

Healthy Eating & Eating Disorders - Anorexia, Bulimia, Binging | Huberman Lab Podcast #36

In this episode, I discuss what drives hunger and satiety, and the role our brain, stomach, fat and hormones play in regulating hunger and turning off the desire to eat more. I also address how protein is assimilated better early in the day than it is later in the day, and why those using intermittent fasting might want to shift their feeding window to earlier in the day.

Then I delve into the topic of disorders of eating: Anorexia Nervosa, where people starve themselves and Bulimia Nervosa where people binge and purge their food. I discuss some common myths about Anorexia such as the role of media images increasing the rates of anorexia and the myth of the "perfectionist" anorexic. I also review the symptoms, and the brain and chemical systems disrupted in this condition. I explain how anorexics become hyperaware of the fat content of foods and develop reflexive habits of fat-hyperawareness. Then I discuss the most effective treatments ranging from family-based models to those that target the habitual nature of low-fat/calorie food choices. I also discuss new more experimental clinical trials on MDMA, Psilocybin and Ibogaine for Anorexia, and both their promise and risks.

I review the latest work on binge eating disorder and brain stimulation, drug treatments and thyroid disruption in Bulimia and why the treatments for Bulimia are so similar to those for ADHD. Finally, I discuss "cheat days," body dysmorphia and the growing list of novel forms of eating disorders start to finish. As always, science and science-based tools are discussed.

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- [Andrew Huberman] Welcome to the Huberman Lab Podcast, where we discuss science and science-based tools for everyday life. - I'm Andrew Huberman. And I'm a Professor of Neurobiology and Ophthalmology at Stanford School of Medicine. Today, we are going to talk all about healthy and disordered eating. And indeed, we are going to

talk about clinical eating disorders, such as anorexia, bulimia, and binge eating disorder, as well as some other related eating disorders. However, before we get into this material, I want to emphasize that today's discussion will include what it is to have a healthy relationship with food. We're going to talk about metabolism. We're going to talk about how eating frequency and what one eats influences things like appetite and satiety, as well as whether or not we have a healthy, psychological relationship to food and our body weight and so-called body composition, the ratio of muscle to fat, to bone, et cetera. So, as we march into this conversation, I'd like to share with you some interesting and what I believe are important findings in the realm of nutrition and human behavior. I know these days, many people are excited about or curious about so-called intermittent fasting, intermittent fasting is as the name implies, simply restricting one's feeding behavior, eating to a particular phase of the 24 hour or so-called circadian cycle. Other forms of intermittent fasting involve not eating for extended periods of time for an entire days, or some people will extend to two days or three days typically. And hopefully they will drink water during those times, sometimes referred to as water fasting, which means that they are ingesting fluids. And hopefully they are ingesting electrolytes such as salt, potassium and magnesium as well, because well one can survive for some period of time without ingesting calories, it is extremely important to continue to ingest plenty of fluids and electrolytes. And the reason for that is that the neurons of your brain and body that control your movements, your thoughts, clarity of thinking in general, et cetera, is critically dependent on the presence of adequate levels of sodium, potassium and magnesium, the electrolytes. And that's because neurons can only be electrically active by way of movement of particular ions, which include things like sodium potassium and magnesium. So, without those, you can't think, you can't function and it actually can be quite dangerous. So, why all the excitement about intermittent fasting? Well, a lot of the excitement relates to work that was done by a former colleague of mine, down at the Salk Institute for Biological Studies in San Diego, named Satchin Panda, Satchin's lab identified some very important and impactful health benefits of restricting one's feeding window to particular within the 24 hour cycle, or even to having extended fasts that go for a day or two days, or maybe even three days. What they saw was an improvement in liver enzymes and improvement in insulin sensitivity, which is something that is good. It means that you can utilize the calories and the blood sugar that you happen to have, being insulin insensitive is not good, and is actually a form of diabetes. What Satchin's lab and subsequently other labs showed, was that restricting

one's feeding window to anywhere from four to eight or even 12 hours during each 24 hour cycle was beneficial in mice. And some studies in humans have also shown that it can be beneficial for various health parameters. However, the excitement about intermittent fasting seems to be related to the foundational truth about metabolism and weight loss and weight maintenance and weight gain, which is that regardless of whether or not you intermittent fast or whether or not you eat small meals all day long, or you eat one meal in the evening and snack up until then, it really doesn't matter in the sense that the calories that you ingest from whatever source, are going to be filtered through the calories that you burn, by way of exercise, basal metabolic rate, which is just the calories that you happen to burn, just being alive and thinking and breathing and your heart beating, et cetera. And the reason why many people will prefer intermittent fasting to other forms of let's just call it what it is diet or nutritional framework is that many people find it easier to not eat, then to limit their portion size. And here I'm not talking necessarily about eating disorders. I'm talking about the general population. So, I think that's one reason why there's so much excitement about intermittent fasting. Now, within the context of intermittent fasting on a circadian timescale, once every 24 hours, you generally find two categories of people, people who prefer to not eat in the morning, either because they are not hungry in the morning, or because they find it relatively straightforward to just drink things like coffee or water, et cetera, and push their feeding window out to noon or 2:00 P.M. or 3:00 P.M. and then they'll eat between, say 1:00 P.M. and 8:00 P.M. or 9:00 P.M.. It depends on the individual. Other groups of people find that they are very hungry when they wake up in the morning, they don't feel well if they don't eat breakfast. And so they prefer to eat early in the day, but then they limit their feeding window such that they cut off their food intake or stop ingesting any calories of any kind, somewhere around 5:00 P.M. or 6:00 P.M., et cetera. So, the duration of the feeding window has not been broken down into the kind of nuanced type of information that one would really want. At least not in human studies saying, well, a six hour feeding window or an eight hour feeding window is ideal. It really is going to vary based on lifestyle and circumstances, for instance, some families really want to eat dinner together every night. So, do you want to be the person that's sitting there watching everybody eat? Because you're fasting from 5:00 P.M. onwards? I don't know. That's an individual difference. What you can start to identify, however, is that people tend to fall into either one category. The other people who prefer to skip eating in the morning or people that prefer to, or managed to skip eating in the evening. And there has been no evidence

thus far, that one is better or worse, at least in terms of weight loss or overall health parameters. Now, you can imagine that some people might eat breakfast and dinner. And indeed I have several many colleagues in fact who just choose to skip lunch, because they're busy during the day, they eat breakfast and dinner, that doesn't afford the long, fast associated with sleep. What do I mean by that? Well, if you went to sleep at 11:00 P.M. and you wake up at 6:00 A.M. by extending your fast until 1:00 P.M. in the afternoon, you get quite a long period of no ingesting any calories. Whereas when you don't eat during the middle of the day, you are getting a fasting period. That's probably anywhere from four to seven hours, but it's not linked to the longer fasting period of not eating while you are asleep, because most, all people and I want to emphasize most, do not eat while they are asleep. But we are going to talk about any new disorder that does exist, where people actually eat in their sleep. I know it sounds pretty wild, but indeed it, that eating disorder does exist. And it has a very interesting underlying mechanism. So, why are we talking about this? And in particular, why are we talking about this during an episode that includes a discussion about eating disorders? The reason is, nobody not the government, no nutritionists, no individual, no matter how knowledgeable they are about food and nutrition and food intake, can define the best plan for eating for any one individual. I'm going to repeat that. Nobody knows what truly healthy eating is. We only know the measurements we can take, liver enzymes, blood lipid profiles, body weight, athletic performance, mental performance, whether or not you're cranky all day, whether or not you're feeling relaxed, nobody knows how to define these. And these have strong cultural and familial and socio-societal influence. So, if you hang out with people that intermittent fast all day, that will seem normal. If you spend time with people that have never heard of intermittent fasting, intermittent fasting is going to seem very abnormal. Now we are going to talk about eating disorders that really fall into the category of clinically diagnosable eating disorders, for which there's actually serious health hazards and even the serious risk of death,

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we will get to that topic. But for the time being, I want to emphasize a new set of findings that I think many people will find interesting. And at least we'll want to consider in light of their current nutritional plan or pattern of eating, whether or not you're intermittent fasting or not. And I want to cue up an important framework for the rest of the conversation on

healthy and disordered eating, which includes an understanding of thinking, decision-making and what we call homeostatic processes, meaning regulation of things that are going on in our brain and body and reward mechanisms. So, I'm going to return to that in a moment, but first I want to share with you these new findings that were just published in the Journal Cell Reports, a Cell Press Journal, excellent journal. This was a study that was performed both in mice and it included a crossover study with a human population. The human population was women, but it relates to a previous study that was also carried out in men. I'm going to simplify this study. We will provide a link to the full study so you can explore it in more detail. And if you're really excited about the results, I would encourage you to explore some of the references within that paper as well. What was the study? The study looked at giving mice or humans, two meals. And explored whether or not putting those meals early in the day or late in the day, had an impact on muscle hypertrophy, muscle growth and overall protein synthesis of muscle. So, when we eat, the amino acids from various foods are broken down and synthesized into different types of tissues. They can be utilized for energy, burned up for moving about and thinking et cetera, or it can be synthesized. Those amino acids can be synthesized into skeletal muscle. The sorts of skeletal muscles that allow you to move your limbs. This study explored how protein intake, which included what are called branch chain amino acids, and amino acids, like leucine, which are important for muscle protein synthesis. Explored whether or not emphasizing or skewing the protein intake toward early day or late day was better in terms of muscle hypertrophy. And they also looked at some parameters of strength, like grip strength. Now mice are nocturnal. So, before you say wait, mice are nocturnal, how did they look during the day? And it's completely, it doesn't apply because it's in mice. Of course they knew that. And they looked during the mice's active phase of their circadian cycle, which corresponds to our day. And in humans, they looked at whether or not eating most of one's protein early in the day, was better than if the protein intake and the sprint chain amino acids were placed later in the day. And yes, they had the mice do resistance training. They did that by emphasizing overload to one limb of the mouse. And that actually generates hypertrophy. It's a form of resistance training in mice. So, they don't have them weight training. They weren't doing curls and dips and squats and things of that sort. They were moving their own body weight, but they skewed that distribution of body weight by restricting a limb and forcing them to use one limb that did indeed grow in response to that. And then in humans, there was an exploration of grip strength. And then with resistance training that was also carried out

through a peripheral study. Basically the takeaway from this study was that mice and humans can utilize amino acids that are ingested early in the day, better than they can utilize amino acids ingested later in the day in particular toward muscle hypertrophy and growth or maintenance of muscle, which for those of you that aren't interested in much muscle hypertrophy that aren't trying to grow your muscles. I've talked before in the episode on building strength and hypertrophy, that maintaining muscle, regardless of one's athletic prowess, regardless of one's age is extremely important because loss of skeletal muscle is one of the major causes of injury. As we age. It's one of the major causes, believe it or not, of cognitive and metabolic deficits as we age. So, maintaining muscle is important. Building muscle might be important to some of you, but what they found was ingesting protein early in the day. And these amino acids early in the day, led to more muscle hypertrophy than if the majority of amino acids and proteins were ingested late in the day. So, this translates to intermittent fasting, such that if you are interested in muscle hypertrophy, you might, and I want to emphasize, might consider making sure that you're getting sufficient protein intake early in the day. What sources of protein you use, is going to be highly individual. Some of you are meat eaters. Some of you don't eat red meat. Some of you eat chicken and fish and eggs. Some of you don't, some of you are vegans. It has been shown that the amino acid leucine is vital for the cell growth process, including muscle growth, because of its relationship to the so-called mTOR pathway, mammalian target of rapamycin. We can talk about that more if you like in a future episode, this means that if you're somebody who wants to maintain or increase the amount of muscle mass that you have, ingesting a high protein meal early in the day ought to be beneficial for that. Does it mean that you should not eat protein in the afternoon and evening? No. I think a lot of people might've misinterpreted this study and I don't want that to happen. This is only pointing out the fact that ingesting sufficient quality amino acids, including leucine, early in the day can be beneficial for maintenance and growth of muscle tissue. It does not say that you should avoid protein later in the day. Now for you intermittent fasters, this could be relevant. I, for instance, with somebody who for a very long time skipped breakfast, my first meal of the day would be in the early afternoon, mostly protein and salad, in my case, animal protein. 'Cause that's in alignment with my values. Then in the evening I would eat pasta, vegetables, et cetera. I might have some protein, some small piece of fish or chicken or something like that, but I didn't really emphasize that. On the basis of these results. I am experimenting with. I want to emphasize experimenting with, I haven't completely tossed out my old

protocol, but I'm experimenting with eating proteins early in the day and eating lunch. And then dinner might be light supper of some sort, but not so much protein later in the evening. Again, if you want to eat six meals a day, you want to eat round the clock. I'm not going to stop you. I'm not telling anybody what to do. As I mentioned earlier, nobody knows exactly how to eat for one's particular goals. But this study was really interesting, because it really did show that we can utilize the proteins that are ingested early in the day, better than we can utilize the proteins that are ingested later in the day. And of course there will be factors that can shift that. For instance, if you work out very hard with resistance training later in the day, resistance training is known to increase protein synthesis. So, it stands to reason that ingesting amino acids after that training would be beneficial. However, in this study, it did not seem to matter when the resistance training fell within the 24 hour schedule. The morning ingestion or early day ingestion of amino acids seemed to be beneficial. How early? Between the hours of about 5:00 A.M. and 10:00 A.M. for humans. Now just a bit of mechanism to explain why this happens. So, why would it be that ingesting protein early in the day would lead to more synthesis of muscle than ingesting protein later in the day? And the reason it turns out is related to the circadian clock mechanism that is present in all cells, including muscle cells. So, muscles have fibers. I think most people are aware of that, that your muscles are not just one big blob of tissue. A lot of these little fibers that contract. Within those fibers, however, there are cells with nuclei. Those nuclei contained DNA. DNA is transcribed into RNA. RNA is translated into proteins. The DNA of your cells, including these muscle cells are under strong circadian regulation. Each one has a pattern of gene expression that is different at different times during the 24 hour cycle, this is an unescapable reality of all cells in your body, right from your hair cells to your brain cells, to your retinal cells, to your toe on both feet. These cells make a gene called, BMAL, BMAL, B-M-A-L is a clock gene. And the expression of this clock gene varies across the 24 hour cycle, and proteins that are downstream of this BMAL gene influence protein synthesis. The circadian regulation of this BMAL gene turns out to be vitally important for this protein synthesis mechanism. How do we know that? Well, in this particular study, because they had a mouse that lacked BMAL, the gene was knocked out, they had bunch of these mice. They were able to explore whether or not this early day feeding effect was present or absent in these mice that lack the gene BMAL. And indeed it was absent. In other words, the effect of increased protein synthesis early in the day was eliminated in the absence of the BMAL gene. So, what this means is that when you wake up in the

morning, assuming you're following a standard schedule of being asleep at night and awake during the day, your muscle cells are primed to incorporate amino acids and synthesize muscle, regardless of whether or not you weight trained the night before 8:00 P.M., or you don't weight train at all, or you weight train afterwards or before. I said five to 10:00 P.M. is the sort of critical window for this increased protein synthesis. All this means is that if you are interested in maintaining or enhancing muscle tissue volume, that you might want to consider eating quality, protein and amino acids early in the day, you could train first. You could train after, you can not train at all. That's entirely different discussion. What is quality protein, well quality protein is going to be a protein that includes most of the essential amino acids. And in particular leucine. Now, there's a lot of debate as to whether or not you can get all the essential amino acids from a purely plant based diet or whether or not you need to ingest animal-based foods or not. The term quality protein has no strict scientific definition. Some people define quality protein as a protein that has a high essential amino acid to caloric ratio. Now, what that means is, a small piece of chicken or steak or eggs for instance, will have many essential amino acids with a low caloric content relative to say beans or plant-based food that can also get you essential amino acids, but it requires more calories to access those essential amino acids. Now that's that has many exceptions and nuances. And I for one, and perfectly respectful of the folks that just want to ingest plant-based foods in order to get their high quality protein. I think that actually can be done. One has to be careful and thoughtful in their choices about how to do that. So, this really isn't about animal based versus non-animal based foods. This is about getting quality amino acids early in the day from whatever foods are in alignment with your particular values in your particular eating plan. So, that's a lot of information, but the key takeaways are every cell in your muscles has a clock gene. The clock genes vary such that protein synthesis is greater early in the day than it is later in the day, such that in both mice and in humans, ingestion of quality proteins early in the day will be more so incorporated into muscle. Than the proteins that are ingested late in the day. And of course there are the caveats of if you're training hard late in the day, if you're adjusting your hormone status through whatever mechanism et cetera, protein synthesis can also be high later in the day. But for most people it's going to taper off due to this circadian BMAL gene related mechanism. Again, we will provide a link to the study and the other key takeaways were that nobody knows. Nobody can tell you what healthy feeding windows are, what the best feeding windows are. There's absolutely no information in that context, you talk to 10 nutritionists or academics or

trainers or individuals about what healthy eating is, and you are going to get vastly different answers. And that's one of the reasons why I believe that the internet in particular social media, are so filled with contradictory opinions, but the calories in versus calories burned formula, is that more or less holy foundation of all things about nutrition, eating and weight. And as we transition today into the discussion about eating disorders, I'd like you to keep this in mind because for the treatment of eating disorders, it doesn't matter what psychological or early trauma based effects led to the eating disorder. If the person isn't adjusting their feeding behavior

00:22:04 Sponsors

in a way that is going to ameliorate the symptoms of that disorder, which is ultimately the goal. 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. In keeping with that theme, I'd like to thank the sponsors of today's podcast. Our first sponsor is Belcampo, Belcampo is a regenerative farm in Northern California that raises organic grass fed and finished certified humane meats. I don't eat a lot of meat, but I eat meat about once a day. That means a small piece of steak or chicken, et cetera, and usually a salad. I usually do that for breakfast or for lunch. And then in the evening I tend to follow a more or less vegetarian diet. I tend to eat pastas and vegetables and things of that sort. Well I don't eat a lot of meat. It's important that the meat that I eat be a very high quality and that I am certain that the animals were raised and treated humanely up until the point of slaughter. Belcampo's animals, graze on open pastures and seasonal grasses, their entire lives resulting in meat that's higher in nutrients and healthy fats. It also results in healthy happy cows. Often talk about how important omega-3 fatty acids are. They've been shown to be important for regulating mood, for the microbiome, for restricting inflammation in the brain and elsewhere in the body. Belcampo's meats are known to be high in omega threes. And given that the meat is grass fed and grass finished, that combines all the features of the nutrition and the animal wellbeing that I want to see for any meat that I ingest. If you'd like to try Belcampo, first-time customers can get 20% off by going to belcampo.com/huberman and using the code `huberman@checkout`, that's belcampo.com/huberman for 20% off. Your first order. Today's podcast is also brought to us by Headspace. Headspace is a

meditation app. That's backed by 25 published studies and has over 600,000 five-star reviews. I've been meditating for a very long time. Although I admit I meditate on and off, meaning I'll go a few weeks or months meditating regularly. And then I tend to stop. A few years ago, I got into a regular meditation practice because I started using Headspace meditation app. The thing I really like about their meditation app is it has meditations of different durations. So, sometimes I'll just meditate for three minutes or five minutes, or ideally I'm doing two 20 minute sessions per day, but I confess I don't always manage that, but they have a ton of different meditations on the Headspace app that allow you to tailor your meditation practice to your particular schedule. And there are now a plethora of studies showing the benefits of a regular meditation practice. If you want to try Headspace, you can go to [headspace.com/special offer](https://headspace.com/specialoffer). And if you do that, you'll get a free one month trial with Headspace's full library of meditations. You get them all. That's the best deal offer by Headspace right now. So, again, if you're interested, go to headspace.com/specialoffer. Today's episode is also brought to us by Athletic Greens. Athletic Greens is a vitamin mineral probiotic drink, and it's one that I've been drinking since 2012. The reason I started drinking Athletic Greens and the reason I still take Athletic Greens is that it really helps me cover all of my nutritional basis with respect to vitamins and minerals and probiotics. And we now know that a healthy gut microbiome is supported by probiotics. And for me, Athletic Greens is the best way to get those probiotics. I also ingest some fermented foods, but by ingesting Athletic Greens, I'm certain to get all the things I need. And also, I just feel better when I drink it. I genuinely feel like I have more energy and I just feel better. And I happen to really like the way it tastes. I mix mine with some water and some lemon juice. And in doing that, I'm certain to get all my nutritional basis covered and the probiotics support a healthy gut microbiome, which is important for mood, regulating inflammation and so on. If you want to try Athletic Greens, you can go to athleticgreens.com/huberman. And if you do that, you can claim a special offer. They'll give you five free travel packs. In addition to your Athletic Greens order, those travel packs make it really easy to mix up Athletic Greens while you're on the road, in the car, on the plane, et cetera. And they will give you a year supply of vitamin D3, K2, vitamin D3 and K2 have been shown to be important for blood lipid profiles for metabolism and a whole bunch of other metabolic and neural processes. So, go to athleticgreens.com/huberman to get the Athletic Greens,

00:26:29 Defining & Diagnosing Eating Disorders

the five free travel packs and the year supply of D3 and K2. So, let's talk about eating disorders. And as we do that, I want to emphasize again, that nobody can really define what healthy eating is, with a single protocol. However, there is some general agreement about what unhealthy and disordered eating is. There are clear criteria in the psychiatric and psychological communities to define things like anorexia bulimia, binge eating disorder, all of which we will talk about, but as we have that discussion, I want to emphasize that self-diagnosis can be both a terrific, but also a very precarious thing. We talked about this a little bit in the episode about depression, there's always a temptation as one learns about the symptomology of a given disorder. It doesn't really matter what the disorder is, to ask the question. Well, do I have that? Does so-and-so that I know have that, ah, I see this sort of behavior or that pattern of thinking. In that individual, it's tempting to diagnose them and or ourselves as either having or not having a particular disorder. However, diagnoses really need to be carried out by people who are trained in that particular field, and that have deep expertise in recognizing the symptomology, including some of the more subtle symptomology of eating disorders. So, if any of the symptoms resonate with you, by way of you thinking that you have this particular disorder or someone that, you know, has this disorder, I would take that seriously, but I would take that information to a qualified healthcare professional that could diagnose or rule out any of these possible disorders. I say that not to protect us, but to protect you, because information is valuable. And I do believe that knowledge of knowledge can be very valuable in navigating any topic and improving our thoughts and behaviors around that topic. But one doesn't want to, or I should say, one, shouldn't start to self-diagnose simply on the basis of information without running that through the filter of a qualified professional. So, what is an eating disorder? Well, we have to take a step back, and confess to the fact that every society, every culture, every family, and every individual has a different relationship to food, eating disorders, however, have particular criteria that allow us to define them and to think about different modes of treatment. As it relates to the particular symptoms and particular, the psychological and biological symptoms

00:29:00 Anorexia Nervosa (Overview & Myths)

of those disorders. Now that's a mouthful, no pun intended. What are the major eating disorders? Anorexia nervosa, most commonly referred to as anorexia is perhaps the

most prevalent and the most dangerous of all eating disorders. In fact, anorexia is the most dangerous psychiatric disorder of all, even more than depression. The probability of death for untreated anorexia is very high, and sadly the prevalence of anorexia is very high. So, what is anorexia and how prevalent is it? Anorexia, if you look it up online or you talk to a qualified professional, is essentially a failure to eat enough, to maintain a healthy weight. You can see all sorts of very troubling symptoms of somebody who's been anorexic for some period of time, a general loss of muscle mass because they're ingesting fewer calories than they burn. Muscle is very metabolically active. They tend to lose a lot of muscle mass. They will have a low heart rate. This is the body and brain's attempt to lower energy output. They will have low blood pressure. They'll sometimes have symptoms like fainting. They will have sometimes even hair growth on the face, something called lanugo, which is essentially the body's attempt to insulate the body because of loss of body heat. When you're that thin. Loss of bone density, osteoporosis, loss of periods in girls and women, and all sorts of disrupted gut and immune functions. So, there are just tons of terrible symptoms of anorexia that really placed the anorexic into a very risky state, which is why mortality from anorexia gone untreated is extremely high. Now, one of the misconceptions about anorexia, is that it stems from an overemphasis on perfectionism, or that because of all the images in social media and in advertising of extremely thin and fit or muscular people that individuals are looking at themselves and comparing themselves to those images and thinking that they don't match up and developing anorexia, that turns out to not be the case. If you look at the prevalence or the rates of anorexia, in the last 10 years or 20 years, and you compare that to when anorexia was first identified, which was in the 1600s, and perhaps even earlier, what you find is that rates of anorexia are not going up. So, this idea that the images that we're being bombarded with are causing anorexia doesn't seem to be true. Now, that is not to say that the images that we in particular young people are being bombarded with are healthy for the psychological state of mind. But classically define anorexia has existed at essentially the same prevalence for the last 100, 200, 300 and 400 years, which is incredible and really speaks to the likelihood that there's a strong biological contribution to what we call anorexia nervosa. Anorexia nervosa is extremely common. It's anywhere from one to 2% of women. And the typical onset is in adolescence close to puberty, but it can show up later in life as well. In fact, the identification and diagnosis of anorexia tends to be in the early '20s. But if you look back at the history of those individuals, there were typically signs of anorexia that back into

their early teens. Or maybe even before that. Now, of course, men can be anorexic as well, but anorexia nervosa does seem to occur at 10 times the rate in women and young girls, than it does in men and young boys. So, while there does seem to be more of a prevalence of anorexia in boys and young men, these days, that's probably due to better diagnosis and detection than it is to some sort of societal shift related to imagery, et cetera. Later, we will talk about body dysmorphia and some of the images that are present in media and social media and how those are impacting other forms of eating disorders. But when you look at anorexia nervosa, this failure to maintain weight, even to healthy levels and often drops in weight that are very dangerous or even deadly, that has existed for a very long time, and seems to be somewhat hardwired into the biology of individuals that suffer from it.

00:33:44 Bulimia (Overview & Myths)

Now, when I say hard wired, that doesn't mean that it can't be treated or cured, and indeed it can. Bulimia which is defined as binge eating or overeating. Let me explain what that is. Binge eating is consuming vast amounts of calories in a short period of time. Overeating can be ingesting more calories than one needs, but over an extended period of time, both can exist of course, but bulimia is also very common. It's more common in young girls and in women that it is in young boys and in men, but it is present in both sexes. Bulimia and rates of bulimia might be increasing. That's sort of an interesting finding. It's not quite clear whether or not it's existed in its same form for a long period of time or within other new forms that are evolving or showing up, we're going to drill into bulimia and what it actually is and what it represents. But one thing I want to be clear about, just as the perfectionist mindset has been associated with anorexia, and it turns out that's not the case. It can be, but it's not always associated with anorexia. There was the idea that bulimia is associated with early trauma in childhood, in particular sexual trauma. And while that can be the case, there's no direct correlation between the two. Now, obviously psychological phenomena and trauma can have a profound impact on the way that the brain wires up and the way that people approach food and other types of behaviors. But the sort of classic idea was that all anorexics are perfectionists, they want to perform well. It's all about control and autonomy. And bulimics are kind of dysregulated and acting out against some early sexual trauma, those stereotypes of the psychological framework of anorexics and

bulimics, doesn't hold up. When you look at the data, many, many meta analysis have been done. It just simply is not the case. And in both instances, both anorexia and bulimia, there are clear biological underpinnings, to what's driving the under-eating or the overeating. So, we're going to talk about the biology of under eating and overeating and appropriate levels of eating. And by doing that, we will start to identify some of the mechanisms that serve as entry points for the treatment of both anorexia and bulimia. And as some of you are probably aware, anorexia and bulimia can be comorbid, they can exist with one another. There are anorexics who will binge and then purge in order to maintain that unhealthy low weight. There are bulimics who fit the psychological criteria of anorexia. And so there's a lot of overlap between those two categories. Now let's talk about the categorization for a second and why the categorization has led to now a bunch of other eating disorders as defined by the psychiatric community. One of the classic symptoms of anorexia is a loss of menstrual cycles, loss of periods. And the reason for that is when the body is undernourished, the body fat stores, send signals to the brain to inform that the body is undernourished, or they turn off the signals that say, look, there are enough body fat cells out here to support healthy metabolism. And therefore let's shut down ovulation, literally signal sent from the fat and muscle to the brain and the brain, the hypothalamus and pituitary will send signals down to the ovaries, or they will turn off the signals heading to the ovaries to deploy eggs, to maturation of eggs in the follicle, et cetera. So, there are instances in which people have anorexia or have bulimia, but are still maintaining healthy menstrual cycles

00:37:35 Binge Eating Disorders, EDNOS, OSFEDS, Pica

or at least menstrual cycles. And that has led to a whole set of other categorizations of eating disorders, like binge eating disorder, where there tends to be a lot of overeating, but not the purging or categorizations of anorexia, in which people are under feeding, but they are not losing their periods. And so these have a number of different names and acronyms. Some of them include things like, EDNOS, EDNOS is eating disorder, not otherwise specified. So, that's a sub categorization or OSFEDs. So, OSFEDs is or specified feeding or eating disorder. So, right now, if you were to look online or you're looking to the psychiatric and psychological textbooks, what you would find is that there's a huge constellation of eating disorders today. We're mainly going to talk about anorexia, bulimia, binge eating disorder and body dysmorphia. You can even find eating disorders

like pica, where people actually ingest things like dirt or rocks or metal because they have a genuine appetite for those things. I certainly do not recommend sampling any of those non food items. As foods, is incredibly dangerous. People often poisoned themselves. They often can cause structural blockages some people have died from those sorts of things. But nonetheless, there are aspects of our brain and biology that when disrupted can lead to very bizarre types of eating behavior, sometimes pica is caused by malnutrition, but not always. And so today we're going to focus on the most prevalent eating disorders, but we are going to build up toward that understanding by looking at what healthy metabolism and eating and satiety and hunger looks like. Because one, I realized that not everyone out there has an eating disorder. And two, I want people to understand this relationship between how they think, the decisions they take about what they eat and how the body and the brain at subconscious levels are driving some of these behaviors healthy or otherwise. Because I do think that it can lead us to a better understanding of what healthy eating is for most of us,

00:39:44 What is Hunger? What is Satiety?

and to increase compassion and hopefully even increased improvement in treatment of eating disorders for those that are suffering from them. So, what is hunger and what is satiety? Satiety, of course being sated or feeling like we've had enough food. I want to remind people of the basic mechanisms by which the brain and body communicate. This is vitally important, not just for this discussion, but for any discussion, about how we think, how we behave, how we feel, the body is communicating two types of information to the brain on a regular basis, but in particular around feeding, and those two types of information are mechanical information, and chemical information. What do I mean by mechanical information? Well, if you take a deep breath, oh, and you hold your breath, what you'll find is that you can hold your breath a lot longer than if you exhale all your air and you hold your breath with lungs empty. And the reason is not because when your lungs are full, you have enough oxygen and therefore you can hold your breath. It's because when your lungs are full, a particular class of neurons called baroreceptors, send information to the brain and say, there's pressure in the lungs. And that means that there's probably oxygen in here. And so the trigger to breathe is actually suppressed, when your lungs are empty. Even if you have plenty of oxygen in your system, those baroreceptors send a different signal to the brain, which is there's no oxygen in here and

you should breathe. And so the impulse to breathe comes earlier. Likewise, when your stomach is full, it sends signals to your brain that are purely based on this mechanical fullness, has nothing to do with nutrients, that says I'm full. And therefore don't be as hungry. Don't motivate to find or ingest food. Whereas when our gut is empty, even if we have plenty of nutrients or plenty of body fat stores, we tend to focus on food a bit more. So, volume and mechanical influences have a profound effect on how we think. And what consider doing or not doing, likewise chemical effects. When we ingest food, our so-called blood sugar or blood glucose levels go up. That information is signaled to the brain via neuronal pathways and hormonal pathways. And in particular, there are neurons within our gut, that signal to areas of our brain stem that are involved in satiety in our sense of having enough

00:42:00 Neuronal & Hormonal "Accelerators & Brakes" on Eating

that there's food in our system. So, that's chemical information. So, how our hunger and feeding and satiety regulated by way of mechanical and chemical signaling. You have, I have, we all have neurons in our hypothalamus that trigger eating and neurons that trigger cessation or stopping of eating. We have an accelerator on eating and we have a break. And I covered all of this in a lot of detail in the episode on feeding and metabolism and hunger. So, if you want a lot more detail, see that episode, but right now, I'm just going to give you the top contour of how all that works. Your hypothalamus is an area of your forebrain, which tells you it's in the front, but it's at the base of your forebrain sits more or less above the roof of your mouth. The hypothalamus contains lots of different kinds of neurons, including neurons that stimulate sexual activity and desire, regulate your body temperature and control appetite and ceasing of eating and appetite. There are two types of neurons within a particular area of your hypothalamus that are relevant here. There are the so-called POMC neurons, okay? Pro-opiomelanocortin neurons that tend to act as more of a break on appetite, by way of another hormone called melanocytes stimulating hormone. And not so incidentally when you're getting a lot of sunlight and you're viewing a lot of sunlight, that system is ramped up. This is why appetite is lower in the summer months than it is in the winter months. This is true in animals. And this is true in humans. And you have a class of neurons called the AgRP neurons. The AgRP neurons are the ones that stimulate feeding, and they create a sort of anxiety or excitement about food, can be positive anxiety, or it can be negative

anxiety. What do I mean by that? Well, if you ever seen kids heading in to get ice cream, they're absolutely excited. You see people getting raised, sit down and eat a big meal. They're excited to eat. Sometimes that's due to social factors, but they have an increase in overall levels of autonomic arousal. And depending on the context, they can feel excited or anxious, but it is a ramping up of energy. These AgRP neurons are what caused that, in fact so much so that if you eliminate or kill these neurons, which has been done in experimental mouse models in the laboratory, but also there are humans that have lesions or neurotoxic effects on these AgRP neurons. And what you find is that they don't want to eat. They essentially become anorexic, meaning they don't want to ingest food. They have no appetite for food whatsoever. Now that's not exactly what anorexia is, but these AgRP neurons are like an accelerator on wanting to eat. Whereas if you stimulate these AgRP neurons or in humans that have say a small tumor near these AgRP neurons, they become hyperphagic. They will eat to the point of bursting, both animals and humans that have elevated levels of these AgRP neurons are anxious. They want to eat, and they will ingest food to the point where they override those mechanical and chemical signals in the body. And I know it sounds horrible, and it is horrible. They will eat until the point that they burst. Now, there are signals coming back from the body to inform the brain about presence of different levels of nutrients. And that generally comes from three sources. First of all, is body fat. The more body fat we have, the more we secrete a hormone called leptin, L-E-P-T-I-N, leptin from body fat, leptin goes to the brain and suppresses appetite. This is a body to brain signaling mechanism that says, look, I've had enough, not incidentally, leptin signaling is disrupted in people that have bulimia and obesity and certain forms of binge eating disorder. So, that system has disrupted they have had enough signal or there's enough body fat here such that you don't need to eat more right here, I'm sort of in the voice of the body fat, trying to talk to the brain, that signal, that dialogue is mixed up or messed up. In some cases it's absent entirely. So, the body fat is signaling to the brain about how much reserve you have. It's sort of like a savings account for energy, 'cause that's what body fat is. You've got lipids in there and through lipolysis, that can be metabolized. If you're interested in that process, both how to increase it.

00:46:17 Fat, Leptin & Fertility & Metabolic Dysfunctions in Obesity

And just generally how it works. You can see the episode on the science of fat loss. The

body fat is doing something else really interesting that relates to anorexia, when they're sufficient levels of body fat and leptin circulating in the blood. And that leptin signal gets to the brain, the hypothalamus and the pituitary gland register that signal. And in a completely subconscious way, trigger the deployment of eggs in females and the production of sperm in males. So, when body fat stores are very low, the reason why periods shut off or sperm production is reduced or even shut off is because there's not enough leptin getting to the hypothalamus and to the pituitary. And they shut off the signals, the hormones, things like gonadotropin-releasing hormone, luteinizing hormone, follicle-stimulating hormone, all these hormones. So, you don't have to remember the names of if you don't want to that travel to the ovary or to the testes and cause the ovary and testes to ovulate or to produce more sperm. So, the reason why anorexic stopped having periods, while they stopped cycling, is because there isn't sufficient leptin in the bloodstream. Now there have been attempts to give leptin to anorexics because leptin has been sequenced and the peptide has been synthesized. And so you can inject leptin into people. There are studies where they've done that, when that happens, it does not tend to alleviate the anorexia, does not cause people to start eating again. And that actually makes sense because leptin is also a way of shutting off the hunger signals saying, it's the body fats way of saying, hey, there's a lot of body fat here, or there is sufficient body fat. There doesn't even have to be a lot, but it has, in some cases been shown to rescue the menstrual, cycling in some anorexics, okay? So, body fat is signaling to the brain. The gut is signaling to the brain. There are neurons in your gut that are primarily responding to meaning they fire electrical signals. When there are sufficient fatty acids coming from fats you ingest, amino acids coming from proteins you ingest and sugars coming from carbohydrates and sugars. Things like fructose, glucose, et cetera. Those signals are being sent from the fat and from the gut up to the brain. And therefore your body has multiple signals of directing you toward eating more or eating less. So, you've got two categories of neurons. One that acts as an accelerator, the AgRP neuron saying, eat, eat, and get you excited to eat. And then you have a category of neurons. The POMC neurons that are suppressing hunger. They're acting like a break, and the body is informing the brain all the time about the status of the body and whether or not it needs more food or not. So, you might ask why is it that people who are overweight and have a lot of body fat, why they would continue to eat a lot, well past a certain threshold of body fat that's when you start getting into these so-called metabolic disorders, where blood glucose metabolism is disrupted, leptin signaling is disrupted and

there are all sorts of changes on both the brain side and the body end of things, such that they're hungry, despite the fact that the body has plenty of energy on reserve. Okay, that I think is sufficient to explain the basics of hunger and satiety are kind of a biological mechanism. And the important thing again, to remember is that they're mechanical and chemical signals that come from fullness or absence of fullness that come in the presence of glucose in the blood or the absence of glucose in the blood. When you haven't eaten for a long time, glucagon levels go up, for instance, GLP1 levels go up and those will drive you to seek out food and want food. And then there are the signals that are coming from body fat and from neurons in the gut. So, there's a lot of convergence, in a lot of pathways. I don't offer you all those pathways to confuse you. I offer you those pathways to clarify the extent to which something as simple as eating or the decision to not eat is complicated. We've perhaps heard, or I've certainly heard that, oh, you know, it takes about 20 minutes for satiety to set in, so you should eat slowly that you won't realize that you're full until about 20 minutes. That's actually not true. I don't know where that got started, but we should probably all chew our food better

00:50:30 Why We Overeat

and eat more slowly, be more mindful of what we're eating, et cetera. So, in anticipation of this episode, I consulted extensively with a colleague of mine at Stanford, who sadly for us is going off to University of Pennsylvania. So, our losses University of Pennsylvania's win. His name is Dr. Casey Halpern. He's a MD, Medical Doctor and Neurosurgeon, and a PhD who studies binge-eating disorder and other types of eating disorders and how they arise in the brain. And he's developed some really pioneering treatments for them. We'll talk more about his work a little bit later in the episode, but we got to the discussion of why a body that has sufficient energy levels would desire to eat more at all. And this is not just the case for binge eating disorder for bulimia, but why that would be the case. You know, this is primitive biology that evolved over many tens. If not hundreds of thousands of years, you see it in mice, you see it in humans, very similar types of pathways and effects. How is it that human beings who have plenty of fat on reserve and plenty of glycogen in their liver, et cetera. In other words, plenty of energy, why they would be hungry, why they would eat at all. It seems like that just shouldn't happen. And he had a very important, and I think clear and intuitive way of framing up all this stuff around eating and motivated behaviors and how they can go

awry, not just in eating disorders, but in all of us. Basically what he said was, from an evolutionary standpoint, it makes sense that we should eat as often as we can, as much as we can, and as fast as we can. Well, that sounds crazy. I've been told to eat not too often, not too much, and to eat slowly and chew my food. But as Dr. Halpern pointed out, there are circuits in the brain to reward eating often eating fast and cramming as much food into you as possible. Because from a purely evolutionary standpoint, food was scarce, and seeking food was dangerous, whether or not it was from animal sources or not. And it's always been competitive, for those of you that grew up in families with a lot of siblings. This may resonate with you. I just one sibling, we were competitive about certain things, but typically not competitive about food, but I had friends that had a lot of siblings. It was really interesting to see how food was served up and how it was taken in those households. It was like food would hit the table and it was just an absolute war for portions and who got what and how much and who got a slightly bigger piece of cake, et cetera, turned out to be a frequent happening in these meals and that these birthday parties, whereas the only children perhaps were used to having more food presented to them without having to compete with other members of the species. Every animal, including humans has a hardwired circuit that we were born with that pays attention to how much food is available, how much we are getting now and how much we are likely to get in the future. And without going down the rabbit hole of arcuate nucleus biology, in two sentences, you have a hypothalamic area called the arcuate nucleus. It's a fascinating area. It's actually the area that houses, these PMOC neurons and these other types of neurons that regulate hunger and satiety. And these neurons in the arcuate nucleus start getting active. When we see food and think about food, they drive hunger, and they drive hunger in a way that's responsive to what the food looks like, what it smells like, but also our prior history of interactions with that food. And it takes into account social context, whether or not we are going to get the whole pizza to ourselves or whether or not there are going to be others that we are going to have to compete with. So, there are a lot of signals that this arcuate nucleus in your brain are paying attention to. So, Dr. Halpern pointed out that you actually have an accelerator that increases your level of awareness and anxiety and sort of constricts your field of view and all your senses. Anytime you interact with food and is driving a primitive reflex to ingest as much food as you can, as quickly as you can, and then move on from there, and presumably to do the same elsewhere. So, that changed the way that I think about eating behavior and eating disorders. In fact, we could think about eating disorders like

bulimia as an unmasking of that mechanism without the so-called top-down control, without the mechanisms that we use to regulate our behavior. And indeed bulimia and binge-eating disorder are closely associated with impulsivity and with impulsive behaviors of other kinds, something that we also will discuss more. What's the pathway? How does this work?

00:55:30 Homeostasis & Reward Systems/Decisions

What is Dr. Halpern and his colleagues doing in order to try and treat things like binge eating disorder? Well, you can frame all of behavior, good decision making and bad decision-making. In a pretty simple box diagram model. And I realized that many of you are listening to this, not watching this. There is no diagram to look at. I'll just explain it so that you can conceptualize it in your mind. We have knowledge of what we should do, in one box, okay? We should eat that. We shouldn't eat that. We should wait for dinner. We shouldn't wait for dinner. And then we have what we actually do in another box, okay? Now this is true for all behaviors, we should say something or we want to say something, but we don't, we shouldn't say something, but we do anyway. That's the knowledge that kind of looping in your head. I should do my homework. I should go for a run. I shouldn't do this right now. I shouldn't be on social media, all those kinds of shoulds and shouldn'ts that are circulating your head. That's one box. Then there's what you actually do. The behavior, whether or not you suppress the behavior, you turn off your phone and you go read a book or you go to sleep or whether or not you stay up all night, or you stay up for another hour, even five minutes. In between those two boxes are two intervening forces. And those intervening forces are critically important. Those intervening forces are homeostatic processes, called by some processes, same thing, homeostatic processes, that regulate the balance of different systems in your body, hot and cold, awake or asleep, dopamine and the desire to pursue things, serotonin and the desire to just relax and chill. So, homeostatic processes and reward systems. And as we now move into discussion about anorexia, and bulimia specifically, what you'll see is that anorexia and bulimia are not a breaking of the mindset of what one should do or shouldn't do. It's a disruption of these homeostatic and reward processes, such that decision-making is completely disrupted. And in many cases is not available to the anorexic or bulimic. Now, I don't want to be abstract here. What I'm saying is that the person who starves themselves to the point where they might die and in some cases, sadly do die. They can

know perfectly well that their behavior is leading to bad outcomes and possibly even death. And yet they are not able to intervene unless they get particular clinical help, because the homeostatic processes, the signals from the body and brain that say, you need food. Those aren't registering in the same way that they are for other individuals. and for the bulimic or the person that suffers from binge eating disorder. They don't necessarily want to eat that food. They simply cannot help it. It's like a reflex for them, because the homeostatic processes and the reward processes associated with food, are such that they can't intervene between the should do X, Y, or Z, or shouldn't do X, Y, or Z. And what their actual behavior is. Now, this isn't just a biological mechanistic explanation for what could have been summarized in two sentences. What this is, is a roadmap of where interventions can really make a difference. So, as we talk about different drug based interventions or behavioral interventions or social interventions, I'd like you to think about whether or not those interventions are breaking into, or tapping into this box of the thinking, the sort of pattern of thinking around food, whether or not it's the behavior, the actual ingestion or the restriction of food, or whether or not it's tapping into the homeostatic process, the balance of energy systems and kind of getting enough, but not too much, or it's tapping into the reward system. And just as a little teaser of where we're headed, what you'll find based on the data clinical data experiments done very carefully and very well by excellent groups. What you'll find is the anorexics have a sort of switch that's been flipped, such that their decision-making is actually pretty darn good. It might even be better than yours in terms of evaluating food, nutritional content, but their habits are disrupted. So, they're not even consciously aware of the fact that they're making terrible. And in some cases, very dangerous food choices,

00:59:58 Anorexia

and turns out that habits. And the way that we build and break and rebuild new habits is one of the most effective treatments for anorexia. So, now let's talk about anorexia, this failure to consume enough energy, such that the individuals at risk of death, and if not death, then severe metabolic disorders, lack of bone density, et cetera. As I mentioned earlier, anorexia and things that almost certainly were, and are anorexia have been described as early as the 1600s. And maybe even earlier, there are some records from the saints, from the 1400s of people that refuse to ingest food. Another common myth is that anorexia is only the sort of thing that you see in rich societies. These are spoiled

children with so much food that they decide they're only going to focus on how slim they are, how they look in bathing suits, et cetera, not true. A careful analysis through medical epidemiology has shown that you find anorexia even in cultures and societies where food is scarce. So, that really speaks to biological mechanism. Now it's hard to unveil in societies where food is scarce, because a lot of people are starving and hungry, but there are individuals that choose still to avoid food and seem to have some sort of reward mechanism that rewards them, where makes them feel better if they don't eat, despite the fact that their body is severely depleted of nutrients. So, that's very interesting and points again to some disruption in some biological mechanism. Now, I want to make sure that I'm emphasizing that I'm not in favor of people, in particular young children, adolescents, and teenagers being bombarded with unrealistic imagery about bodies. But the idea that that's the cause of, or is amplifying anorexia, the data just don't seem to support that, anorexia in its classic sense, requires that there be an endocrine, meaning a hormonal disruption, menstrual abnormalities, lack of sperm production, or low testosterone in males, in order to meet the classification for anorexia. But as I mentioned earlier, there are now nuanced and new classifications of anorexia that even for individuals that still menstruate or that maintain a sperm production anorexia, can still be considered a clinically diagnosable disorder. Now, typically anorexia starts in adolescence, right around puberty. Let's take a look at what puberty is. Puberty at a very broad level is the most significant and dramatic developmental step. Anyone goes through in their lifespan. The body changes, the brain changes, perceptions, change, one's own self perception, changes. And most of those changes are driven by changes in circuitry within the hypothalamus. So, neurons that are controlling the production of the so-called sex steroid hormones, things like testosterone, estrogen, and related hormones, prolactin, et cetera. Those are all changing at very rapid rates. Anorexia tends to show up around this time in a subset of individuals who on the face of it seem to find food, aversive, now the purely psychological theory of this is that they are fighting for autonomy. They want control. Puberty is also a time in which children and parents are in a tug of war over control. You were once a small child being told when to go to bed sent to your room. Now you're a child that can talk back and say, I don't want to, or I refuse to. And that happens a lot in various households, as I'm sure you're familiar with. Adolescence and puberty is also when girls start menstruating typically, or boys develop deeper voice, they start producing sperm, et cetera. So, there are a lot of bodily changes that also drive perceptual changes and perceptual changes

that drive bodily changes. And it is a dramatic shift for a young girl or boy that doesn't nourish themselves sufficiently. During that period, there are a number of downstream negative effects. I'll list out some of them, these are just a subset of the effects, hypogonadism. That's the lack of sperm production or healthy egg production. There is amenorrhea, which is the lack of menstrual cycling, okay? So, a failure to have a menstrual cycle. Reduced insulin secretion, insulin is this hormone that's released in order to help shuttle glucose

01:04:28 The Cholesterol Paradox

into various tissues for energy utilization. That's down because energy levels are down so much. One of the symptoms that's a little more cryptic, and that has actually interesting implications for sake of the cholesterol hypothesis is that anorexics who ingest very little food often have cosmically high levels of cholesterol, including LDL, low density, lipoprotein cholesterol. You say, well, how could that possibly be? We were all told and continue to be told from many sources that ingestion of dietary cholesterol is what drives high levels of bodily cholesterol. Cholesterol is manufactured by the liver and in anorexics who consume very little food. They often have cosmically high levels of cholesterol, which is one of the kind of wrinkles in the so-called dietary cholesterol hypothesis that all of our cholesterol that we see on a blood panel is due to what we eat. But the explanation for it is that under conditions where there's not sufficient cholesterol to synthesize the sex steroid hormones, things like testosterone and estrogen, which are required in both males and females, those are made from cholesterol that the body, the liver will start generating its own cholesterol will often overshoot the mark to a dramatic degree. So, the blood lipid profiles and anorexics are often very unhealthy despite the fact that they're eating very little food. In addition, they tend to have elevated levels of things like vasopressin, which are hormones that regulate body temperature and salt and blood volume. They tend to have low blood pressure. They can pass out. I mentioned some of the other symptoms earlier. In other words, there are a huge number of terrible things happening. Thyroid levels are down. Heart rates are down, if I'm painting a very bleak

01:06:13 Psychological vs. Biological/Genetic Factors in Anorexia

picture here is indeed a bleak picture. So, we have to ask ourselves what can be done for the anorexic, right? Let's say it's a failure of the AgRP neurons to stimulate appetite and feeding. Let's say it's too much anxiety around food. Let's say it's because of the way that food restriction was used for reward in the household, right? I'm making this up, but you can imagine a hypothetical scenario where let's just say the mother of a particular individual is very vocal about her avoidance of food. We've seen this before, right? You've probably seen somebody who loves to cook and prepare food, but then sits down and doesn't seem to eat. And they always seem to in air quotes have eaten earlier. I ate while I cooked, I ate while I cooked, right? These people that you never actually see eating, we all know people like this, are they anorexic? Possibly, we don't know. A child observes that kind of behavior. Maybe that individual is being always being told how beautiful they look or how wonderful or fit they look, what incredible meals they produce. And you could imagine a purely psychosocial set of events that could lead a child to be anorexic. That doesn't seem to be the case, at least not in terms of driving classic, anorexia, a really extreme deprivation of oneself from food. However, there is a strong genetic component for anorexia. So, you could imagine a mild form of anorexia in a parent that is supported or exacerbated by praise, so that the person feels good from the praise they're getting, that they want to be a low body weight for whatever reason, for aesthetic reasons or for whatever reasons that happened to appeal to them. And the child has a genetic predisposition, right? We never think about genes in terms of controlling behavior, genes, bias, probabilities for behavior, okay? So, you can have a gene for depression or schizophrenia, but it's not deterministic, in the same way that there are genes that determine your eye color, or your skin color or your hair color, okay? So, there's a genetic predisposition there. And that genetic predisposition could exist such that if one is rewarded enough times for a particular behavior, that behavior can start to ratchet in to our neural circuitry, because behavior drives neural changes, so called neuroplasticity. And you could imagine that that child could develop a full-blown case of anorexia. And this is why I raised at the beginning that no one really knows how to define healthy eating. And so therefore we have to rely on just identification of unhealthy behaviors, but what do we point people to in terms of what healthy replacement behaviors would be. So, rather than just look at anorexics and say, they're not eating enough. And there's this huge array of terrible things that they're doing to their body, and they need to eat more. We need to rescue them from themselves. Let's look under the hood. Let's look at, what's known about the neural circuitry and the sorts of

perceptions and behaviors of the neural circuitry is driving, in order to understand what they are truly suffering from, at the level of cause, not just symptoms, it's clear what they're suffering from at the level of symptoms, symptoms are how we diagnose. I listed off a number of those things, but let's look under the hood and try and identify where one could intervene in theory, in order to try and rescue the anorexic or help the anorexic rescue themselves. Because it turns out that the answer or at least one

01:09:44 Chemical Imbalances, Serotonergic Treatments

of the answers of how to do that is not intuitive at all. At least to me was very surprising. I would be remiss if I didn't start with the obvious, which is, is there a chemical defect? Meaning is there some disruption in one of the major chemical systems in the brain that makes anorexics anorexic and therefore, can we replace that chemical? Or can we reduce some chemical and essentially eliminate anorexia? And the answer is not really sort of maybe no, here's why, there are a lot of different chemicals in the brain and body, but there are a category of chemicals that are particularly important that if you've listened to this podcast before, even if you haven't are going to come up again and again and again, and that is the category of chemicals in the brain and body called the neuromodulators, neuromodulators are different than neuro-transmitters in the sense that neuromodulators modulate or change the activity of brain areas in neural circuits, you can think of them as microphones that are held between particular sets of connections in the brain that make those connections in the brain, more likely to be active relative to others, okay? They make them louder so to speak, there are many neuromodulators, but the ones that are important for sake of today's discussion are the classic ones, dopamine, acetylcholine, or epinephrin and serotonin. Let's focus on serotonin. Serotonin is a neuromodulator that tends to increase the activity of certain neural circuits, including within the hypothalamus, but also within the body that trigger a sense of satiety, of having enough, enough food, enough warmth, enough social connection, enough of any motivated goal or drive or any type of thing or behavior that one would want more of, serotonin tends to make those circuits quiet down. Now, there are many categories of drugs that emphasize the serotonergic circuitry, meaning they cause the release of, or the efficiency of serotonin in the brain and body. Things like Prozac, Zoloft, Paxil, things of that variety. Those drugs have been used to some degree of success. Although not much to treat things like anorexia nervosa. That should make

sense, because if these drugs increase serotonin, if their general effect is to increase serotonin, it will be to lower anxiety. That sounds like a great thing. A lot of anorexics are really anxious around food. We'll talk about why, lowering anxiety you might think would lead to ingestion of more food, but that's not often what happens, increasing serotonin, by way of some drug regimen will tend to make one less hungry, because with heightened levels of serotonin in the blood and brain, there isn't the desire to go seek out the things that will raise serotonin on their own. Now, some anorexics do well or benefit from these serotonergic drugs, these drugs that increase the activity of these circuits that leads to satiety. But if you think about the major goal of treating

01:12:56 Altered Habits & Rewards in Anorexia: Hyperacuity for Fat Content

an anorexic it's to get them to have more hunger, more appetite. So, now I want to focus on some of the work that's been done around the habits and behaviors of anorexics, because those turned out to be ideal places for intervention. The work I'm about to describe was done by Dr. Joanna Steinglass and colleagues at Columbia University in New York. And there are other groups as well. Of course, they're doing this type of work, but they did what I think are really some beautiful experiments and some beautiful explorations of potential treatments for anorexics. That seemed to have a quite high degree of effectiveness when they are applied correctly. First of all, there's a challenge in studying anorexia because in anorexia, what you're essentially studying is the absence of a behavior. It's very hard to study the absence of a behavior, as opposed to a behavior. So, they did some experiments with anorexics, giving them a gallery of pictures of different foods, and allowing those anorexia patients to arrange those foods, according to preference about what they would select, about food, nutrient content about caloric content. They essentially asked these anorexics to evaluate food, and in doing so, they were able to identify something that's very unique to anorexics at the level of their perception of food. What they found is the anorexics, rather than being anxious in the presence of food, and that anxiety driving and avoidance of food. What they found is that anorexics have a hyper acuity, a hyper awareness of the fat content of foods, almost to the point of being sort of fat content savant. Now they don't necessarily know that they're doing this. They're not looking at an avocado and thinking, okay, that's X number of grams of fat rather, or looking at an apple and saying, okay, that has no fat. They start to do this more or less reflexively. Now it's a well-known symptom of anorexia, especially

young anorexics that they have kind of an obsession with food, caloric contents, macronutrient ratios, meaning fat protein and carbohydrate ratios. They know caloric numbers, but then they sort of pass that information into a memory system in their brain that allows their interactions with food, to be very reflexive in a way that they are actively avoiding high-fat content, foods, calorie rich foods, and defaulting towards very low calorie foods. If they have to eat. Now, this might seem like an almost trivial result on the face of it, you think, okay, they don't like to eat when they do eat. They eat low calorie, low fat foods, duh, but it's the way in which they are doing this subconsciously that they learn this information and then they pass it off to a reflexive habit. And that's very important because what that means is that we need to look at what processes in the brain, what brain areas, what chemicals drive decision-making and knowledge. And we also need to look at the areas of the brain that drive habit formation and habit execution, because for any of you that have habits. And that means all of you, the hallmark feature of a habit is that it's reflexive. You have a mosquito bite on your leg, you scratch it. You didn't necessarily even think, oh, I'm going to scratch that. In fact, just to take a little bit of a moment of respites and talk about habits in general, there's a beautiful study that was done out of Caltech University, looking at the parking lot of where people park in the morning, without designated parking spots, and the trajectories that they use to walk to their offices in the morning. So, they put cameras up on the roof of Caltech, is the kind of thing that the nerdy kids at Caltech do. I think at Caltech, if you call someone a nerdy is I think it's a compliment. So, my apologies to the non nerds at Caltech, I think there's one or two of you and for the nerdy ones of you at Caltech, you're welcome. They videotaped the behaviors of these faculty and students and staff. And what they found, is that people follow trajectories from their car that are remarkably stereotype. First of all, they tend to park always in the same spot. If they can, they tend to get out of their car. Of course, 'cause they're on the driver's side or passenger side in the same place. They turn and pivot their body at approximately the same rate every day. They close the door, they've put their bag on their shoulder or across their chest, or however it is that they carry their briefcase or whatever it is. And they follow trajectories onto campus that are so stereotyped. That you'd wonder if you just trace line, after line after line. What you'd find is that every day is almost exactly the same and you do this too. You don't realize it because if you're being videotaped in this kind of behavior, it's not being released to you, but your behaviors are so stereotyped to the point where if you were to see them laid out in front of you, in kind of diagrammatic format of the lines and the trajectories that you

follow throughout the day, the lifting of your mug and how frequently you drink each hour, you would be amazed and probably a little bit scared by how much of a robot we all are. Now that robotic aspect of our neurocircuitry is vital, because it's what allows us to think about other things and do other things, and drive other behaviors. But the work of Dr. Steinglass and colleagues showed that in the case of the anorexic, those habits are exactly the place where things start to go awry. And that drive this very dysfunctional under-eating behavior that sadly often leads to death or certainly bad medical outcomes. And it turns out that the brain areas associated with habit formation and execution

01:18:28 Brain Areas for Reward Based Decision Making vs. Habits

are the best point of intervention. So, what Dr. Steinglass and colleagues did, is they took anorexics and they of course had control groups and they put them in an fMRI scanner, which are these brain scanners that allow you to evaluate which brain areas are active, during particular tasks. And because when you're in one of those scanners, you actually, you know, I've actually been in one of these things. You're biting down on a bite bar and you're most of the time and most all of these scanners you're immobile. So, you're looking at things on a TV screen. Sometimes you can press buttons to select choices and so forth, but you can't really eat within those things. What they found was that reward based decision-making, the drive to pursue a particular food or the drive to perform a particular task, which is a lot of what we do throughout our day, that was controlled by a brain area called the ventromedial prefrontal cortex. Let me simplify a little bit of this, but I'm going to simplify it by giving you a little detail, because it's the Huberman Lab Podcast. And I believe in mechanism, mechanism is the way that you get true understanding and that you can then be very quick and give overviews of things, but you need the mechanism. So, you have reflexes and you have neural processes that include what are called duration path and outcome type processes, a duration path, outcome type process, we can shorten with DPO. DPO is for all types of goal related behaviors. So, for instance, if you want to get a particular grade on an exam, you want to learn something, you want to complete a workout. You want to go to the grocery store and pick some stuff up and then head home. You're going to think duration. How long do I have, okay, do I have 45 minutes to get to the store? How long does it take to get to the store path? Which way am I going to drive there? Which way am I going to navigate through the grocery store, outcome, was able to get in and get the items I need and get

home in time, okay? DPO, duration path outcome. It's a very conscious process. You tend to take into account different criteria related to what's preventing you from accomplishing what you want to do and what's helping you or assisting you. So, of course, as you get to the checkout line in the grocery store, you're going to select the shortest line for instance. So, that's all DPO stuff. It requires decision-making and it's reward-based, you use these DPO type processes in the short term to pick up groceries and pick a line at the grocery store and decide which trajectory to take home. And you use them for navigating long extended processes in life, trying to get a degree or raise children or get through a particularly challenging year, et cetera. So, duration path outcome, and that entire process relies on your fore brain. This prefrontal cortex, the prefrontal cortex is what allows you to take information from memory, combine it with information about what's happening in the present context, and then to direct your behavior, your speech, et cetera, toward particular outcomes. And if all that sounds like a mouthful, it is, and it's very metabolically demanding, decision-making is metabolically demanding. It takes effort, okay? Reflexes on the other hand, don't involve the prefrontal cortex in the same way, habits and reflexes. Like once you know how to walk, you get up and you walk, you don't have to think about right foot, left foot, right foot, left foot. You just do it. That doesn't rely on prefrontal cortex. It's subconscious as it's sometimes called, but basically you don't have to use the parts of the brain that are involved in duration path and outcome type analysis. Okay, so, in this particular study, they examined brain activity in anorexics who are selecting different foods. And as I mentioned earlier, they have a hyper acuity or awareness of which foods contain more or less calories than other foods and what the fat content of particular foods is, in particular, et cetera, they're doing all this while in a scanner. And then they look at what sorts of brain areas are active after that task is done. And what they found was really interesting, what they found was that the dorsal lateral prefrontal cortex not surprisingly is involved in the decision-making and the evaluation of this food, which foods are going to be best to eat in this context, which foods are going to be appropriate for at least that anorexics framework about what's okay to eat and what's not okay to eat and how much. However, there are areas of the brain that were active after that decision-making process. And those are the brain areas that turn out to drive the habit of avoiding particular foods and approaching other foods. And in that case, it wasn't the dorsolateral prefrontal cortex. It was an area of the brain called the dorsal lateral striatum. Now the striatum is a big area in the brain. It's involved in a lot of different things. It includes areas

like the caudate and putamen. And I just want to mention, as I throw out all these names, you do not need to remember the names of these different structures. They're just there, if you are interested in that level of detail, but basically you have a brain area and anorexics have a brain area that's involved in evaluating and decision-making around food. And then another brain area that's involved in the reflexive consumption of particular foods and the reflexive avoidance of other foods. If you remember way back at the beginning of the episode, I feel like that was a long time ago now. When we talked about how you have these sorts of processes in the brain,

01:24:06 Habit-Reward Circuits Are Flipped in Anorexics: Reward for Deprivation

but there are always homeostatic and reward systems influencing this kind of thing. Well, in the brain of the anorexic, it turns out that the reward systems have been attached to the execution of habits in a way that is unhealthy for body weight, but at least from a purely neural circuit perspective, the reward is now given this chemical reward in the brain, is given for avoiding particular foods and only approaching these very low calorie, low fat foods. So, there really does seem to be a flip in the switch, in the anorexic brain that rewards them internally. They feel good when they avoid certain foods and they approach others. So, it's not a deprivation based model where they are flagellating themselves or masochistic or actively avoiding food in order to punish themselves, which is interesting because a lot of psychological theories support that idea. Rather, once this transitions into a set of habits, they are actually getting a sense of reward. They feel good, presumably from the release of a different neuromodulator called dopamine, by approaching foods that are low fat, low calorie content. And so their whole brain circuitry is skewed toward avoiding particular things. And they actually are rewarded for that, and they feel good. They feel better than if they were eating in a healthy weight supporting way. Now the dorsolateral striatum is a structure that we should think about in a little bit more depth. It's part of a set of circuits that are involved in what are called go no-go tasks. And I don't want to go into this in a lot of detail right now, because it would take us too far down the rabbit hole of neurocircuitry. But basically in terms of behaviors, we both have DPO type behaviors. So, decision-making, reward based behaviors. And we have habits that we learn and we acquire. And then we just start to reflexively, things like walking, things like yawning when we're tired, things like taking a particular route through the parking lot, right? We learned that the first time we go to a given parking lot and walk

into a building. But after that, we tend to follow the exact same trajectory becomes very automatized. It's just like, we just do it without thinking. Well, the go no-go circuitry is another aspect of our behavior, where we both have to select behaviors to perform. And we have to select behaviors to suppress. And the anorexic brain seems to reward suppression of one set of behaviors, ingestion of high calorie foods, and to reward focus, or even hyper-focus and consumption of low fat, low calorie foods. So, this homeostatic process that we learn about from like high school onward, that, oh, everything in your body is designed to keep everything in balance. You stay awake for a certain amount of time. You want to sleep, you don't eat for a while. Then you want to eat to maintain weight, right? You eat too much. Then you want to eat less. Those systems are disrupted. And so what's so beautiful about this work from the Columbia group, is that what it says is the place to intervene has to be the habit. This stuff has already passed through all the learning, it's passed through all the reward systems. It's clearly not being overrun by the homeostatic processes of the body. There's very little body fat. There's no leptin, whatever neurons in the brain respond to leptin are starved for leptin, periods of shutdown, sperm production, and testosterone is lowered. Bone density is down. Clearly, this is overriding all those homeostatic processes, all the signals that would say eat, eat, eat. Those don't matter in the brain of the anorexic. In the brain of the anorexic is just performing habits and they're being rewarded for it. So, when you come along and say, look, you should really eat this whole pie or this whole pizza you'll feel better. That's how she aversive to them. So, since it appears to be a habit, a reflex that's perpetuating the anorexic phenotype. As we say, in science, it's perpetuating anorexia in this individual and telling them about all this terrible stuff that's happening in their body won't work, taking them away from all the images of thin people online, et cetera. That's not going to work. What's going to work.

01:28:30 How Do You Break a Habit?

What's going to work is intervening in the neural circuitry. That's related to the habit itself. And it turns out that there are ways to do that. So, how do you break a habit? How do you rewire the brain circuitry that's literally causing a reflex? And in this case causing a reflex that is killing the individual, or at least leading to very bad health outcomes. The way that you do that is through a cognitive mechanism where you teach the individual, what is leading up to the habit? This is a little bit similar to the way that somebody who

suffers from addiction starts to put in different constraint type behaviors, constraint type behaviors, are the sorts of things like where the alcoholic will call a hotel ahead of time and say, listen, I want the mini bar taken out of the room. I don't want a television in the room, et cetera, constraint type behaviors. Those are really ways of keeping oneself from the temptation. But with these habits, they work at such a subconscious level. That what seems to work best is a combination of teaching the individual about their internal state and how to register their internal state. What we call interoception this ability to perceive your internal state, so that they can start to learn, to associate the interactions with different types of food, with the sorts of cues that are occurring within their body, quickening of heart rate, hyper acuity of focus that we talked about earlier. Once they start to be able to notice that those things are happening, then they can start to intervene. So, let's talk about what those things are that lead into a habit, because those turn out to be the exact points of entry for changing and eliminating and rewiring habits, to a more healthy behaviors. And I should highlight that this isn't just about rewiring habits for sake of the anorexic. These are also the same types of mechanisms that one would want to incorporate in order to rewire any habit of any kind. There are two main features of thinking that go into the sorts of habits that anorexics execute. The first is something called weak central coherence. Weak central coherence is essentially an inability to see the forest through the trees. It's a hyper acuity and focus on details within a given environment. And there's actually an interesting probe test for anorexia that involves something akin to kind of a where's Waldo type of puzzle, where an image is put up. The one that I saw was one in which there is a big array of coffee beans. Actually, they're all brown coffee beans. And your job is to identify where in that array of coffee beans, there's a face. And indeed there's a face embedded in there. It looks a little bit like a coffee bean, but once you see it, you realize it's a face, not a coffee bean. And it becomes very hard to not notice the face after that. Anorexics, are very good at identifying the face. They find it much faster than do non-anorexics, which is really interesting, right? They somehow are able to hone in on details and find those details and fixate on those details. Now eventually, most, if not all people find the face, but once you do what you will find and what everyone finds is that you can't unfixate the face, it just jumps out. So, what essentially you've lost is the ability to see the whole picture, because there's some detail within that picture that you're obsessed by. So, this has kind of elements of obsessive compulsive disorder, but it's not really obsessive compulsive disorder per se. So, we call that weak central coherence. It's a hyper acuity on one

particular feature. You miss the big picture. The other is a challenge in set shifting that once you identify something that's of particular interest and that's driving some sort of reward, for the anorexic that would be identifying the high-fat foods or identifying the one food on the table that one could eat without anyone, hopefully noticing that they're eating just the green beans and not touching any of the other food. If you ever had a meal with an anorexic. You might be familiar with this. It's kind of uncomfortable to be around. Actually they go through a lot of elaborate procedures to kind of hide food too. They'll sometimes even chew food, hold it in their mouth and then go to the bathroom and discard it things, very elaborate, very troubling types of things to hear about, and to be around. But you'll notice that they push food around their plate a lot. They become masterful actually at trying to keep people's awareness away from what they're doing, which is to hone in on these low fat, low calorie foods. And they can't seem to set shift. They can't just relax and enjoy the meal, because the meal for them is essentially like this where's Waldo or find the face in the coffee being tasked. They're constantly monitoring how much people are observing them and trying to navigate this. What would otherwise be a really pleasant circumstance for most people they're trying to navigate through this because remember for them, the reward is in the avoidance of certain things and the acquiring of only the foods that their brain rewards them for,

01:33:23 Family Based Models, Cognitive Behavioral Therapy

because those are the foods that have been preselected and are now habit. What's amazing. And frankly also important are these findings that once you teach anorexics, what's happening to them, that they're doing this, they are able to intervene. Now they need support, right? And another form of therapy that seems to work well for anorexics that ideally is combined with this habit rewiring, is a family-based model. Family-based models are starting to surface a lot now in various therapy settings, therapy based models in short are basically where the entire family is made aware of the individual's challenges with a particular eating disorder or other disorder. And in understanding some of the biology and psychology around it, they stopped condemning the individual. They start to support that individual through queuing them towards their own habits that they observe. They give them some autonomy. They realize that none of this changes overnight, but they're taught about things like neuroplasticity and the ability to change one's brain in response to experience. And so there's a whole internal support network.

Now, for people that live alone, this isn't available to them. This isn't the kind of thing that you share with your coworkers. You might involve a close friend or a spouse, but it's not the sort of thing that people that don't live in a family context can really benefit from. All of these things fall under the umbrella of cognitive behavioral therapy. And I should mention that cognitive behavioral therapies are often done in conjunction with pharmacologic therapies. I think that there's this idea out there that it's either, or when often it's both. So, cognitive behavioral are often combined with this habit recognition and rewiring approach, which is starting to become more and more common. And I think the data on it looked really good that especially when it individuals are taught this early in adolescence, that there are positive outcomes over time, the relapse rate of anorexia is quite high. It's about 50% of individuals will relapse at some point often triggered by a stressful life circumstance. But the combination of cognitive behavioral therapy that includes this family model, or at least habit reformulation seems to be fairly effective.

01:35:39 MDMA, Psilocybin, Clinical Trials, Ibogaine

And at present might be the most effective treatment. Now there are additional treatments starting to surface, and that takes us into the realm of chemical treatments for anorexia. And I just want to mention that there are clinical trials, meaning legal clinical trials being done at Johns Hopkins School of Medicine by Matthew Johnson and others, exploring how drugs like MDMA, which increases dopamine and serotonin to very high levels or siliciden so-called magic mushrooms, which increases serotonin and other compounds to very high levels within the confines of a professionally supported therapeutic environment can help people rewire their brain, such that they can get relief from major depression and various forms of trauma. And now eating disorders are also being explored in the context of MDMA and siliciden clinical trials. I do want to emphasize that those are clinical trials, that those compounds are not yet legal. And in many cases, most cases they are still illegal. I do not think that they should be explored without a properly trained medical doctor, that the clinical trials are essential to complete before one explores those compounds in particular, because lately I get a lot of emails about these compounds. People telling me that they've had amazing experiences and relief from various things, not just eating disorders, but depression, et cetera. However, I get an equal number of emails from people saying that they worked with some self appointed guide. This would be outside the clinical trials I was referring to, and they are

now experiencing chronic visual, snow. They're getting genuine visual field deficits. They are having ticks that they have never had before, they have chronic insomnia. So, I'm not passing judgment on any of these compounds or the people that are doing this sort of thing. I just want to see the clinical data. And I do believe that we should wait until these clinical trials are done before people start approaching the stuff. And that's because they are serious compounds. They can open plasticity, but whether or not they work quote unquote for different types of eating disorders or depression and trauma, the data are looking promising, but that the clinical trials are still not done. And I know a number of people are going out of the U.S. and into other countries where this stuff is being done more regularly and there too. I've gotten reports back of people doing so-called ibogaine treatments. Some of you who are familiar with eating disorders will immediately be asking, well, what about ibogaine? Does it work? Does it work? Well, the clinical trials in this country are not complete. I've heard evidence direct. I've heard directly from people who have benefited from the sorts of things, for treatment of eating disorders. But I've also heard of people that have developed chronic seizure disorders from pursuing things like ibogaine for the treatment of eating disorders. So, again, I'm not passing judgment. I would just like to see more data. And it's very important that the safety aspects of safety be in place. So, this is definitely not something to get renegade about. So, it appears that once anorexia has established that habit breaking through self-awareness of what the habits are, is going to be a primary entry point. That might seem kind of trivial. You might say, well, could you have just told us that in one sentence, but I want to return us to this model about homeostatic processes, reward, processes, et cetera. That leads us to a place where the short answer is no, you can't simply say break the habit. An individual needs to be informed about where that habit comes from. And the fact that what currently seems like a rewarded habit should actually be a punished habit. Now, I don't mean by actual punishment, but what I mean is within the brain, there's been a switch and the anorexic needs to learn that there's been a switch such that what should be rewarding is now punished and what should be punished. Starvation is now rewarded. The beauty of being a human being is that knowledge of knowledge can allow you to make better decisions. I'll say that again, the beauty of being a human being is that knowledge of knowledge can allow you to make better decisions. Now, of course, when we are anxious, when we are tired, when we are intoxicated, we have less access to that ability to use knowledge of knowledge, to intervene. The anorexic will often do things that are in keeping with their habits, such as

overexercising. This is an area that anyone who's treated anorexics or interacted with anorexics is well aware of, that they are constantly moving. They're constantly on the treadmill. They're constantly running. They always want to be moving and burning calories, so that they can feel okay about interacting with food or because they have the distorted body image. Well, does breaking a habit mean

01:40:35 Anabolic vs. Catabolic Exercise, Spontaneous Movements, NEAT

that they should stop moving around and exercising? No, not necessarily. There's some really interesting studies that show that shifting anorexics towards activities that for instance, build muscle resistance training and allow them to eat a bit more food without necessarily losing weight, but rather to put more muscle on their body can actually be beneficial. Now I'm not talking about anorexics becoming bodybuilders, has all body dysmorphia associated with bodybuilding, but certain forms of exercise are just catabolic. Meaning they break down the amount of muscle. They reduce body weight, overall, other types of exercises like resistance training or anabolic, they allow muscle to be put on. And there are some interesting studies, not a lot, but some interesting studies trying to encourage anorexics, not to stop exercising, but rather to stop exercising in this neurotic catabolic way of breaking oneself down, but rather getting them shifted toward breaking habits of only approaching low calorie, low fat foods, while also encouraging them to embark on resistance training and to start to learn and reward the relationship between exercise for sake of making one's body strong, including the bones, not just the muscles, but the bones, which is important, especially in anorexics. And then to see food as a way to nourish that process, to building a body that could be of the stable weight. Hopefully there, once the anorexic is of a healthy weight that they're maintaining that weight, but that they don't have to constantly be on this treadmill, no pun intended of balancing whatever food intake they have with activity. And along the lines of that. During the episode on fat loss and metabolism as well, I talked about this neat and non-exercise induced thermogenesis where people who tend to be thin, tend to bounce around a lot. They're kind of fidgety and that burns 1000 of calories a day, anywhere from 800 to 2000 calories a day. Now that can be beneficial for the folks that are overweight and have a healthy mindset about food, but are trying to lose weight. And it turns out that by, you literally fidgeting and bouncing around, like, this is why I'm doing this. It looks ridiculous. You actually burn a lot of body fat and calories. That way provide

you're in a caloric deficit, you'll burn body fat because body fat is not just a passive tissue. It actually receives input from neurons that release noradrenaline and adrenaline. And this neat. Has been described for several decades now. And it actually is a pretty terrific way to burn off more calories. So, with the anorexic, you actually want to encourage them to not constantly be trying to burn off calories. That can be very challenging. So, shifting them toward activities like weight bearing activities or resistance training that promote

01:43:23 Distorted Self Image in Anorexia

this more anabolic type of relationship to activity, as opposed to catabolic can be beneficial. Before we move on to talking about bulimia and some related disorders, I want to talk about an aspect of anorexia. That's very interesting, quite troubling in fact, but that has received a lot of attention and that's the distorted self image. Now, episode and depression, we talked about a very powerful aspect of major depression, which is this anti-self confabulation that people who are depressed seem to genuinely believe. And even confabulate about the fact that they are performing poorly in life and that they are no good or not, or worthless, et cetera. It's literally a lie that they believe and their statements and their feelings and their behaviors start to reflect that lie. They're not conscious of it. That's why we call it a confabulation. Anorexics often will see themselves as overweight or imperfect in ways that are of an obsession for them, they'll think, oh, you know, their arms are a little bit fat, you know, or, you know, the contour, their face makes they don't like the pictures of themselves or they. What I'm describing here is actually pretty typical behavior of a lot of people. I mean, how many people do you know that after you take a picture of them, they say, can I see the picture? And then they tell you that you have to throw it away. That doesn't necessarily mean they're anorexic or they're suffering from some sort of disorder. That just means that they're a human being that cares about how they appear in the world. We're not here to judge that in the case of the anorexic. The problem seems to be that they have a genuine distortion of their self image so much so that they don't actually see themselves accurately, their visual perceptions are off. And the reason we know this, it's because of some really important and beautiful studies that were done with my colleague, Jeremy Bailenson's lab at Stanford, he's in the department of communications, he's actually collaborated with a Dr. Halpern that I mentioned earlier. What's really interesting about these studies is they

give us a window into the perceptual defect that anorexics have. I've actually done one of these experiments. I'm fortunate to not be anorexic, but I've done some work with the VR lab over there. And what you get to do is you get to adjust this avatar of yourself to the point where you think it's, as accurate as it could possibly be, and anorexics, really distort this avatar. In other words, they create this serious mismatch between their perception of themselves and the reality. So, indeed it does seem to be the case now what's relieving, or I should say what's encouraging about some of the therapies that we talked about before the family based model, the Connie behavioral treatments. Yes, and the drug treatments as well. But this habit intervention model is that as one starts to shift those things, it does appear that the perception of self seems to follow that the perception of self seems to shift along with the change in habits. And that's a relief, or at least I find that reassuring because changing one's perception is actually very hard, as somebody who's worked almost his entire career on visual perception and related things. The perceptual apparatus of the brain are not very amenable to neuroplasticity, meaning they don't change that easily. Whereas it appears that the circuitry that's related to habit formation, and decision-making and the reward, circuitry, that stuff can be rewired. And so anorexics as they progress out of their anorexic state into one, which they are intervening in their reflexes, gaining better habits around food, eating more, more accurately, assessing foods and environments that they're in related to food, as they change their behavior. And they start to put on healthy weight, maybe they're also doing the sorts of exercises that allow them to put on healthy weight and avoiding kind of extreme exercises of cannibalism and breaking themselves down. They also managed to somehow just as a consequence of all that rewire their perception of self. So, it doesn't seem that trying to tell someone, oh my gosh, you're so thin. You really need to eat. That doesn't seem to work. They just don't see themselves the same way that you see them. And so I offer that as a point of consideration, if you know someone that's anorexic, or if you look at an anorexic and you think, how is it that they are still critical of the small, even nonexistent amount of body fat on their triceps or something? How is that? Well, it's literally that their brain, as it relates to perceptions, visual perceptions in particular, they're completely off.

01:47:54 Bulimia & Binge-Eating, "Cheat Days", Thyroid Hormone

And fortunately by changing habits, you rewire those circuits as well. Okay, so let's talk

about bulimia, which is overeating and then purging typically by self-induced vomiting or by ingestion of laxatives, sometimes also in concert with people taking stimulants and fat burners, over ingestion of stimulus to try and burn off more energy. And then we'll also talk about binge eating disorder, which has a lot of the same features as bulimia, but typically no purging. I'm not going to list off all the clinical criteria that would allow someone to be diagnosed as bulimic or binge eating disorder. But the general features are that they ingest far more calories than they need, anywhere from 10 to 30 times, their daily caloric intake, oftentimes within a two hour period, which is just a staggering amount of food and nutrients in a short period of time. Oftentimes they're overriding those mechanical signals from the body that they're full. It's a really troubling thing to think about, but people are literally gorging themselves with food. This looks a lot like a laboratory animal that has these AgRP neurons stimulated, these neurons that will eat until they almost burst or burst. So, you wonder is that these AgRP neurons that are active almost certainly yes. That they're involved. Although I don't think that that's going to be the major point of intervention, but we're going to talk about other types of interventions. There are a number of clinical criteria. For instance, if somebody has one of these binges once a year, does that make them bulimic? Technically, no, but I certainly don't recommend people do this. If you are one of these people who has so-called cheat days, right? Some of you may be familiar with cheat days. I think they're a little less common now, but the idea is you eat clean for six days or five days a week or two weeks. And then you have a so-called cheat day where you just kind of go wild and eat whatever you want and whatever volumes is that bulimia. And it has some of the contour of bulimia. If you're vomiting afterwards or binge eating disorder, if you're not, does it constitute full blown bulimia or binge eating disorder? And it's pretty hard to say, the criteria that were described to me is that if somebody is doing this at least once a month, over a period of anywhere from two to three months, then it likely would qualify. And I certainly know people who do these cheat days and by those criteria, they have something like binge eating disorder. But in general, one of the hallmark features of bulimia binge eating disorder is that people are unable to control their eating. They're just simply, they're not making the decision to have a cheat day. They're not making the decision to overeat. They are simply driven from the inside without question by way of neurocircuitry. They are driven from the inside to ingest far more food than they need. And in some cases than they would want to eat. So, it's a lot like the habit that we described for anorexia, it's almost like it's turned into a reflux once they get going, all the

homeostatic signals are being overridden, all the signals from the body, the leptin, the insulin, the glucose, all that stuff has cosmically sky high. And yet they're just what we, the nerds call hyperphagic, they're just eating like crazy. So, what's going on there? Well, there've been a lot of ideas, about why this arises. There's the so-called thyroid hormone hypothesis. That one's a tricky one. It turns out that cortisol and thyroid hormone concentrations vary according to when the binge purge happened. So, there were some studies that looked at thyroid hormone levels and they found elevated thyroid hormone levels. Thyroid hormone is involved in metabolism and not just the burning of energy, but the use of energy in converting it to different tissues of the body, cartilage bone, fat, and muscle, et cetera, did a whole episode on thyroid and growth hormone. By the way, if you're interested in learning more about thyroid hormone, but thyroid hormone can also be depleted at other phases of the binge purge cycle. Now, without listing off all the terrible things that happen with this binge purge cycle, there are a number of things that are really worth pointing out. One is that the vomiting itself, the use of laxatives that can cause severe disruption to the mucosal lining the mucus lining of the digestive tract can severely disrupt the gut microbiome. It can cause all sorts of even a ulceration of the esophagus and just really terrible stuff. There's a lot of shame associated with bulimia, oftentimes because people are vomiting and it's hard to hide that vomiting behavior, people are aware of it. There's some social isolation. So, you recall from the beginning, it does not appear that sexual trauma

01:53:05 Inhibitory Control, Impulsivity, Adderall, Wellbutrin

is a prerequisite for bulimia. Although sometimes it can occur the hallmark feature of bulimia that distinguishes it from anorexia, aside from the fact that it's overeating as opposed to under-eating is a lack of what they call inhibitory control. And that might come as no surprise. But first of all, the bulimic, unlike the anorexic is hyper impulsive and oftentimes has other types of impulse behaviors. They might have a little bit of alcohol and then start to eat like crazy. Whereas normally they're very restrictive. That's a common feature of bulimia, sometimes they over ingest alcohol during these binges. Sometimes they are sexually promiscuous, not always, but it's a general issue with satiety once they start eating and with impulse control generally. And for that reason, many of the treatments that you see for bulimia and binge eating disorder are the sorts of treatments that don't seem to work so well, or at least most of the time for anorexia.

So, the drugs that increase the neuromodulator serotonin, for instance, fluoxetine also called Prozac, Paxil, et cetera. Those things oftentimes can be effective in bulimia. Some of the drugs that are used to treat attention deficit hyperactivity disorder an ADD, a topic that we're going to talk about in depth here on the podcast soon, some of those same drugs like Adderall, Vyvanse and things of that sort can also be used to treat bulimia and binge eating disorder. Why would that work? Well now you are familiar with the prefrontal cortex. You probably know more about prefrontal cortex than you ever wanted to, just from this episode, prefrontal cortex is involved in this analysis of duration path and outcome. Duration path and outcome is how we avoid impulsivity. It's how we think. Okay, if this, then that, if that, then this, you can imagine how for the obsessive compulsive or for the anorexic, these are circuits that are overactive. For the bulimic this is the circuit that's going to essentially be underactive and is under conditions where they think, oh, you know, I shouldn't eat anything. I shouldn't eat anything. And then they just tear the refrigerator open and plow through that. And then at that point they're plowing through the cupboards and then they're ordering food. And then they're feeling horrible about themselves. There do tend to be these cycles of binge and purge followed by feelings of real shame because they just can't control their behavior. And what is more embarrassing than not being able to control one's behavior as an adult or as a young adult. So, really the polar opposite of what you see in anorexia. So, this lack of impulsivity implies a lack of prefrontal control. What we call top-down control. Why do we call it top-down? Because the prefrontal cortex is suppressing the activity of deeper limbic and hypothalamic circuitry, and things of that sort. Anytime you feel like you want to say something really offensive and you don't, that's top-down control. That's your prefrontal cortex. Anytime someone says something and you like grow your teeth. 'Cause you'd know you shouldn't say anything, gritting your teeth is top-down control, okay? When you explode or burst or say the wrong thing, or say the thing that you shouldn't say or do the thing you shouldn't do, that's lack of prefrontal control. And indeed people who have frontotemporal dementia due to aging or head injuries, see this a lot and people play sports get a lot frontal damage. They become more impulsive. So, bulimics have an issue with impulsivity, and therefore drugs that can increase serotonin. And sometimes these drugs that increase dopamine and adrenaline also called epinephrin, will increase the tone as we call it the dopaminergic tone or the, it's called adrenergic, but norepinephrine levels in the brain allow for more top-down control. And that's also why they're used to treat ADHD and attention deficit disorder. They tend to

create a hyper-focus. They tend to push the brain into, these drugs tend to create a hyper-focus, and tend to push the brain and general motor processing into one in which you think if this, then that, if this, then that, so anticipating outcomes. And for that reason, drugs like Wellbutrin, bupropion, which is an antidepressant, which mainly increases the amount of dopamine and norepinephrine and less serotonin, that can also be effective for certain types of binge-eating disorder is actually used to treat smoking, for promoting smoking cessation and for depression, but also for certain forms of obesity related to binge eating disorder. And the data are pretty good. And there are timed release forms of this and non-time release forms. And I think you have to consult with a psychiatrist in order to get these prescribed because they are prescription drugs,

01:58:00 Direct Brain Stimulation: Nucleus Accumbens

but it's a very different constellation of neurochemicals and brain areas and approaches for bulimia. The treatment of binge eating disorder has been explored from a new standpoint recently. And that's the work of this now, sadly, former colleague of mine, Dr. Casey Halpern, who's at University of Pennsylvania that I mentioned earlier, they are using deep brain stimulation in order to treat binge-eating disorder. Now why deep brain stimulation? Well work from Dr. Halpern and others while at Stanford showed that there are particular patterns of brain activity in both the prefrontal cortex, but also in an area of the brain called the nucleus accumbens, very important and very relevant area of the brain in this context, and in any discussion about motivated behaviors of any kind, feeding, sex, drug relay behavior, people exercise compulsively, the nucleus accumbens is in a ongoing dialogue with the prefrontal cortex and the nucleus accumbens has no mind of its own, but it's associated with dopamine release. It's part of this so-called reward pathway. And what Dr. Halpern and colleagues discovered is that there are particular patterns of activity that ripple through the brain, through these prefrontal networks and through this nucleus accumbens area, those areas are connected. It's called Delta oscillations, Delta, just being a particular frequency of electrical activity for your aficionado as wonderful heart activity. But in any case, those Delta oscillations in the nucleus accumbens are associated with food reward in both mice and humans. Somehow this reverberatory activity creates a perception in the individual that food is hyper rewarding. And that's interesting, and has allowed them to use a targeted deep brain stimulation approach to treat binge-eating disorder. And this deep brain stimulation

is appearing to be an effective treatment. There's still more studies that need to be done. Actually, if you think you have binge-eating disorder, you can find the criteria for that. And you could contact Dr. Halpern he's. As I mentioned, he's moving to University of Pennsylvania. They are recruiting patients for these studies all the time. The studies are fairly invasive. They involve a FDA approved approach of literally placing a wire down into an area of the brain that, and allows the individual to stimulate a particular brain area to offset some of these activity patterns that lead to a elevated sense of reward from food and binge eating. And the data looked really promising. Now I realize that's a very invasive approach. Not everybody is going to be willing to have this wire inserted into the brain, but for people that suffer from binge-eating disorder. This is a great and very exciting potential treatment. Because what I didn't tell you is that many people have binge eating disorder are obese to the point where their health is greatly risk. Now, obesity causes all sorts of shifts in the dialogue between the brain and body. Some of which you'll recognize from earlier in the discussion, for instance, leptin signaling is disrupted. So, the fat there's lots of body fat, but even though that body fat is secreting, this hormone leptin in that signal should shut down the desire to eat. The receptors to leptin in the brain are totally screwed up. And so the signal to eat is there, but the signal to stop eating is not there. So, again, you have an accelerator and a brake, and it's like, the accelerator has always pushed down. Some of these brain stimulation approaches seem to be able to bypass some of that, and of course there all the metabolic syndromes and the problems with having excess levels of body fat, things like insulin resistance, type two diabetes. I mean, as disturbing as is to here, there are many individuals, actually, I know some who are so obese that they start getting bodily sores. They're not just bedsores, but they have skin sores that are very disruptive to them. They don't like having these sores. And in addition to that, they can get peripheral neuropathies because of some of these metabolic issues. They're not getting enough utilization of the nutrients in the tissue, because the way that insulin has disrupted insulin signaling, and they actually have to have certain portions of their limbs amputated, and yet they continue to overeat. So, this is not an issue of self-control that can easily be dealt with simply by telling the person, look, you have to stop eating or you're going to die, or you're going to have your legs amputated. Like with anorexia, there's a distortion in the relationship to food, but the homeostatic and the reward aspects are disrupted. So, unlike anorexia, where it seems to be a habit based mechanism with bulimia and binge eating disorder, something deep within the neural circuitry is causing food to be

hyper attractive and the break is off. So, if you want to develop some empathy for what these people are dealing with, consider this, it's like driving a car, you get onto a grade, maybe a 10 or 15 degree grade, and you're heading down and you figure, well, you'll just pump the brakes a little bit, but there is no break, right? So, you start going faster and faster and faster. And your only choice is to use the accelerator just to coast through it. That's essentially what's happening to these neural circuits. So, the work of Dr. Halpern and others, I think is really exciting. And even though it's highly invasive, I think is going to lead to not just some relief for the patients that do get that deep brain stimulation, but also the identification of what sorts of receptors are present in those brain areas. That could help. What that means is that once we understand which brain areas are involved in disorder, and we understand what receptors, those brain areas express, then there can start to be additional interventions by way of non invasive treatments, things like drug treatments, do behavioral interventions work for bulimia? In some cases, yes, provided that those interventions are done early enough. Regardless, behavioral interventions, coupled with drug based interventions are always more effective than either one alone. Fortunately, there is a decent size kit of drugs that can help with bulimia. I mentioned some of them before things

02:04:28 Anorexia/Reward. vs Bulimia/Binging

like bupropion, Welbutrin some of the serotonergic drugs and some of the drugs used to treat impulsivity. So, we have on the one hand anorexia, which seems to be a disruption in habit and a coupling of unhealthy habits in this case, food restriction to the reward pathway. And on the flip side, we have binge eating disorder and bulimia where a very unhealthy habit of gorging oneself with food sometimes followed by purging, is not necessarily coupled to reward. They feel terrible when they do that, right? The anorexic feels great about restricting their food intake. They feel like they're winning some sort of game. The circuitry is flipped somehow that way. With bulimia they feel horrible about the fact that they're bingeing, there's immense shame. They can't control themselves. The reward is set up before the behavior, the reward is set up in drawing them to food and in making food look like something that's incredibly appetizing and there's no impulse break. There's no way for them to stop that kind of behavior. So, really kind of troubling thing to think about. In either case, I think for those of us that know anorexics or have observed anorexia, it's so hard to see somebody starved themselves to near death

or to death. What more could be disturbing? Well, equally disturbing is somebody who has an abundance

02:05:45 Healthy Eating Revisited

of food and is gorging themselves, and then feels terrible about it. So, these are heavy topics. These are topics that frankly no one really wants to talk about unless they know someone who is suffering from them, or they themselves suffer from them. What I've tried to do today is try and give you a window into what really underlies these things that we call eating disorders. I hope I've done that at the level of biology neurocircuitry mechanism endocrinology, and some of the psychology, as with any episode of this podcast. But especially in this month where we're talking about mental health issues and mental health disorders, behavioral disorders, there's no way that I can exhaustively cover all the different forms of treatment. You have the modely approach, you've got all these different approaches to depression, into anorexia, et cetera. What I've tried to do is give you a framework. And in doing that, I've tried to give you a framework of understanding that also applies to this question. That's I think equally important and goes alongside the treatment of eating disorders is what in the world is healthy eating. What in the world is a healthy relationship to food. I like to think that I have a healthy relationship to food. I know the foods I like. I enjoy them. They're 10 or 15 foods in particular that I liked very much. I've mentioned a few of them on the podcast before, and I was sort of amused, surprised and perplexed as to why. For instance, I do enjoy eating butter, not in huge amounts, but I do like butter. So, that seemed to be pretty triggering for folks out there. A small selection of people decided that the ingestion of butter was a health concern. Look to me, ingesting butter in small quantities is something that I'm comfortable with. And my blood lipid profiles feel good. They look good to me. For other people that might not be the case. For some people. The idea of eating an animal-based food is probably so repulsive that it actually can make them feel physically sick. And I think that we should be aware that that kind of mental phenotype exists. I'm not calling it a pathology for other people like myself, things like butter and meat feel healthy. Now, what quantities? Well, I enjoy eating very much. I'm not shy about this. I've talked about on the podcast before, I enjoy eating. Some people have a very complicated relationship to food. They don't think of it as nourishment. They don't enjoy it socially. It's a stressful thing for them based on their personal history, or maybe

just general anxiety around food. And I hope that in sharing this information about the fact that anytime we approach food, these neurons in our hype, in the arcuate area of our hypothalamus actually increase our levels of anxiety. This is related to that point that Dr. Halpern made, which was that from an evolutionary standpoint, it is advantageous to ingest as much food as often as possible, as quickly as possible. We now know that to not be healthy in this age of abundance, where calories are essentially everywhere. And yet a lot of people feel anxious in anticipation of a meal. What could be useful to them? Well, whether or not they have an eating disorder or not. It's very clear that developing methods to calm oneself in the presence of any anxiety or fear inducing stimulus can be beneficial. I've talked about some of these episodes related to stress, things like the physiological side to inhale through the nose and a long exhale, things like mindfulness meditation certainly can help. There are data, a lot of studies out there showing that meditation practice can help people deal with eating related anxiety and disorders. I think as a general rule, trying to avoid approaching a meal or sitting down to eat in an anxious state is probably a good idea, but let's be realistic. How often can we do that? I think most of us are going to have circumstances where we're rushing around trying to just eat before we head out or get to a meal. And then we sit down and we find ourselves eating. This is one of the first times in human evolution where we mostly eat out of a desire to consume food, not out of a need for food. Most everybody could go a fairly long period of time, just ingesting water and electrolytes. And not that I'm suggesting people do that, but let's face it. We largely eat nowadays because of a desire to eat, not a need to eat, and yet we need to eat on a fairly regular basis. And so no topic is more complicated and nuanced than food and nutrition. And in particular, as it relates to eating disorders. So, the major takeaways today are, we should all be asking the question, what is healthy eating for us? How do we develop a relationship to food that we can enjoy food, hopefully both socially and on our own, but that we are not neurotic and compulsive about it. For those of you that intermittent fast, this also applies, right? What, you know, God forbid, if you eat 30 minutes before your eating window starts, what does that mean? If it means something catastrophic, do you have an eating disorder? I don't know. Maybe you have an anxiety disorder, that's for you to explore. If you don't manage to eat five meals a day and that's your obsession. Well, then, you know, the same thing applies.

02:10:55 Synthesis, Body Dysmorphias

These are questions that we can all ask ourselves. Today, we focus on the extremes of food related behaviors that really qualify as genuine disorders. They are in the psychiatric manuals and they are diagnosable and they are serious health concerns. They're not just mentally troubling and concerning for the people suffering from them and the people around them, but they are genuine health concerns, just want to reiterate, that interaction nervosa is the most deadly psychiatric disorder by a huge margin. And if you look statistically at the number of people with eating disorders and that die of eating disorders, it's not far off from the number of people that die from automobile accidents. I know that that sounds like a ridiculous number, but you can look this up. This is particularly true in certain countries, why that is, we don't know, but again, this is not a new phenomenon. This is not just related to body image issues that are created through social media. And as a final point on that, many of you are probably asking what about plastic surgery? What about all the steps that people are going through? Excuse me, to preen themselves and change themselves. Are people addicted to plastic surgery? Is that a form of body dysmorphia? And indeed it is. And so we will do an episode on exercise related and plastic surgery related body dysmorphia. I think there is very little question that those types of disorders are clearly related to what we're observing in social media and in media, that this shift of, for instance, action heroes. If you look at action heroes in the '80s, there were very few men that were very large. You had your terminate, you had your stallone's in your shorts and eggars and a few others, but the men in movies tended to be, if they were muscular, they were far more svelte than they are now. There's this kind of, there's a, literally a hypertrophy of the imagery. And likewise there's been hypertrophy of the female body shape. As it's portrayed in the media. There are body dysmorphia that are related to those types of things. And that relate to things like plastic surgery, steroid abuse, diet, drug abuse, and so on. Definitely important to think about and consider, and definitely deserving of its own episode.

You've learned a lot of neuroscience today. I hope that was useful in thinking about these disorders and in thinking about other aspects of feeding and motivated behaviors, I would love for you to take away this model that was handed off to me, that I think is so powerful for thinking about all sorts of things, not just eating, but all kinds of behaviors and perceptions that you have one box for what you think, one box for what you do and what is intervening between those? Why is it that you can know better and not do better? Well it's because you also have to cope with the subconscious homeostatic processes

and reward processes. And those oftentimes can be disrupted in ways that we find ourselves doing things that are not good for us or not good for other people. But fortunately, there is this great gift, which is that knowledge of knowledge can allow you to do better without question. And that knowledge of knowledge allowing you to do better over time leads to this incredible phenomenon called neuroplasticity, which essentially is translated

02:14:15 Support: Podcast, & Research Studies

into doing better over time. Even if difficult eventually makes doing better reflexive. If you're enjoying this podcast and learning from it, please subscribe to our YouTube channel. That's Huberman Lab on YouTube. And there, you can also leave us comments and feedback and suggestions for future topics and future guests for the Huberman Lab Podcast. As well we hope that you will subscribe on both Apple and Spotify and on Apple, you have the opportunity to leave us up to a five star review and to give us feedback there as well. Please also check out the sponsors mentioned at the beginning of the podcast, that's a terrific way to support the podcast. And if you'd like to support research on stress, human performance, sleep and so forth, you can go to a hubermanlab.stanford.edu. And there there's a tab that you can click. If you'd like to make a tax deductible donation to the laboratory, to explore the sorts of things that relate to neurocircuits stress, sleep and human performance. Not today, but oftentimes on this podcast, we discuss various compounds and supplements that people could possibly take in order to help deal with anxiety, improve gut microbiome, improve their sleep, et cetera. We didn't discuss those today, but for those of you interested in those compounds, if you want to see the ones that I take, you can go to Thorne that's T-H-O-R-N-E .com/the letter U/huberman. So, it's thorne.com/u/huberman. See all the supplements that I take, you get 20% off any of those supplements. And if you enter the Thorne site through that portal, you can get 20% off any of the supplements that Thorne makes we partnered with Thorne because they have the highest levels of stringency with respect to the quality of ingredients, the precision of the amounts of those ingredients. And while supplements are certainly not required or necessary for anything really, you can always use behavioral tools. Many people benefit from taking supplements of various kinds. And we do believe that getting supplements of the very highest quality is going to be important if that's the decision for you. And last but not least, I want to thank

you for your time and attention. And thank you for your interest in science. [fast-paced music]