, years later, whenever. People that have narcolepsy likely had some infarction of the hypocretin neurons maybe 8 months previously or a year previously and so it's like there's no smoking gun at that point. Go ahead.

Dave: I've got a study here that looks at autoimmunity to the brain or to different parts of the brain caused by environmental mold toxins and

very specific which part of the pituitary gland gets targeted in response to exposure to water damaged buildings. It's one of the things that's in the documentary on toxic mold I have because mold is a big trigger of autoimmunity but so is like excessive stress and adrenal dysfunction that tends to precede autoimmunity. Again the stressful period you're exposed to some trigger probably environmentally and then all of a sudden a year later you're like my brain is jacked and I have no idea why and you're not going to find that stuff anymore unless you happen to living in the same house that got you sick in the first place.

Dan: That's likely what is happening with narcolepsy. There is some environmental trigger. There's probably some genetic susceptibility we see that. Maybe it's also under the conditions of stress so that confluence of factors just like you described could absolutely be what's causing a variety of different autoimmune attacks. Narcolepsy it's about 1 in 2000 people have it and I was describing before these hypocretin neurons sit at the center of your awake network. If you imagine the conductor being removed from the symphony then there's just not as much of a signal to other areas at the awake network that keep cortex alert during the day that keep you functioning to kind of say "Hey be on now. It's daytime. Be alert, function."

What happens is narcoleptics have a very interesting pattern of sleep. They don't sleep more than normal people. They actually sleep 8 hours about just like the normal population but they cannot sustain wakefulness for more than 3 to 4 hours at a time and then they have to sleep again. Then they can't sleep for very long. They can only sleep for let's say an hour or 2 and then they could be up again. They're almost like a cat where they can only be up for a little bit of time then they rest, be up for a little bit of time. Over the course of 24 hour period it's almost like they're doing polyphasic sleep.

They're up for a little bit then they sleep. They're up a little bit then they sleep and that's really difficult in modern life which expect you to be at your job for 8 hours, be up for 16 or sleep for 8 hours so that you can have a full day of functioning. It's a very difficult condition. They take very high amounts of stimulants and it still doesn't completely reduce the sleepiness that they feel. They're still clinically sleepy so they'll take

methamphetamine and it's still not enough to get them to feel as alert as you and I do.

Dave: I got an email a while back. Actually I've received a few from narcoleptics. This guy that was like they went from like 30 or so attacks down to 1 a day when I switched to Bulletproof coffee. My question for you is, is it likely mitochondria mediated? Like do some people just suck at using glucose in their brains? Maybe just "Oh my goodness I had ketones because I used some [brain octane oil](#) so now I have enough energy." Is it like the brain cells are building up a charge they just can't hold the charge for very long? There's some studies about that.

It actually doesn't make sense like amphetamine is a very strong stimulant and coffee is not a very strong stimulant but at least in that one weird case where he felt that he should email me about it. I've always wondered, is there some mechanism that you can think of around blood sugar versus fat and neurons versus glial cells and any light you can shed on that? I was so fascinated by that.

Dan: I have not thought about this question before so this is just be like on the fly. The drug that I worked was sodium oxybate. The other name for that drug is gamma-hydroxybutyrate GHB, which is a drug of abuse, but it is a short chain fatty acid. It all sounds familiar to people as if they don't know it for the fact that it used as a medication. It was called the date rape drug. That's a whole other story that's very complex. I'll just mention something about it because people are like "Wait! Tell me about that." Rohypnol is a long acting benzodiazepine that cause retrograde amnesia. It caused people to forget what happened to them 16 hours prior to taking it. That was used to facilitate date rape.

That was cracked down on and GHB which in fact is a very, very different drug started to be used in a similar capacity but it has much different effects. It doesn't cause retrograde amnesia but it will cause basically sedation and hypnosis given in a certain amount. Any drug that has those central nervous system depressant properties like alcohol. There's actually 60 different drugs that are classified as date rape substances they can be all used in that manner. There's nothing unique or specific about GHB but it did get that notoriety. That was the

sociopolitical environment around the same time that the company was looking to develop it for narcolepsy.

It has very interesting properties for narcolepsy. It does things that other drugs don't seem to do. If you think about narcolepsy, a good way to think of it is if there's 2 different main symptoms. One is suppressed wakefulness. That's what most people think about. Narcoleptics are extremely sleepy and they can sleep at any time. They also have something called cataplexy which is basically loss of muscle tone with an emotional trigger. Let's say I'm about to tell you a joke all of a sudden my jaw might sag, my shoulders might sag. I will feel heavy and I might even collapse all the way to the ground. People have mistaken that as "Oh they're so sleepy they fell asleep." That person is wide awake but basically they're temporarily paralyzed.

That is very, very dangerous because imagine if somebody had any emotional reaction at the top of stairs and they had a full collapse. Well people have died that way. The battle is to get GHB approved where basically these 2 camps one is like this is a poison that should not be released under the street and the other people are like this is the only thing ... My friend died because they had a cataplectic attack at the top of the stairs and this is the only drug that's ever helped. I haven't worked with this drug in 10 years but I wrote a lot about it.

The mechanisms of action were it is not clear. There was a lot of different things that seem to have been doing but anyway that's long winded story. GHB, gamma-hydroxybutyrate is oftly similar to beta-hydroxybutyrate which is a ketone that has fast interesting effects on the brain. Appetite surpassing effects, it actually can affect the health of certain neurons within the hypothalamus. Now GHB would have a about the same to bigger impact on wakefulness than amphetamine.

What's going on there? This is a sleep drug that's helping perhaps sleep a little bit better, more deeply but is it also somehow affecting the health of the cells, the remaining hypocretin cells because not everybody has compete removal of those cells. They might have 10% surviving hypocretin neurons and if you could get them healthy or you can actually make the ones that they thought were dead healthier again you

might be able to restore some function or maybe there's other mechanisms altogether. Either way it's a really interesting parallel that you drew and maybe beta-hydroxybutyrate is acting similarly to gamma-hydroxybutyrate and that wouldn't be so farfetched in my mind.

Dave: For people listening the reason that I use brain octane which is about 6% of what's in coconut oil is it is the one oil you can get that most quickly converts to BHB in the body and BHB can convert to coenzyme A which then converts to ATP. That's why a tablespoon of coconut oil is not the same. It's actually 1 tablespoon of [brain octane](#) is 18 tablespoons of coconut oil for this one short chain C8 fatty acid. We're getting a little bit geeky there but like the differences you drink 1 cup of [Bulletproof coffee](#) made with the right recipe versus throwing coconut in there.

Coconut is good for you. You get some lauric acid. It's almost like free and lauric acid is so abundant in coconut oil that you don't need to separate it out and it's not a medium chain triglyceride. Anyway that's a marketing scam. That's probably a side topic. It's a long chain fat that's labeled to be medium chain fat.

Dan: I have a potential mechanism for why [Bulletproof coffee](#) stimulates unusual amount of alertness.

Dave: Please do tell. I've been trying to figure this out because it doesn't make sense. It does like a bunch of them but I want to know.

Dan: The ketones can pass the blood brain barrier and they can serve as a fuel for the brain. You know that but why would that make you hyper alert which a lot of people experience I have myself. As we talked about earlier if hypocretin neurons are inhibited by glucose and you're fasting then you're going to have this dual response from a hyper alert hypocretin system because it's not getting any inhibition from glucose or perhaps subdued. If you have a big glucose meal for breakfast then it doesn't mean that you're going to be sleepy although some people might experience that. It might just mean that you feel a little bit more calm.

Basically with the absence of glucose it could explain why when we're hungry we have this increased arousal. In the morning you have go

ample fuel through the ketones and you've got this basically hyper arousal from hypocretin neurons and that's keeping you in a very lucid alert state. You're amplifying the effects of the primary alertness driver in the central nervous system. I hope that makes sense.

Dave: It did make sense. You're thinking that when people do it the way I recommend without protein that raises insulin and can raise glucose a little bit and without carbohydrates. In other words just fat and coffee including the [brain octane oil](#) and grass fed butter. When you do that in the morning it's the suppression of the glucose just because there isn't any in your diet plus the increase the ketone so it's the ratio of the 2 shifted.

Dan: Yeah.

Dave: I didn't know about that. I didn't put that in the Bulletproof diet book but there's some other mechanism where I've got bacteria and stuff but thank you for that. That's valuable.

Dan: This is something that's not talked about very frequently. This could also be why people experience. The same mechanism could explain the dip in consciousness or alertness in the afternoon after a high carbohydrate lunch.

Dave: Because you have glucose which suppress the hypocretin function.

Dan: That's right. Hypocretin function naturally dips in the afternoon that's why we take siestas between 2 and 4. That natural dip could be basically exaggerated in the presence of glucose. If you want to take a nap, great have a higher carbohydrate meal and go to sleep when your body tells you to and you can get a real deep good nap and then wake up. You can use naps functionally. If you need to do a lot of writing or anything like that in the evening taking a nap can supercharge that.

Dave: That was actually my next question for you. It's like, what can people use right now? You're take on nap. What's the best time for nap if you're going to do it and why should you do it or not do it?

Dan: Naps are neither good or bad but they can be used in a smart manner. We have these ultradian rhythms throughout the day. A circadian rhythm is a repeatable 24 hour process. Ultradian rhythms are small micro rhythms that take place within a 24 hour rhythm. One of those rhythms is this circadian dip in the afternoon of our alertness drive and that is when all around the world humans will rest somewhere between 2 and 4 in the afternoon. That is explained by this reduced activity of hypocretin neurons. Act on that.

There's thought about how long should you nap. When you sleep for a certain length of time you can get into certain different stages of sleep and you wake up out of a slow wave sleep or deep sleep you can feel groggy and you can feel groggy for the rest of the day. A power nap is somewhere between 10 and 20 minutes and it is disproportionately recharging. We don't exactly know why it restores you as much as it does. It might have to do with sodium potassium signaling at the cells. It's not fully explained just by reduction instruction sleep.

We know that when you do fall asleep you have a fairly rapid reduction in sleep pressure. What is the correlate or the thing in the brain that is representative of sleep reassurance it's a built of adenosine. That makes a lot of sense because what is adenosine a byproduct of energy utilization. If you think about adenosine triphosphate as you're using energy there is this accumulation of adenosine it's in the brain and adenosine can do basically 2 different things. It can suppress the activity of neurons that keep us awake and it can also then activate neurons that facilitate sleepiness. In 2 ways it's promoting sleepiness.

What does caffeine do? It's an adenosine antagonist. It's blocking the effects of adenosine which is the primary reason why caffeine will make us more alert. It's blocking sleepiness that exist, that's there. What happens then when you sleep? Sleep actually wears down. You process all that adenosine that's built up and so when you nap you do the same. You process some of that adenosine and because you have less when you wake up then you can acutely feel rather alert for the remainder of the day. It's pretty complex and probably too much to explain without graphs about these different systems that are involved in keeping you

awake but basically how alert or how sleepy you feel across a 24 hour period is this dance between 2 different systems.

Sleep pressure which is adenosine and then wake drive. Wake drive is basically the activity of all of these neuron groups in the brain that keep the cortex alert. They increase in activity over the course of the day as sleep pressure builds. At night they're working really, really hard and right before sleep they drop off and all you have is this unopposed sleep pressure. That makes you feel really sleepy quickly and then it helps you stay asleep over the course of the night. Taking a nap can be really, really good. I also mostly try to avoid naps because I'd rather just to bed earlier and what happens when you get a nap it can actually make you not feel sleepy when ordinarily you'd be going to bed.

I just oftentimes try to get most of my sleep between when I go to bed at night when I wake up in the morning because I can't always predict when I can have the opportunity to nap. You can also condition to a nap where you're like "I'm taking a nap every day at 3." If you don't get that opportunity then you can feel really, really sleepy. If you happen to be driving at that time then that can be problematic. Mostly I try to avoid naps. I do take them to catch up on sleep so if I haven't been getting enough then I will try to get one. I like naps. I do take them. Can I ask myself a question, is it really necessary or can I actually just go to bed a little bit earlier? That's what I usually aim to try to do.

Dave: That's very much what I do as well. I don't want to nap every day. Other people say it increases performance of what not but that's time that you're not doing stuff. You have to lay down, wake up and get yourself going again. If I'm really short on sleep or if I'm dealing with crossing lots of time zones sometimes there's a good case for it but to do it every day it doesn't fit well with my lifestyle and the amount of stuff I do. Let's talk about mattresses. Soft, hard, cold, warm, what's the ideal mattress for you?

Dan: It's pretty funny. I don't know anything about mattresses. I really don't

Dave: You call yourself a sleep expert!

Dan: I feel like people can condition to a lot of different surfaces. Generally at night you want your environment to be dark, cool, quiet and comfortable. Different people love a hard mattress and they feel they get really rock solid sleep on it. Some people like a softer mattress. Some people have certain anatomical situations they're trying to address like they might have shoulder pain or they like sleeping on their side or their front. There's other reasons where a certain type of mattress might be better for you.

Generally I think you can get good sleep on a variety of surfaces and you can condition to that surface. Let's say you're used to a softer mattress and then you go to a hard mattress, your sleep might not be as good for a period of time but it might be fine after let's say 6 weeks or a month.

Dave: It might also be better. I did this I haven't even written this up yet but about almost a year ago a yoga teacher friend said "I've been sleeping on the floor on a blanket because that's what they're deduced that somewhere that she learned in some class, and that's sounds really uncomfortable. She said "No." After a week or 2 all body pain just went away and that it was really interesting. We theorize that maybe the proprioceptors in your joints get no signal from a soft mattress. These are the things that tell your joints where they are. I tried it and I've been sleeping on like a 1 inch piece hard neoprene foam close cell like almost like sleeping on the floor.

The first week everything hurt and after that I wake up with way less in fact almost no joint pain. I've been working with some sciatica from over exercising my posterior chain and even that got essentially gone. I was blown away by how good I feel and I go to hotel I think "This mattress is like sleeping on jello. It's gross." which is weird. Any thoughts about signaling from the environment to the body about just pressure while sleeping?

Dan: My bias in the absence of either available knowledge or understanding or my own knowledge or understanding tends to gravitate towards what was the conditions like for our ancestors? Did they have a 12 inch thick temper-pedic mattress or something that was uber soft.

- Dave: They had a sleep number sealed into the wall.
- Dan: While not paleo I do have an ancestral bias. It's good to think that way. What were the conditions like over the millennium that we evolved? It's likely that we probably had less of a perfectly smooth surface and it was probably harder. I would not be surprised if there was at minimum at least as good sleep maybe better. Like you said if the hard floor could feel really uncomfortable for a while but then it also might have some benefits in sensitizing the nerve receptors to that you experience less pain during the day, I'm totally open to that idea. I just don't know that much on it.
- Dave: There may not be any research about this to be honest. It was just an observation that was profound enough that I really notice the difference now but it's also I'm just conditioned to a hard surface. Maybe that makes me tougher, maybe it's like intermittent fasting or something like teach your body to deal with more so it does. When I come home and lay down on that thing which is the floor I'm like "I think now I sleep like I want to sleep."
- Dan: I had a very thick pillow for a long time and my neck always hurt. I basically sleep on a very minimal pillow now. I feel like I have better body alignment. We're in this position all day long sitting in chairs so I use a lot of foam rolling to lay back across it several times a day but also laying flat is a lot of different than laying up with shoulders still hunched in that position. A flat pillow is something that I appreciate. That's 1 modification that I definitely made to my sleep environment.
- Dave: On Bulletproof radio I had another guest come on with a sleep sensor to teach you to not sleep on your back to solve apnea. Are you a side sleeper or back sleeper?
- Dan: It's funny the first half of the night I sleep on my back and then I probably say 75% of my time asleep on the second half of the night is on my stomach.
- Dave: You're a back and stomach sleep something said it's really unusual. Is that conscious or it's just what your body does?

Dan: It's just what my body does.

Dave: I have tested the back sleeping which I did for a long time because I thought it was healthier versus side sleeping and I don't believe I have apnea and my zeo scores and all the other sleep hacking stuff don't show that I do. I have a bed sensor and I use stuff on my iPhone like I overtrack my sleep because it's painless to do. I found that I probably sleep best on my side but the problem is that I'm not a small guy and the distance from my shoulder to my head is bigger than most people. If I put a normal pillow here my head is at this odd angle and then I have to have shoulder out.

Just getting the right height pillow totally changed my ability to side sleep and I think most people just never pay attention like I just had a pillow. I didn't know what's inside it. Just paying a little bit of attention there it works and I get another pillow if I'm going to sleep on my back. That fat one is going to do the tuck your chin thing. Just looking at anatomy and sleep is something that no one's ever trained to do with that unless your parents were like obsessive and they'll teach you when you're a kid. This is invisible but it seems to matter.

Dan: It's a good point. Because I'm a back and stomach sleeper, a thin pillow is good for me but if you're a side sleeper like you said you could be in this very weird position if you don't have adequate support underneath your head. My wife, she sleeps with a thicker pillow because she's a side sleeper herself.

Dave: How do hack jetlag then? Now in your hotels or whatever, you don't get to have your favorite pillow but you deal with people like in military where they might fly the other side of the planet, blow stuff up, and fly back. What's the short jetlag hack that people might appreciate?

Dan: Most people take melatonin incorrectly. Melatonin is more of a timing hormone so it tells the body what time of day it is than it is a sleep induction hormone. It has some soporific effects or sleep inducing effects but they're pretty weak. Melatonin is produced in response to something called dim light melatonin onset. When light goes down, the tone and the intensity of light change light will enter into the eye and

there are receptors in the back of the eye that are sensitive to light. Now these are not rods and cones. Rods and cones are also sensitive to light and they are communicating with the primary visual cortex to turn that light into shapes and images that we can see.

In the mid 90's researcher Ignacio Provencio discovered a very similar class of these neurons that can transduce photons into nerve signals but instead of going to the visual cortex it went instead to the master clock. These are called intrinsically photosensitive retinal ganglion cells. It's a long word but it's just descriptive of what they do and where they are. Anyway, they're basically responsible for helping our body understand what time of day it is. During the day we like to get a lot of light and you think your eyes almost like a photon counter. The intensity of light outside is much more intense than indoor light.

Indoor light range somewhere between 1000 and maybe 10,000 LUX. LUX is a measurement of light intensity. You go outside on a blue sky at noon and it's going to be over 100,000 LUX. It's an orders magnitude different. Anyway, in the evening as the light changes then our eyes are attuned to that so the intensity decreases and the tone of the light becomes a little more amber dusk colors and that actually tells the brain to start producing melatonin. Melatonin will then reinforce to the master clock. It actually is produced in response to low light but then it also tells the brain "It's actually low light." Then it says "It's dark out. You got start dark activities throughout the body."

What's the jetlag hack? If you are going to a different time zone then think about when it is getting dark there. Take ½ mg of melatonin starting 3 to 5 days prior to when you leave in your current time zone. What you're basically doing is you're not going to induce any sleepiness. That is not a dose that's strong enough to cause you to be sleepy but it is a dose that's strong enough to tell you to start to basically adjust you to the new time zone before you leave. What that means is that you're going to have less adjusting to do once you arrive.

Dave: You can shift your internal time zone starting 3 days before and if you pair with light exposure wearing the amber glasses and not looking at

bright lights at a time in the time zone you're going to be, you can probably amplify that effect?

Dan: Absolutely. That's going to further facilitate endogenous melatonin release so you have exogenous in the form of a pill. You have the endogenous production by wearing amber glasses. You can also then use light in the morning so let's you're going to be shifting so that you're waking up earlier and going to bed earlier. Let your body start to wake up earlier and as soon as you do get bright light as soon as you can that is also going to facilitate that shift and make it faster as well.

Dave: There you go on Bulletproof Radio new hacks for jetlag. I've read about a lot but I love getting it directly from someone who spent 8 years looking at GHB. This is so cool Dan. We're coming up on the end of the show. Last year Paleo Effects you gave a keynote about why we get fat, are you going to be speaking or are you going to be attending Paleo Effects this year?

Dan: Yeah. I didn't submit a presentation just because I'm very busy with other things. I love presenting. It takes a lot of time.

Dave: It does.

Dan: It does but I am going to be presenting. I think we're on a panel together.

Dave: Are you on the same panel as me? I know I'm presenting there as well but I haven't checked out who's going to be there. The reason I'm asking is that A I want to give out a shout out to Paleo Effects in Austin. It's a totally cool thing to do. I think this will be the third year Bulletproof has been there. I would love to have more conversation with you and I'm wondering if there's a possibility when we're there if I can grab you. If I bring a couple of cameras we can set up and do another set of Q&A because I only got through half the questions I want you to answer because you can answer all these questions then. You got too much knowledge.

Dan: I'd love too. My wife doesn't want to hear me talk about this stuff. She's heard it enough.

Dave: We're going to work on doing a second live episode with you where we can talk about some of the other sleep hacks because this is just great fun. It's such a way to get people to get value out of what ... You're going to do it anyway you might as well sleep better. Since this is our first episode now there is the final question that I always ask on Bulletproof Radio. Given all the stuff you know not just about sleep but about life, your top 3 recommendations for people who want to kick more ass in life. If you want to perform better at everything you do, do these 3 things.

Dan: I would say focus on the mundane but meaningful. There's a lot of things in our world today around health which have merit. We're looking for some exotic solution that can supercharge us and they exist but what we shouldn't do is overlook the fundamentals that are important to cognition and health. Getting good sleep can sometimes not be that sexy it's certainly not something you're going to post on your Facebook wall but it has a massive impact on both how well you perform and how well do you live and how healthy you are.

I would say mundane is something that's it's easy to overlook but it means a lot. Next time when we speak I'll tell you about how I translate knowledge into what I think are the best things to focus on in order for you to get good sleep. They can be as simple as have a clear idea in your mind about what time you want to go to bed. I'll tell you how to architect that. How do you base that idea and it has to do with how much time you want to be in bed and also circadian timing. Once you do that having that clear idea and track it so that you can then know "Am I actually meeting my goals on a regular basis?"

Life today whether it's work or other distractions like Game of Thrones or House of Cards there are things that are out there that are competing for our attention and if left unchecked then sleep gets sacrificed and that is the condition of the modern world. You need to have clarity around "What is my sleep practice? How do I get good sleep?" Then objective feedback has absolutely been shown to be beneficial to say "These are your goals and here's how you're doing towards them on an ongoing basis." That type of feedback can help us in this world where it's so easy

to miss sleep. It's easier to miss sleep these days than to get perfect sleep. That's one. Let's see so 3 of them?

Dave: Exactly.

Dan: Focus on the mundane but meaningful that's like focus on the fundamentals. Three is know how you learn. I became a better and better student over the course of my academic career. I was an okay student in high school, a better student in college and a good student in graduate school. I think it had everything to do with understanding how I learn. The way that I figure that out is that I was very intentional about exploring what that meant for me. I know that in order for me to learn things I need to interact with information. I can't passively consume it. Because there's so many things in the world that interest me I have a breadth and depth approach.

My breadth approach is say I'm going to then try to just get exposure to a lot of information but I'm not going to try to learn all of it. I'm going to use that breadth to pluck the things that I actually want to take a deeper dive on. Then I'll spend a disproportionate amount of time on one academic paper. I'll spend 3 days just learning it but when I do that my own learning is so much better than if I just casually consumed things. I can recall and refer to studies that I read years ago only for the papers that I spent more time really looking into. Whether it's a paper or anything else learning back and forwards and you'll have that knowledge for life and talk about it and teach others.

That's number 2, know yourself and know how you learn. Then I think probably the third one is like the tail end of the fourth one is for the things that you like and learn teach others. Teaching others is a great way to share stuff that's valuable. A lot of people in the world of course care about the same things that you do. Being able to teach them is a great way for you to learn and it's also a great way to help your friends and people you love to benefit from these cool things that you're picking up on.

Dave: You might be the first person to say teach others as one of their top 3. It's very wise. I wouldn't be where in my career if I hadn't spent years

teaching people because it is how I learn too. It's very perceptive that you say that. That's an unusual one.

Dan: Focus on fundamentals, know how you learn and teach others.

Dave: Dan, thanks a lot for being on Bulletproof Radio. If people want to hear more about your work and what you do, where should they go?

Dan: Go to dansplan.com. I bet your audience would really like a blog I just wrote. It's a little bit of a controversial title why dietary fat is fattening and when it's not.

Dave: Timing matters.

Dan: Check that out. That got really good traffic. It's a difficult topic to unpack and I try to do it well. Then also my site which we didn't talk about is basically the blue model that I developed. I'm trying to operationalize that into a tool that people can use to benefit their own life.

Dave: Let's make sure in the next interview that we do have Paleo Effects that you and I talk about that so remind me then.

Dan: Will do.

Dave: Dan, thanks for coming on Bulletproof Radio and I'm really looking forward to the next time we record because I just didn't get enough.

Dan: I know. I can talk about this stuff all day and I love talking with people that are really passionate like I am so thanks. Appreciate being on.

Dave: You got it. If you enjoyed today's episode of Bulletproof Radio there's an easy way to say thanks. Actually there's a whole bunch of them but the easiest one is to go over to your favorite online bookstore or offline and buy a copy of the Bulletproof diet book. This is the easiest way to say thanks for episodes like this that are chockfull of information where you can learn stuff you're not going to find anywhere else. When you buy that book, it's going to help me write my next book. Now is a really important time for sales to go up. Buy it as a gift for one of your friends.

If you already have a copy, buy another one and carry it with you all the time and you'll see me in an airport and I'll sign it for you. However you do it I appreciate it. If you don't want to buy the book or buy another copy of the book, then just head out there onto iTunes and click this is a really good show or whatever that like button is on iTunes. Thanks so much. Have an awesome day and I will see you on the next episode.

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