Welcome to the Huberman Lab podcast where we discuss science and science-based tools for everyday life. I'm Andrew Huberman and I'm a professor of neurobiology and ophthalmology at Stanford School of Medicine. Today we're talking all about habits. In particular, we're going to discuss the biology of habit formation and the biology of how we break habits. I think we can all appreciate the value of having habits. Habits organize our behavior into more or less reflexive actions so we don't have to think too much about performing the various behaviors that, for instance, allow us to brush our teeth or which side of bed we roll out of in the morning. And then of course, habits can be more elaborate too. We can be in the habit of exercising at a particular time of day. We can be in the habit of eating certain foods. We can be in the habit of saying or not saying certain things. But of course, there are many habits that don't serve us well or that perhaps even undermine our immediate and long-term health goals and psychological goals. And even some habits that can really undermine our overall life goals. So today we're going to talk about making, meaning forming and breaking, meaning stopping various habits. There's a lot of information out there about habits. You'll find this in the popular sphere. There are books, there are articles, there are workshops, and so forth. However, lesser known is that there's a whole neuroscience of habit formation and habit breaking. And there's a whole field of psychology devoted to understanding habit formation and habit breaking. And within those scientific literatures, I think there are some real gems that at least to my knowledge, we haven't paid too much attention to in the popular sphere. So today we're going to talk about the biology of habit formation and habit breaking. I'm also going to spell out two specific types of habit formation and habit breaking programs. I'm going to boil these down to some very explicit steps that anyone can use. My reasoning for doing that is, first of all, it's the end of 2021. Many people are thinking about New Year's resolutions. They're thinking about leaving some things behind from 2021 and previous and acquiring some new behaviors, taking on some new challenges and trying to bring new things to their lives. But regardless of when you're listening to this, the programs that I'll outline are grounded in the neuroscience and biology of habit formation. And they map very well to what the psychologists have described in terms of habit formation and breaking. So today you're going to learn a lot of science. You're also going to come away with some practical tools. And I'm certain that regardless of your present state or goals, there'll be something of value to you. 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. Let's talk about habits. And anytime we're talking about habits, that means our nervous system learns something. Now, many people think that habits are just like reflexes, but pure reflexes are things like the eye-blink reflex. Something comes toward your eye and you don't want it to get in your eye, you'll blink. Or if you happen to step on a sharp object or get too close to something that's too hot, you'll reflexively move away. Those aren't habits. Those are what we call hard-wired reflexes. Habits are things that our nervous system learned, but not always consciously. Sometimes we develop habits that we're not even aware of until they become a problem, or maybe they serve us well. Who knows? But the fact of the matter is that habits are a big part of who we are. What we do habitually makes up much of what we do entirely. In fact, it's estimated that up to 70% of our waking behavior is made up of habitual behavior. So you can imagine that there's a lot of biology, meaning cells and hormones and neural pathways, etc. that are going to support the development of those habits. So if habits are largely learned consciously or unconsciously, we have to ask ourselves what is learning? Well, learning is neuroplasticity. Neuroplasticity is simply the process by which our nervous system changes in response to experience. We have to ask what changes? Well, what changes are the connections between neurons? Neurons are just nerve cells. They communicate with one another by electricity and by sending chemical signals to one another that inspire the next neuron and the next neuron to either be electrically active or not. But at the end of the day, neuroplasticity is about forming new neural circuits, new pathways by which certain habits are likely to occur, and other ones are less likely to occur. So we've got habits. We have that habits are learned. We have that learning involves neuroplasticity, and that neuroplasticity involves changes in the connections between neurons, nerve cells. Okay, so that describes habits through the lens of neuroscience and biology. But as many of you are well aware, there are popular books about habits, and there's a whole psychological literature about habits. And those two areas point to some very interesting aspects of habits that I think are worth mentioning. First of all, is this notion of immediate goal-based habits versus identity-based habits? Immediate goal-based habits are going to be habits that are designed to bring you a specific outcome as you do them, so each and every time you do them. So for instance, it might be that you want to develop a habit of getting 60 minutes of zone two cardio each day, or perhaps three, four times a week, as we head into the new year. I've talked before on the podcast about the fact that the scientific literature and the health literature really points to the incredibly positive effects of getting 150 minutes to 180 minutes per week, minimum, of what's called zone two cardio. Zone two cardio is basically any cardiovascular exercise that gets you moving and your heart pumping and breathing, but not so hard that you can't hold a conversation. It kind of puts you at the threshold of being just able to have a conversation that's a little bit strange, but if you were to exercise a little bit harder, run a little bit faster, et cetera, you wouldn't be able to talk while you did it. There's a lot of literature that points to that as a healthy practice. So maybe you're somebody that wants to get more of zone two cardio, for instance. That would be an immediate goal based habit. If your goal is to get that cardio maybe four times a week, every time you do it, you could check off a little box and you'd say, okay, I did it, you met the goal. That is different than so-called identity based habits, where there's a larger overarching theme to the habit, where you're trying to become, quote, unquote, a fit person, or you're somebody who wants to be an athlete or something of that sort. It's where you start to attach some sort of larger picture about yourself or what it means for you to do that habit, where there's both the immediate goal, complete the exercise, complete the session or whatever it is. Check off that box, but that you're linking it to some sort of larger goal. Now, why am I making this distinction? I mean, first of all, I'm not the one to first make this distinction. Others have made the distinction between identity versus immediate goal based habit formation. But the reason I'm making the distinction is that pretty soon in our discussion today, we are going to talk about dopamine molecule that's associated with motivation and reward that we make in our brain. And how different schedules of dopamine release predict whether or not we will stick to a habit or not. And in particular, whether or not we will be able to form that habit quickly or not. Now, this is absolutely critical to understand for the following reason. Another thing that you'll hear out there in the literature is that it takes 21 days to form a habit. Some people say 18, some people say 21, some people say 30 days, some people say 60 days. So which one is it? Does it depend on the habit that one is trying to form or does it depend on the person that's trying to form the habit? Well, it turns out that there's excellent peer review data on this. There's a study published in 2010 first author, Lally LLY. This study found that for the same habit to be formed. It can take anywhere from 18 days to as many as 254 days for different individuals to form that habit. The reason I bring this up is that I always get asked, is it true that it takes 21 days to form a habit? Is it true that your nervous system changes in six days when you're doing something repeatedly? And the answer is, as I mentioned before, it's highly variable. What I didn't tell you actually was what specific habit they were looking at in that Lally study. And it's interesting that the specific behavior was a health related behavior. That's pretty relevant to our discussion here on the podcast, which was taking walks after dinner. It was actually a really nice literature showing that walks after a meal can speed glucose clearance from the blood. So, those clearance from the blood stream can be beneficial for not just weight loss, but cardiovascular health, etc. So, a walk after dinner seems pretty straightforward, right? Well, in order to form that habit, it took some people 18 days and other people 254 days. How did they know when they formed the habit? Well, they were doing it about 85% of the time. And they also reported not having to spend that much mental effort in order to get into the mode of taking a walk after dinner. So, for those of you listening, some of you might be thinking, I can't believe that it would take some people 254 days to get into that habit. But as I said, people are highly variable. And if you can't form one habit easily, it doesn't mean that you can't form other habits easily. The mystery of why certain people can form certain habits more easily than others probably has something to do with how well people manage what's called limbic friction. Now, limbic friction is not a term that you're going to find in the formal neurobiological literature or even psychological literature. It's, frankly, a term that I coined to encompass a number of different pieces of the psychology and neuroscience literature. limbic friction is a shorthand way that I use to describe the strain that's required in order to overcome one of two states within your body. One state is one of anxiousness where you're really anxious and therefore you can't calm down, you can't relax, and therefore you can't engage in some particular activity or thought pattern that you would like. The other state is one in which you're feeling too tired or lazy or not motivated. Both of those states, feeling too alert and too calm, if you will, relate to the function of the so-called autonomic nervous system, a set of neurons and hormones and chemicals in your brain and body. An act is sort of a seesaw. You're either alert or calm. You're either asleep or stressed. Those two states are not compatible with one another. You've probably heard of wired and tired, but that's really once you've been very stressed for a long time to the point where you're exhausted. What does the autonomic nervous system have to do with any of this? Well, limbic friction is a phrase that can be used to describe how much effort, how much activation energy you need in order to engage in a particular behavior. So using this Lally study as an example, some people would eat dinner and then say, oh, that's right, I'm trying to develop the habit of taking a walk after dinner. So let's get up and go. Other people will feel like I just don't want to do it today. They're going to feel too much limbic friction and that limbic friction could arrive again from one of two sources. It could be because they are too tired to do it or it could be because they're too anxious and distracted in order to do it. So this is a key distinction. A lot of habit formation has to do with being in the right state of mind and being able to control your state of body and mind. So as we march forward, what you're going to find is that this phrase or this term limbic friction is going to be a useful metric or way for you to touch in with yourself and address whether or not you are likely to be able to form a certain habit easily or whether or not it's going to be very challenging. And I'm going to teach you a way to measure your degree of limbic friction. That is how much activation energy it will take in order for you to execute a new habit. And I'm going to teach you how to measure your limbic friction and activation energy for how likely it is that you're going to be able to break a habit that you don't want to have. The other key concept for us to address that's really mainly found in the books and articles out there about habits is this notion of what I call Linchpin habits. Linchpin habits are certain habits that make a lot of other habits easier to execute. Now that sorts of Linchpin habits that I'm referring to are always going to be things that you enjoy doing. I'll just give you an example from my life. I happen to like exercise, not all forms of exercise, but I happen to like resistance training and I happen to like running. So I'm personally in the habit of getting cardiovascular exercise three or four times per week, maybe 30 to 60 minutes per session. And I'm in the habit of doing resistance training three or four times per week, typically also for about 45 to 60 minutes per session. Now I enjoy those. And for reasons that I'll get into a little bit later, I place those activities typically early in the day because of the neurochemistry and the various types of hormones, et cetera, that are associated with performing those activities. But I really place those activities under the umbrella of what I call Linchpin habits. Why? Because those particular habits are easy to execute because I enjoy them. But they also make a lot of other habits easier to execute things like being alert for work, things like making sure that I get good sleep the night before, things like hydration, things like making sure that I eat the foods that are better for me than maybe some of the other foods that I would more reflexively reach to. If I weren't doing that training. So certain habits act as Linchpins, meaning that they shift a lot of other things. They can control and bias the likelihood that in this case you or me will perform other habits that are harder to access that we have less of an affinity for. So again, there's three concepts that we need to include here. We've got identity based versus goal based habits. We've got the concept that different habits take different periods of time to adopt depending on the person and the habit. And that there are these what I call Linchpin habits, certain habits that make other habits easier to execute. And those Linchpin habits always, always, always are things that we enjoy doing. So our goal throughout this episode is for you to identify which habits are easy for you to perform, which ones are hard for you to perform and which habits you want to break. If you want to grab a pen and paper, you can do that or if you want to dictate some of that into your phone, you can. But right now, actually, if you just want to think about these concepts, you can always go back later. I'll make sure to spell out a very specific way that you can chart out a map towards forming particular habits and breaking particular habits later on. What I'd like us to do at this point is to take that concept of limbic friction. And for you to ask yourself, what habits you perform on a daily basis? And these could be things as basic as brushing your teeth before breakfast or brushing your teeth after breakfast. It could be, for instance, that you get exercise or you get it at a particular time of day or even that you take a particular route to work. Right? We are very habitual and we tend to do things more or less over and over in the same way unless we intervene in ourselves. That's just the way that we are wired. So now I'd like to shift to thinking about a particular aspect of habits. And that's habit strength. Now, you all have different habits. You probably brush your teeth at a particular time of day. You probably exercise at particular times of week. You probably go to the refrigerator in a very habitual way. We are incredibly habitual organisms. Unless we intervene in our habits, they tend to carry out the same way that they always have once they've formed. So you can do this exercise now. You don't have to write this down if you don't want to, but you certainly are welcome. We're going to evaluate what's called habit strength. That's not a concept that I created. Habit strength is something that you will find in the psychological literature. Habit strength is measured by two main criteria. The first is how context dependent a given habit is. So context dependence is if you go from one environment to the next, do you tend to do the same thing in the same way at the same time of day. So for instance, brushing your teeth first thing in the morning, maybe some of you do that before breakfast, maybe some of you do that later, maybe some of you like me don't even eat breakfast. But when I travel, I tend to brush my teeth at more or less the same time of day relative to when I wake up as I do when I'm at home. So it's context independent. So it's a very strong habit. There are certain behaviors like perhaps what you eat or perhaps how you dress that are context independent that you might perform one way in one context and another way in another context. Another aspect of habit strength is how much limbic friction is required to perform that habit on a regular basis. This is extremely important because if you were in the process of building habits and consolidating those habits, then it's probably going to take more limbic friction to execute those habits. What do I mean by that? Well, let's say you set out to get let's say 45 minutes of zone two cardio exercise every day, five or maybe even seven days a week. Well, if at first you're highly motivated, limbic friction might be pretty low. limbic friction is how much top down, meaning from your forebrain to your limbic system, the part of your brain that generates autonomic responses, how much limbic friction, meaning conscious override of your state is required in order to engage in that particular behavior. So if you're feeling particularly tired and you don't want to get up out of bed and you don't want to go out into your zone to cardio, then there's a high degree of limbic friction. Some people think of his motivation, but motivation is a bit of a vague concept, whereas limbic friction involves specific neural circuits. And you can think of it in a more or less quantitative way. You can think of that your body is very tired, so it's going to take more limbic friction in order to get into action. You're going to have to overcome more limbic friction, excuse me, whereas if you're very, very alert, there's less limbic friction because you're moving towards something that's action oriented. However, the inverse is also true. Let's say that you are trying to get into the habit or you're in the early stages of forming a habit to meditate regularly. That's a pretty quiet and calming activity. So if you're somebody who comes home from work and you're very anxious and you have a lot of work to do and you have to deal with a bunch of things, there's a lot of limbic friction to overcome in order to get into that calm state. So these two aspects, context dependence, whether or not you're likely to do the thing regardless of where you are, right, on travel at home, on vacation with people around, not people around, etc. and how much limbic friction is required to execute that habit will tell you whether or not that habit is deeply or just shallowly embedded within your nervous system. The goal of any habit that we want to form is to get into what's called automaticity. Automaticity is fancy language for the neural circuits can perform it automatically and that's the ultimate place to be. If you have all these goals and things that you want to be doing on a regular basis, you'd love for them to be habitual because it takes less mental and physical effort, less limbic friction in order to execute those. And so much of what's out there, again, in the popular psychology literature and books that you'll find on the bookstore shelf and on Amazon and in the airports, are about how to get from that mode of high degree of limbic friction to automaticity. And they offer a number of different ways. I think many of which are useful trying to get you to organize different types of habits into different bins like value based and goal based and trying to persuade you that structuring habits at the particular times of day or in a particular way or going to be beneficial. And indeed, I think they have helped a lot of people. So what I'd like to do is to take the scientific literature of how the nervous system learns and engages in neuroplasticity and apply that to habit formation, habit maintenance, and if so desired, how to break particular habits. I'd like to give you a particular tool that's gleaned from the research psychology literature. I should mention that I learned about this from an excellent review article that's available online. It's called Psychology of Habit. The authors are Wendy Wood and Dennis Runger. This is published in annual review of psychology. The annual reviews series is a very high quality series. There are annual reviews of neuroscience, annual reviews of psychology, annual reviews of nutrition science, et cetera. For those of you that are interested in exploring review articles that are grounded in hundreds of quality peer reviewed studies, the annual review series is really terrific. Certainly among the best, if not the best, and they also tend to be quite long and quite comprehensive. So this review psychology of habit by Wood and Runger is excellent. And here I'm more or less paraphrasing from them. So I want to be clear that these are their words not mine. They're talking about the various ways that habits form in the nervous system. And they mention with each repetition of a habit, small changes occur in the cognitive and neural mechanisms associated with procedural memory. So I just want to talk for a second about what procedural memory is. In the neuroscience of memory, we distinguish between what's called episodic memory and procedural memory. Episodic memory is a recall of a particular set of events that happened, whereas procedural memory is holding in mind the specific sequence of things that need to happen in order for a particular outcome to occur. So think of it like a recipe or a protocol or if for sake of exercise, it's like sets and reps or a particular course that you're going to run or cycle or the number of laps you're going to swim and how you're going to perform it. It's very clear that for anyone trying to adopt new habits, getting into the mindset of procedural memory is very useful for overcoming that barrier that we call limbic friction. How do you do that? Well, a simple visualization exercise or it doesn't even have to be done eyes closed. You know, oftentimes we hear visualization exercise. You think about sitting in the lotus position eyes closed and trying really hard to visualize something. It doesn't need to be anything like that. It can simply be if you are deciding to adopt a new habit to just think about the very specific sequence of steps that's required to execute that habit. And I'll use a trivial example, but this could be applied to anything. Let's say I want to get into the habit of making myself or someone else in my household a cup of espresso every morning. I would actually think through each of those steps, walk into the kitchen, turn on the espresso machine, draw the espresso, walking through each of those steps from start to finish. And turns out just that simple mental exercise done once can shift people toward a much higher likelihood of performing that habit regularly, not just the first time, but as they continue out into the days and weeks that follow. So that's remarkable to me. And the literature is really robust. Just one mental exercise of thinking through what are the sequence of steps required in order to perform this habit from start to finish can shift the likelihood of being able to perform that habit from unlikely or to moderately likely to very likely over time. And that's because it pulls from this process that involves our hippocampus and our neocortex and other areas of our brain and nervous system that engage in procedural memory shifts the brain towards a mindset, if you will, it's more of a neural circuit set is would be more accurate, but a mindset slash neural circuit set of doing things in a particular sequence, which allows that limbic friction to come down and increases the likelihood that we're going to perform that thing. Simple tool, but very powerful tool according to the psychology literature and actually the seller and molecular mechanisms that under a lie that sort of procedural memory stepping through phenomenon are known in this article I mentioned this beautiful review. They talk about so called heavy and learning Donald, head was a psychologist in Canada and birthed this field that has now lasted gosh more than 50 years and is still very strong in neuroscience and psychology of heavy and learning. Heavy and learning is when particular neurons are co active meaning when they fire together they tend to strengthen their connections with one another and has a number of different underlying seller molecular features that we don't have to go into in detail, but for those of you that want to know I know some of you are hungry for a little bit more neuroscience. This involves things like NMDA receptors and methyl deasperate receptors NMDA receptors are really important I think for everyone to understand so I'll just tell you a little bit about them. These are receptors that are on the neuron surface and normally they don't contribute much to the activity of those neurons those neurons are perfectly capable of doing their thing without activation of this NMDA receptor. But when a neuron gets a very strong input a strong stimulus that NMDA receptor triggers a number of mechanisms that recruit to the surface of the neuron more other receptors in other words it makes that neuron more responsive to input in the future such that it doesn't require so much input in other words it takes a neuron that is very unlikely to fire and makes it more likely to fire. So this procedural stepping through of the steps of the recipe or the series of action steps that are involved in sitting down to study and writing for an hour or generating exercise whatever it is the habit that you're trying to learn when you're doing that exercise it's not as if your nervous system thinks you're actually performing the behavior nervous system isn't stupid it's actually a lot smarter than that it knows the difference between a thought and an action. But when you do that it sets in motion the same neurons that are going to be required for the execution of that habit and so when you actually show up to perform that habit it's as if the dominoes fall more easily it's it's a lower threshold as we say in order to get the habit to perform so heavy and learning NMDA receptors all that nuts and bolts stuff really the guts of the mechanisms of how this works but for those of you that just want to be more habitual about certain things be able to perform certain things. More reflexively that you would like in your life simply take the time do it once maybe twice and just sit down close your eyes if you like and just step through the procedure of what it's going to take in order to perform that habit the psychology literature as I mentioned and also the neuroscience literature strongly supports the fact that it is going to make it far easier for you to adopt and maintain that habit. And if you are somebody who used to perform a habit and you don't understand why you dropped it and you're frustrated with yourself and trying to figure out how you can get back into that habit well by all means lean right back into that habit but if you're having trouble doing that also just use the procedural memory exercise in order to shift your nervous system toward a higher likelihood that you will return to that habit just the same way I described for trying to initiate a new habit. So now I'd like to discuss a second and what I think is perhaps the most powerful tool for being able to acquire and stick to new habits. This tool is rooted in what we call neural circuits and I do think it is important to understand a little bit about how those neural circuits work for those of you there saying just tell me what to do. I have to say as I always say understanding a little bit or a lot of underlying mechanism will help solidify these concepts for you and will help ensure that the tools that I offer are going to make sense and that they're going to make sense in different context and for different types of habits that you're trying to learn. So rather than just tell you what to do I'm going to tell you how this particular tool works and then in doing that you should be able to apply it to any habit under any conditions. The tool that I'm referring to is something called task bracketing and the neural circuits associated with task bracketing are basically the neural circuits that are going to allow you to learn any new type of habit or break any habit that you'd like to break. We have in our brain a set of neural circuits that fall under the umbrella term of the basal ganglia the basal ganglia are involved in action execution meaning doing certain things and action suppression not doing certain things. In the experimental realm these are referred to as go meaning do or no go don't do certain things and some of us fall more into the category of we find it very easy to do certain things but harder to not do. Some people have a lot of no go type circuits that are very robust and they have a lot of behavioral constraint but they have a harder time getting into action and some people have a perfect balance of both but I've never met one of those people. So again drawing from more or less paraphrasing from this beautiful review that I described earlier in an annual review of psychology excuse me by wood and runger. Task bracketing involves a particular set of neural circuits within the basal ganglia so I'm going to describe this here again paraphrasing a sensory motor loop sensory means just input coming in about site sounds taste etc. And then the motor systems the systems of the brain and body that generate action taking that information and generating action. So the neural strideum door so means up lateral means to the sides of door so lateral and strideum is a subdivision of the basal ganglia and it's very important for the establishment of behaviors that are associated with the habit but not necessarily the habit itself and beautiful studies in both animals and humans that record the electrical activity in the door so lateral strideum. Find that the door so lateral strideum is associated meaning it becomes active at the beginning of a particular habit and at the very end and after a particular habit hence the phrase task bracketing it brackets the habit now other sets of neurons are going to be active during the actual execution of the habit. But what the literature on the door so lateral strideum tells us is that we have particular circuits in our brain that are devoted to framing the events that happened just before and as we initiate a habit and just after and as we terminate a habit in other words it acts as a sort of marker for the habit execution but not the execution of the habit per say this is very important because task bracketing is what underlies whether or not a habit will be active. Whether or not a habit will be context dependent or not whether or not it will be strong and likely to occur even if we didn't get a good night sleep the night before even if we're feeling distracted even if we are not feeling like doing something emotionally or if we are completely overwhelmed by other events if the neural circuits for task bracketing are deeply embedded in us meaning they are very robust around a particular habit. And it's likely that we're going to go out for that zone to cardio no matter what that we're going to brush our teeth no matter what in fact brushing our teeth is a pretty good example because for most people even if you got a terrible night sleep even if everything in your life is going wrong chances are unless you're very depressed if you're going to leave to work or even if you're not that you're going to still carry out the behavior of brushing your teeth in the morning I would hope so actually but you are probably less likely to perform particular habits that are not. Not what you deemed as necessary but if you think about it brushing your teeth exercise eating particular foods maybe engaging socially in particular ways. You are the one that places any kind of value assessment on which ones are essential and which ones are negotiable so task bracketing sets a neural imprint a kind of a fingerprint in your brain of this thing has to happen at this particular time of day so much so that it's reflexive. And as we'll talk about in a moment there's a way that you can build up task bracketing so that regardless of what it is you're trying to learn there's a much higher probability that you're going to do that thing when I say learn meaning let's say you're trying to acquire habit that for you is really challenging maybe it's that you're going to write for an hour a day on a book project that you've been thinking about or you're going to work on mathematics or you're going to do any sort of thing that for you there's a lot of limbic friction. While it is important to think about the sequence of events that would be required in order to engage in that behavior that procedural memory visualization exercise we talked about before that will help. There is a way also that you can orient your nervous system toward this tax bracketing process so that your nervous system is shifted or oriented towards the execution of a given habit. So this is sort of like warming up your body to exercise when the doorcell lateral striatum is engaged your body and your brain are primed to execute a habit and then you get to consciously insert which habit you want to perform so in order to leverage the neural mechanisms of task bracketing in order to increase the likelihood that you're going to perform a particular habit. I have to break it to you that one thing that you've probably heard over and over about habit formation is not true and what I'm referring to is this idea that if you are very specific about exactly when you're going to perform a particular habit that you're more likely to perform that habit. And while that is true in the short term, it is not true in the long term. And the reason for that is that our nervous system tends to generate particular kinds of behaviors based not on time but on our state, meaning what level of activation is taking place in our brain and body. How much focus we happen to have, how fatigued we are, how energized we are. So while schedules are important, it's not that specific time of day per se that's going to allow you to get into a habit and form that habit and consolidate that habit. Rather, it's the state that your brain and body are in that's important to anchor yourself to. So now I'm going to offer you a tool. It's actually an entire program by which you can insert particular habits and activities at particular phases of the day, not times of day, but phases of the day because it turns out that particular phases of the day are associated with particular biological underpinnings, chemicals and neural circuits and so forth. And in doing so, it will make it far more likely that you'll be able to regularly engage in these habits and activities over a long period of time. Whether or not that will move you from somebody who ordinarily would take 200 days to form a habit to one of those 18 days to have it people in that earlier study I mentioned, I don't know. But I am certain that it will have a significant shift on allowing you to engage in particular habits more easily and to consolidate those habits more quickly. The program I'm about to describe, I formulated for you based on the neuroscience literature and the psychology literature of learning and this concept of task bracketing. It involves dividing the 24 hour days into what I call three phases. The first is phase one, which is 0 to 8 hours after waking up approximately. You can put a plus or minus 30 minutes on this for yourself. The second phase is the 9 to 14, maybe 15 hours after you wake up. And the third phase is 16 to 24 hours after waking up. So we've taken the 24 hour cycle, we've carved it up into three phases, phase one, phase two and phase three. Now everything I'm describing, or at least the way I'm going to describe it, is based on what I would call a typical schedule, diurnal schedule. You've heard of nocturnal? Well, we are diurnal. Most of us are asleep at night and awake during the day. I do realize that a number of people have shift work or they have newborns or other reasons why they have to be up in the middle of the night and sleeping during the day. If that's the case, please listen to the episode that we did on jet lag and shift work because there's a lot of tools specifically for that population. But most people go to sleep somewhere around 10 p.m. plus or minus two hours and wake up sometime around 7 a.m. plus or minus two hours. So today I'm going to use the two bed at 10 p.m. and the wake up time of 7 a.m. as the framework for this, but you could adopt it easily to your particular schedule. Phase one, which again is 0 to 8 hours after waking, has a particular neurochemical signature. Regardless of what you do, the neuromodulators, nor epinephrine, as well as epinephrine, so that's noradrenaline and adrenaline, as well as the neuromodulator dopamine, tend to be elevated during that first 0 to 8 hours after waking. There are a number of reasons for this related to the fact that also cortisol is higher in our brain and bloodstream. It's a healthy level cortisol upon waking. Body temperature is increased, etc. And there are several things that perhaps we should all be doing. I've talked about many of these on the podcast before, that in addition to those chemicals further support an alert and focused state. And I'll just list those off. I've done many podcasts on each of these. If you'd like to access those podcasts, you can find them in the menu of podcasts on YouTube, Apple Spotify, etc. They involve, for instance, viewing sunlight or bright artificial light if you can't access sunlight within the first 30 minutes of waking. Physical exercise of some kind in this first phase of the day, 0 to 8 hours of the day, ideally pretty early in that phase. But, you know, if it has to be at the 7 to 8 hour transition point, that's fine too. Cold exposure in the form of cold showers or ice baths or outside with minimal clothing, appropriate yet minimal clothing. Caffeine ingestion, fasting, for instance, not ingesting calories. Also will lend itself to increased norepinephrine, dopamine, etc. If you are going to consume foods, foods that are rich in things like tyrosine, which is a precursor for dopamine, you can look up which foods are high in tyrosine. And for those of you that are interested in supplementation and like to use those routes, things like alpha-GPC or phenolethylaming, or L tyrosine, if that's in keeping with what you're able to do. Of course, consult your doctor if you're going to rely on supplementation. What's this all about? Well, the already elevated norepinephrine and dopamine, the sunlight, exercise, cold exposure, caffeine, tyrosine, etc. All of those place the brain in body into a state in which you are better able, or I would say more easily able, to engage in activities that have a high degree of limbic friction and where you need to override that limbic friction. We've heard that the morning is kind of sacred, conquer the hardest things first thing in the morning. And that's been discussed in the pop psychology literature and in the habit formation literature, merely from the perspective of get it out of the way so you can feel good about having done it. But what I'm referring to is quite different. What I'm referring to is a particular phase of day that after rising, after waking up that is, for zero to eight hours, right? In that first phase, your whole system is action and focus oriented. And we know that when you're action and focus oriented and because of the neurochemicals that are naturally released into your brain and body, that you will be more likely to overcome any limbic friction that stands in the way of performing particular habits. So as you list out or think about the various habits that you'd like to adopt in your life, take the habits for which you know there's the highest degree of limbic friction. They are the hardest for you to engage in. They require the most activation energy and put those in this zero to eight hours after waking. This will greatly facilitate your performance of those new habits. I'm certain of that. And in addition to that, by doing them in this particular phase of the day, not necessarily at the same time. I mean, if you want to be very habitual and you want to do, you know, the exercise or the sunlight viewing always at the same time where you want to do, you want to drink your caffeine, always at the exact same time. That's fine. But by placing them in this broader window of zero to eight hours after waking, what you're doing is you're creating task bracketing. You're making it such that your nervous system will predict when you are going to lean in against limbic friction in order to perform particular types of habits. And this is very different than saying, I'm always going to run or I'm always going to study from 10 to 12 a.m. every morning. That's great. And if you can do that terrific. But the literature indicates that people who do that who are very rigid about when they do things tend because of context dependence to not necessarily stick to those habits over time. Some people do, but many, many people don't. So think about the hardest habits to form and the habits that you most want to form that are hardest for you to adopt and to maintain. And I highly suggest placing those somewhere within this phase one of zero to eight hours after waking. Now, of course, some of the things I listed out, sunlight viewing exercise, cold exposure, caffeine fasting, those might be the actual habits themselves. But here I realize where I rather I want to acknowledge that many people, including myself, are doing some or all of these things already. And many people, including myself are trying to adopt new habits that don't fall into the category of just trying to set your overall state. Again, nor up an effort in dopamine and all these neural systems will be greatly elevated in this zero to eight hours after waking. However, the other things I mentioned, sunlight exposure, exercise, cold exposure, caffeine fasting, if that's for you or if you're eating during that phase, eating things that contain some or elevated levels of tyrosine, maybe supplementing out with GPC or L. tyrosine, etc. All of those things further facilitate the neurochemistry and therefore the state of mind that's going to be ideal for leaning into limbic friction and overriding that limbic friction so that you can regularly perform that habit. What we're really talking about here is leveraging neural systems in order to help you make it more likely that you're going to be able to engage and maintain a particular habit. So what I'm referring to as phase one of each day is useful for acquiring certain habits, but there are other phases of the day and those turn out to be useful for acquiring other types of habits. Phase two, as I mentioned, is about, again, these aren't specifics, but about nine to 14 or 15 hours after waking. During this phase of the day, because of the circadian shifts in our biology, the amount of dopamine and norepinephrine that's circulating in our brain and bloodstream tends to start to come down and levels of cortisol tend to start to come down. That's the ideal circumstance. In fact, you don't really want elevated cortisol late in the day. That's actually a signature of depression and anxiety and a number of other unfortunate things. So nine to 14 hours after waking, dopamine and norepinephrine and cortisol are starting to taper down just naturally and a different neuromodulator, serotonin is starting to rise. Serotonin is definitely going to be highest in this second half of the day and tends to lend itself to a more relaxed state of being. Now, of course, I do realize that some people are less of mourning people and find that they really come alive and awaken the afternoon, but most people don't fall into that category. Most people fear more alert early in the day, even anxious early in the day, and then as the afternoon progresses, they tend to be a bit more sleepy, a bit more relaxed, a bit more calm. There are certain things that we all can and should do during this phase two of each day that lend themselves to a state of mind and a state of body that is going to be beneficial for the generation and consolidation of certain types of habits. What are those things? First of all, as the day goes on, you should try, if you can, to start tapering the amount of light that you're viewing. Now, this doesn't mean putting yourself into dim light at three o'clock or four o'clock in the afternoon. That's certainly not the case. Simply that you want to start tapering off the amount of really bright light that you're getting, unless it's sunlight, talked about this before on the podcast, but if you haven't heard, viewing the sun as it's what we call low solar angle, so as it's headed toward the horizon, you don't necessarily have to watch the sunset, although that can be nice. But getting some sunlight in your eyes in the second half of the day can also be beneficial for a number of brain systems and psychological systems. So you can get some sunlight in your eyes. You can certainly have artificial lights on, but you want to start dimming those lights and bringing them actually physically lower in the room because the neurons in your eye that view the upper visual field. They actually trigger this alertness mechanism in the brain and body and in the second half of the day, even if you're humming around and doing work at three or four or five or even seven p.m. You are probably headed towards sleep a few hours later. So things like limiting the total amount of light if you can, things like NSTR, non-sleep deep rest, another thing that I've talked about on this podcast, if you haven't heard about this before, non-sleep deep rest is an umbrella term for things like meditation, and you can need a very powerful science supported tool for teaching you how to relax. Things like self hypnosis, which might sound a little kooky to some of you, but actually is a clinically based tool for which there's a lot of scientific literature. If you're interested in that, there's a great free resource called ReveryR-E-V-E-R-I. There's an app for both Apple and Android. This is an app that was developed by colleagues of mine and researchers at Stanford School of Medicine. These short 15-minute self hypnosis scripts, as they're called, that can teach you how to relax yourself. There's even ones for focus, for sleep, for chronic pain. Again, all very strongly supported by quality peer reviewed literature. So things like Revery, meditation, things like heat and sauna, hot baths, hot showers. Those are terrific things to do in the second half of the day. They tend to support this serotonergic or high serotonin-like state and lend themselves to more calm and relaxation. For those of you who are interested in supplementation, there's always Asho Aganda, which reduces cortisol. Again, peaks in cortisol late in the afternoon and evening are associated with depression, anxiety, and so forth. Asho Aganda is a pretty potent cortisol inhibiting tool. I personally don't use it very often, and I caution people about using it for longer than two week periods of time without taking some breaks. You can look up more about Asho Aganda on examine.com. There's a lot of terrific literature with links to studies there. But basically this phase two of the day is one in which you're alert, you are present, you are working, you are engaging socially, you're cooking dinner, probably paying attention to a number of things. But you should really be trying to taper off your stress level. So how do you leverage phase two of the day for habit formation? Well given what we know about the neurochemistry of learning and memory, given what we know about task formation and its reliance on certain forms of neuroplasticity, the second half of the day is a terrific time to take on habits and things that you're already doing that require very little override of limbic friction. So these might be things that you could categorize in common terms as kind of mellower activities. It might be journaling. It might be that you already are performing music or I should take practicing music regularly, but that there's a particular type of music that is hard for you or that you're working on a particular piece of music or you're trying to learn a language, something that's a little bit challenging, but doesn't require a ton of energy in order to override that limbic friction. The second half of the day is a much better time to do that, less resistance as we might say. But of course resistance has a neural substrate and the reason for doing those things in the second part of the day, the so called phase two, as I've called it, part of the day is because your ability to override resistance is really diminished in this second phase of the day. Some of you might say, well wait, I like to exercise in the second half of the day. That's actually when I have the most energy. That's when I feel warmer. I'm not a morning exercise. That's absolutely fine. What I'm referring to is the acquisition of new behaviors and placing those consistently at the second half of the day in order to engage this task bracketing mechanisms that I talked about before. One of the hallmark features of those basal ganglia circuits for go and no go is that they are associated with certain neurochemicals, dopamine and serotonin, acetylcholine and other neurochemicals. And by placing particular habits at particular phases of the day, those neurochemicals states start to be associated with the leaning in and the process of beginning and as I mentioned, ending those particular habits. And in doing so, they shift the whole nervous system toward being able to predict that certain things are going to happen at particular times of day, that you are going to be leaning very hard against limbic friction early in the day in phase one, and that you're going to be doing things that require less conscious override of limbic friction in phase two. And in doing so, set up this task bracketing system so that the individual habits that you're learning or that you're trying to learn to have a much greater probability of being executed and consolidated meaning that pretty soon they will just naturally become reflexive. And as with phase one, many of the things that I mentioned that support this, what I'm calling a serotonergic state or more relaxed state in phase two, things like seeing some light in the afternoon but not a lot of bright light from artificial sources, things like NSDR, things like heat and sauna, hot baths, etc., ashruganda. Again, all of those things themselves could be habits that you're trying to adopt, right? In that case, do those if you'd like to explore them. They are quite beneficial for a number of reasons, not just related to execution of particular habits in phase two of the day, but also for improving quality of sleep and consolidating any learning that you might have triggered early in the day. And I should just mention for those of you that can only exercise or prefer to exercise in phase two of the day, 9 to 14 hours or 15 hours after waking, that's absolutely fine. However, because of the importance of sleep and in particular deep sleep throughout the night for not just neuroplasticity but recovery of my life, I think it's a very important thing to do. But it's absolutely fine. However, because of the importance of sleep and in particular deep sleep throughout the night for not just neuroplasticity but recovery of muscle and other tissues that are taxed during physical exercise, if you do train in phase two, I highly recommend, highly recommend that you start doing some sort of NSDR type activity after you train within an hour or two, because that will allow you to taper down and relax so that you can get into the next phase we're going to talk about, which is phase three. Phase three of the 24 hour schedule runs from about 16 to 24 hours after waking. During that period of time, there are a few things that are going to support being in a state of mind, state of body that are going to allow neuroplasticity to occur, that are going to allow the rewiring that you've triggered during the waking part of the day to actually take place. Those things are very low to no light, meaning keeping your environment very dark or very, very dim. I don't think it's necessary to sleep in a room that's complete blackness. I think that's a little bit overkill, but for most people keeping the room dark and keeping the room temperature low is very beneficial for getting and staying in deep sleep. The body has to drop by about one to three degrees in order to get into sleep and to stay asleep. So low light, low temperature environment, you can always pile on blankets, of course, if you don't want to be cold at night, you want to be warm enough, but you want your environment to be cold. Typically, people aren't eating in the middle of the night, although one thing that can be useful is to make sure that you're at least well fed enough when you head into this third phase of every 24 hour day that you're not awake because you're hungry. Now, a lot of people recommend putting a gap between your final bite of food and when you go to sleep at night, some people will say that gap should be four hours, other people say two hours. If you're me, I generally have something I don't know within two hours or 90 minutes of going to sleep, but it's not a big meal, but that's just me and I fall asleep and stay asleep fine with that. You have to experiment for yourself. I've talked about supplements that can support sleep in previous episodes of the podcast, things like magnesium, three in eight or magnesium, bisclisonate, things like theanine, apogenin. If you'd like to read more about those, we actually have a newsletter that I'll just quickly refer you to. This is the Huberman Lab Neural Network newsletter. You can sign up for it by going to Hubermanlab.com. It's very easy to find. But even if you don't sign up, you can go to the toolkit for sleep that's listed there and that toolkit is not just supplements. That toolkit is a number of different things, both behavioral and supplement based and nutrition based, etc. That can allow you to get into sleep and to stay asleep more readily. It's totally zero cost. You can find that again at Hubermanlab.com. So things like low light, low temperature, the supplements I mentioned, adjusting your eating schedule appropriately. Obviously not drinking caffeine in the middle of the night or too close to bed. That's going to be critical. In fact, ideally, you wouldn't ingest any caffeine in phase two of the day so that you could get into this deeper state of rest in which habit formation and neuroplasticity can occur. What if you wake up? The way I've cast phase three is that you're supposed to be in this deep slumber. You're not supposed to wake up at all. You're supposed to be in low light and your brain is rewiring and those habits are getting consolidated, etc. Well, if you're like me, you probably get up once in the middle of the night. Maybe you go use the restroom. Perfectly normal. Perfectly normal. But a lot of people have trouble falling back asleep. Very important, if you get up in the middle of the night to use a minimum of light in order to navigate your surroundings just as much as you need in order to safely do so. Because light inhibits the hormone melatonin can make it very hard to fall back asleep if you inhibit melatonin. The effects of light inhibiting melatonin are actually very potent. It happens very, very quickly. So try and keep the lights low. And if you have trouble falling back asleep, that's when you might also want to use something like the Revery app. They have a sleep script there that can hopefully help you get back to sleep or something like NSDR. You can find NSDR scripts on YouTube. These are zero cost. You can look up one that I particularly like as NSDR made for. It's a company I'm associated with, but the NSDR is completely zero cost. And there are other things like yoga, knee draw, which you can find scripts for elsewhere. Again, all of these habits or these behaviors, these do's and don'ts around phase three themselves might be habits that you're trying to create for yourself. But again, phase three is really about making sure that whatever limbic friction you've been able to override in phase one and trigger some new habit, forcing yourself to write or forcing yourself to study or forcing yourself to exercise during that high limbic friction state. And then whatever things you've been doing in phase two, which are habits that hopefully have moved a little bit further along the continuum of newly formed versus all the way to reflexive or things that take less limbic friction in order to do. Phase three is when all of that gets really locked into the nervous system through those heavy and mechanisms like NMDA receptors, et cetera, that I talked about before. Again, neuroplasticity is the basis of habit formation and neuroplasticity and the rewiring of neural circuits happens in these states of deep sleep. So if you're not obeying this phase three, if you're not giving phase three, the materials it needs and you're not avoiding the certain things like caffeine and bright light and stress during phase three, you're simply not going to be able to build those habits that you've been working so hard to trigger in phase one and phase two of the day. Again, these are things that I've talked about in previous episodes of the podcast and elsewhere. But really this is about habit formation and the whole reason for placing particular types of behaviors at particular phases of the day is to set a framework for that task bracketing. Again, task bracketing and those circuits of the basal ganglia indicate that it's not just the neural circuits that are engaged by the task itself, but the neural circuits that are engaged before and after that task execution. That's what gets consolidated. So when you do things at particular phases of the day under particular conditions of neurochemistry, what you're doing is you're giving the brain a very predictable set of sequences that during sleep, it can start to put into your hard drive, if you will. It can really program it into your nervous system so that within a short period of time, hopefully within 18 or maybe even six days or who knows, maybe even fewer days, you'll find that executing those behaviors is very, very straightforward for you and that you won't have to feel so much limbic friction or override so much limbic friction. Some of you are probably asking, okay, if I perform a particular habit during phase one and then I do other habits during phase two and I eventually get to the point where I'm engaging in those habits in a pretty effortless way. Do I keep them in the same phase of the day? And the good news is the literature says it doesn't matter and in fact moving that particular habit around somewhat randomly can actually be beneficial to you because actually moving it from one time a day to the other is that context independence that we really are seeking by being able to do the same thing that we want to do regardless of time of day or circumstances, that's how we know that we've achieved a real habit formation. That's how we know that the habit has been moved into certain components of our neural circuitry that just allows to do it what seems like reflexively, although earlier I pointed out that these aren't reflexes in the traditional sense. The reason for that is that this brain area, the hippocampus that many of you know is associated with learning and memory is not actually where memories are stored. The hippocampus is where memories are formed. It's where procedures, like I talked about before, procedural memory of how you're going to execute a particular sequence where that's maintained. Like if we use the recipe model, that's where the recipe is maintained until you know how to cook that dish. And then the procedural memory literally migrates off into a different set of neural circuits, which are the neural circuits of the Neo cortex, where we have maps of sensory experience, maps of all kinds of experiences, including motor maps of how to execute things. So we use one part of the brain to learn something, but then that information in the form of the electrical activity of neurons is passed off to a different brain area. Now the neurons themselves don't move from the hippocampus to the cortex. That doesn't happen. What happens is the signals, the sequence of electrical firing, much like a script for a movie or the notes on a sheet of paper for a particular musical piece, is transferred off to a different brain area. So that whole process of really leaning into something that's hard, then it becoming easier, and then eventually that thing becoming more or less reflexive involves a migration of the information in the brain. And once it's migrated out to a different location in the brain, at that point, it's achieved context independence. It doesn't have to be bracketed by, you know, your caffeine and your lunch. It doesn't have to occur immediately after your afternoon NSDR, but before your brain is activated. But before your four o'clock meeting on Zoom or something of that sort. So all this is to say that once something has become reflexive, you should play with it a little bit about time of day. If you want to keep it in the same phase of day, great. But if you one day decide you're going to exercise in the afternoon, next day, you decide you're going to exercise in the morning, and that's the habit that you're concerned with, that's terrific. If you're able to do that, that means that it's truly achieved context independence. It means that you have officially formed that habit. And as I mentioned earlier, much earlier at the beginning of the episode, the strength of a habit is dictated by how much limbic friction, that was one, and how much context dependence there is. So when it doesn't take much activation energy to get into the execution of that habit, and you can do it in any context, well, then you have formed a habit. We really can't have a discussion about learning anything habits or otherwise unless we talk about reward prediction error. Reward prediction error is associated with the molecule dopamine, although I should say there are other neurochemicals in our brain and body that are also related to reward prediction error. But reward prediction error is a very good system, or I should say a lens through which to think about whether or not we should reward ourselves for performing a given habit. And this is a much larger discussion that actually relates to things like parenting and self-regulation. Should we reward kids just for effort? Should we reward ourselves just for effort? What should we reward? How much should we reward ourselves? When should we withdraw reward? Should we use punishment? These kinds of things. This is a vast literature. We don't have time to go into all the details. But the notion of reward prediction error is so powerful that it can predict most, if not all forms of learning, including habit formation. And you can deploy or use particular features of reward prediction error if you would like to reinforce or accelerate the formation of certain habits. So reward prediction error, quite simply, is if you expect a reward and the reward comes, a particular behavior that was associated with generating that reward is more likely to occur again. That's pretty straightforward. However, the amount of reward in the form of this molecule dopamine that you will experience is even greater if a reward arrives that's unexpected. Okay, so let me repeat that again. If I think that something's coming that's going to be great, that I, let's say I lean into a habit, I manage to override my limbic friction and I'm doing my 45 minutes of writing in the morning with no phone and no internet and I'm getting toward the end and I'm anticipating how I'm actually doing this. This is great. I did it. I'm feeling really, really good. I finished. I definitely will receive a dopamine reward. I'll make my own dopamine reward. That's where it comes from. Remember, this is all internal. However, I will also receive dopamine reward if unexpectedly something positive happens. And typically, if something unexpected, but positive happens, the amount of dopamine reward that we get is actually much greater than in any other conditions. However, it's hard to surprise yourself about a behavior that you're deliberately engaging in. So that becomes a bit of a tricky one. Reward prediction error also says that if we expect a reward and the reward doesn't come, that the pattern of dopamine release will follow a particular contour. And that contour is very important. Here's how it goes. Let's say that I'm writing and I'm about 30 or 45 minutes in. I'm thinking, oh, this is great. I'm actually, I managed to do this. I'm succeeding in executing the behaviors that I need to in order to perform this habit. I'm overriding limbic friction. Just that series of thoughts will start to generate a dopamine release within my brain and body. However, if at the 50 minute mark, the phone rings and I pick up the phone or I break my own protocol, I break my own self discipline and I go on and check social media or I do something that takes me out of that. What's going to happen is that my level of dopamine is actually going to drop below the baseline, meaning below the level of dopamine I had before I even started the habit execution. So what this is is this is a system that predicts whether or not rewards are going to come. When we think of a reward is going to come, it starts to actually arrive earlier in the form of dopamine release. This is the feeling that we experience as in positive anticipation. You tell a kid, hey, we're going to go to the amusement park or we're going to go get ice cream. They haven't had the ice cream yet. They're not at the amusement park, but they're excited. The dopamine release comes earlier. They get to the amusement park or they get the ice cream. They will also have some dopamine release associated with that. But most of it believe it or not came in the form of the anticipation. And dopamine has some qualities that make the actual ice cream in the actual amusement park experience more pleasurable than it would be had that dopamine release not happen. Now, of course, the other way to do it is to surprise a kid. You tell them, listen, we're going to the class that you absolutely hate. We're going to go see the person that you absolutely despise and then you drive them to amusement park. That's the big release of dopamine. But reward prediction error also says that if you tell the kid or yourself, okay, we're head to the amusement park. We're going to get some ice cream that really, really excite and then you get there and it's closed, or they're not letting any more people in. Well, then the dopamine level drops way below what it was before you told them that you were headed there. Okay, I've given a number of different examples that hopefully make this clear. Reward prediction error governs virtually all aspects of effort and all aspects of learning. Why? Because when dopamine is released in the brain and body, the neural circuits of our brain and body change, there's a state change. Our overlevel our excuse me, our overall level of energy, but also the sorts of sensory events that we're paying attention to changes when there's a lot of dopamine in our system. Now, you can leverage this for habit formation. Think back to task bracketing. Think back to limbic friction. If you are considering adopting a new habit, or if you are trying to break a habit, something we haven't talked too much about, but we will in a moment, it's very useful to think not just about the procedural aspects of what you're going to do, but also think about the events that precede and follow that particular habit and the execution, or at least the effort to execute that habit. What you're doing is you're casting a kind of a spotlight around a bin of time or a set of events for which dopamine can be associated. What does this look like in the practical sense? Well, again, I'll just try and use very simple concrete examples, but this could carry over to anything. Let's say I, where somebody who has a hard time getting in that 30 to 60 minutes of zone two cardiovascular exercise mid-morning, this is actually an issue for me. I much prefer to do resistance exercise than cardiovascular exercise, although once I do it, I always feel much better that I have done it. What I should do is positively anticipate the onset and the offset of that session. So thinking about leaning into the effort, going out and doing that zone two cardio session, and I should think about how I'm going to feel after. I'm just thinking about how great I'm going to feel after, but also thinking about how hard it's going to be at the beginning, and then trying to reward myself subjectively for the entire experience. In other words, start rewarding task bracketing in addition to rewarding the execution of the habit itself. You might be saying, well, wait, this is all self talk. This is just positive self talk, but it's not positive self talk. It's not saying, you know, I feel so great about doing something that I actually hate. You can't lie to yourself, or you're welcome to lie to yourself, but the neuroscience literature, the literature of growth mindset, all the literature basically of mindset speaks to the fact that when you lie to yourself, you know you're lying, and you actually set up the opposite of a reward system. You're brutally honest with yourself that, for instance, I don't like initiating this cardiovascular exercise, but I do like the fact that I've done it after I've done it. So what you are doing is you are applying reward prediction error to the entire sequence of things that's involved in getting into the habit execution, getting through the habit execution and getting out of the habit execution. How do you do this? Well, I take us back to our procedural memory visualization exercise that we talked about earlier. When I talked about it in that context, I talked about walking through mentally, the series of steps that's required to perform a particular habit. So in the case of the zone to cardio thing, it would be okay, I'm going to put on my shoes, then I'm going to head out the door, then I'm going to drive up the road. There's a particular canyon here that if I'm going to run, I happen to like running or I don't hate running enough that I tend to do it. Going through that, heading back, etc., etc. That's great, but even better would be to broaden the time bin and start to positively anticipate the period headed into the habit. So even before you put on your shoes, the fact that you are successfully placing the habit in, in this case, phase one of the day, and that afterwards I'm going to feel a particular set of positive benefits, elevated mood, etc. I like being hungry and typically after exercise, I'm hungry, so I like being hungry because I like eating. And so there's a whole set of things that link up with one another. So I'm not just thinking about habit execution as this isolated little set of events or this little time bin, but rather I'm drawing a larger envelope around it and starting to positively associate dopamine reward with that larger envelope. And for those of you that are thinking, well, this is just a psychological trick, you know, you kind of, this is sort of like lying to yourself, it's not because you're not actually contradicting the fact that some of this is unpleasant. What you're doing is you're taking this entire series of events, what I'm calling this kind of time envelope, and you're associating it with a particular reward that comes later, which for me would be the feeling that, you know, that I've completed this, right, because for me that's usually a good feeling. So reward prediction error is beautiful, not just because it's a sort of math of anticipation and reward or a math of anticipation and disappointment. It's beautiful because you can stretch out or make more narrow the time bins in which reward prediction error works. Reward prediction error is the way in which people navigate four year degrees, right, I mean, you go sure final exam to final exam, et cetera, but ultimately there's a big payoff at the end and it's all basically for that big payoff. And of course, I understand that it's the journey, not the destination, but let's face it for a lot of us goals and habits are about achieving some sort of destination. In the case of zone two cardio for me, it's about trying to stay alive for as long as I can, as long as I can with vitality that is. And it's also the fact that if I'm doing that, I get to eat the foods that I like, I tend to be able to eat more, which I happen to really enjoy eating so much so that I like it just as an activity. So basically what you're trying to do is not restrict your thinking to just the habit that you're trying to form, but rather to grab a hold of the timing before and after that particular habit and start to positively associate reward mechanisms in your brain with that entire time bin. This is a very useful and very powerful tool in order to form habits. And I should say that it's not something that comes naturally to most people. In fact, even as I describe it, you might find it's still a little bit abstract, but what I encourage you to do if you are finding it to be a little bit vague would be to pick the habit that you want to form. Write down or think about very concretely what is the sequence of steps involved in the execution of that habit. And then write down or think about what is the sequence of events that need to precede that habit, maybe the immediate 10 or 15 minutes before, as well as the immediate sequence of events and or feelings that will occur after that habit. And then call the whole thing a habit execution, the whole thing, an effort to engage in that particular habit and in doing that and imposively associating with the idea that you're going to complete that entire sequence, you will engage reward prediction error in the proper way that the dopamine surge can lend itself toward motivation because ultimately dopamine is not about feeling good. It's about feeling motivated. This is something that I've talked about numerous times before, but dopamine contrary to popular belief is not a reward molecule as much as is a molecule of motivation and drive. And the natural consequence of doing the exercise I just described of writing things out that proceed are involved in the immediate execution of the habit and follow the habit will allow you to experience an increase in energy and thereby an increase in likelihood that you're going to engage in that entire sequence of events. And the reason for that is that dopamine gives us energy and the reason for that is that the molecule epinephrine adrenaline is actually manufactured from dopamine biochemically it comes from dopamine. So dopamine is powerful and you can access more dopamine around even habits that you haven't yet formed by taking this broader time envelope and task bracketing that specific task execution or habit execution. Way back at the beginning of the episode, I promised you that I would deliver two programs that are geared towards habit formation and I promise that I would give you ways in which you could gauge whether or not certain habits had moved from high effort, what I call high limbic friction, too reflexive. And we talked about a number of ways to gauge that in researching this episode, I found a tremendous number of different systems for habit formation. It's really amazing how much is out there. There are ones of 60 days to this or 21 days to that or 18 days to this. I mean, it's just rampant in the popular psychology literature and in the self-help literature. I want to spell out a particular system that I think would be very useful to most if not all people that's rooted in the biology of habit formation rooted in the psychology of habit formation and that is entirely compatible with that phase one phase two phase three type program that I talked about earlier. But encompasses a bit of a longer time scale and really arrives at a kind of a system, if you will, for how to build in habits and then to test whether or not those habits have really stuck and whether or not they're likely to stick going forward. And so this is at least for sake of this example, a 21 day system. I pick 21 days because that seems to be the average or most typical system for engaging neural plasticity as it relates to the formation of new habits. This 21 day system actually is one that someone I know very well uses and is used for a long time, actually use their kids use it as well. And it has a certain elegance to it. And I think as I describe it, that elegance will begin to reveal itself. So basically what this involves is you set out to perform six new habits per day across the course of 21 days. Why six and why 21? Well, we'll talk about that in a moment. But the idea is you write down six things that you would like to do every day for 21 days. What phase of the day those things fall into? Well, that will depend on what they are and how they relate to those earlier phase one phase two phase three. But for now, 21 days, six things per day. However, the expectation is that you'll only complete four to five of those each day. Okay. So built into this is a kind of permission to fail, but it's not failure because it turns out that this approach to forming habits is based not so much on the specific habits that you're trying to form. But the habit of performing habits, right? It's the habit of doing a certain number of things per day. So you set out to perform six. Now, another reason for not necessarily performing all six is that some activities probably shouldn't be performed each day. So in my case, if I were to wait train or even run every day, I'm of the sort or my biology is of the sort that I don't recover so well. So I wouldn't want to do resistance training every day, but I might want to do it four days a week, for instance. So by having six things in that list, it could shuffle out that particular activity on particular days of the week and simply do four or five other activities. So it might be zone two cardio resistance training sunlight viewing, writing could be journaling. It could be learning a language mathematics. Again, this is going to vary depending on your particular goals and the habits that you're trying to create. But no more than six and the expectation is that you're not going to perform more than four to five. If you miss a day, meaning you don't perform four to five things, there is no punishment. And in fact, it's important that you don't actually try and do what in the literature is called a habit slip compensation, which is just fancy psychological language for if you screw up and you don't get all four or five in one day, you don't do eight the next day in order to compensate. This actually brings me back to an example I had from graduate school. I remember when I started graduate school feeling very excited, but a little bit overwhelmed by the amount of things that I had to do because I had to both do research. I was doing coursework at the time, graduate student stipends and still now unfortunately we're depressingly low. So it was financially stressful. There were a number of things happening. And I remember a neurologist, this was at UC Berkeley. It's really fantastic scientist and person. His name is Bob Knight. Some of you may know him. I remember he I went to him and I asked you what is the process by which someone actually navigate graduate school successfully and he said, listen, you don't want to do anything or engage in a routine in any way that you can't keep up consistently for at least five and ideally six days per week. I thought, oh, that's pretty good. And he said every four or five years, you might have to update that, but you need to decide what you can do consistently, what you can do every day or at least six days a week or five days a week. And that was very, very useful to me. And it fits well with this notion of habit slips that if you happen to screw up and not be able to engage in whatever habits you're trying to learn for whatever reason that the next day you just get right back on the on the horse, so to speak. However, there's a really interesting feature from the neuroscience literature and from the psychology literature that says that chunking this 21 days into two day bins can be very, very useful. While it is true that the unit of the day that our cells use is a circadian one a 24 hour clock, there does seem to be something powerful about engaging in particular habits in a particular sequence for two days in a row and then resetting. So thinking, okay, I can do this for a day. And if I can do it for a day, I can probably do it for two days and then resetting. So every two days, you're resetting. So you're kind of chunking this 21 days into a series of two day bins in which you are trying to perform four to five new habits and then completing that 21 days. Now, everything I've described about this 21 day program with six things that you're trying to do as new habits and only performing four to five and not compensating, et cetera, there's nothing neuroscientifically unique about it except for the fact that it's not just 21 days broken up into two day chunks. After 21 days, you stop engaging in this 21 day deliberate four to five things per day type schedule and you simply go into autopilot. You ask yourself how many of those particular habits that I was deliberately trying to learn in the previous 21 days are automatically incorporated into my schedule. How many of them am I naturally doing in other words, every 21 days, you don't update and start adding new habits. You simply try and maintain the ones that you built in that first 21 days. And this, I think, is extremely important because in all of the habit literature that I could find sure there was a lot of psychological data and neuroscience data behavioral science data around. Here's how you form a habit. Here's how you break a habit. There was even some kind of tests for whether or not a habit had really achieved context independence, whether or not it was a strongly formed habit. But there wasn't a lot of information, at least by my search, of what to do once you form to habit and how to evaluate whether or not that habit is likely to persist long into the future. So here's the idea. You set out these six things that you would like to learn or that you would like to acquire in your life, these habits. You only expect that you're going to perform four or five each day. You do that for 21 days. Again, if you miss a day, you just hop right back on the next day. However, you should think about the functional units within this 20 way in one day period as two days. You're going to try and nail four to five of these things for two days. If you happen to get all six, great, but that's not necessarily required. So you can do it for two days, then reset two days, then reset two days. And then in the next 21 days, you're not trying to acquire any new habits. You're not going to throw in six more habits that you want to learn. You're simply going to assess how well, how deeply you've rewired your nervous system to be able to perform those six habits of the previous 21 days. This is extremely useful, I believe, because it will allow you to assess whether or not you can indeed make room if you even have room, I should say, for more habits. Many people are trying to cram so many new behaviors into their nervous system that they don't stand a chance of learning all those behaviors. What you may find is that you kept up two of those things very consistently throughout the 21 days. And perhaps there was one of them that you did sporadically and that there were three others that frankly you didn't manage to execute. You may also be one of these people, one of these mutants that sets out to do six new things per day for 21 days and performs every single one of them. Terrific, more power to you. In that case, for the following 21 days, let's see whether or not you can continue to perform those very same six things every day for 21 days. And then and only then would you want to add more habits in. So you could repeat this 21 day process, you know, 21 days of new habit, 21 days of testing those new habits as whether or not they're reflexive or not. You could do that forever if you wanted. But the idea is that this isn't something that you're doing all year long is that you perhaps starting the new year or regardless of when you're listening to this, you set out to make that 21 day really the stimulus period in which the habits get wired in. And then the following month and maybe even the following months or periods of 21 days are really that kind of thermometer the test bed of how well you've embedded those particular habits. And if indeed you want to continue to add new habits or you find that certain habits that you weren't able to embed in your nervous system and make reflexive, you want to then bring those in. And fantastic, but it's only once you've achieved all those six habits as reflexive that you would move forward. And I think this sort of system while it could have been replaced with many other different systems. Again, there's nothing holy about the system, but this particular system has a number of features, the lack of compensation for miss days. It's a fairly high intensity program for 21 days, but then you test yourself, a kind of a competition test with yourself, if you will. Those features and the fact that habit slips missing of particular habits and not doing all six is kind of built into the system. I think makes it a very reasonable one. It's very adaptable to the real world. And I think it's one that provided you obey the phase one phase two phase three type system that we talked about earlier. You collapse these two programs with one another, which hopefully will be easy based on the descriptions I've given. Well, if you do that, I think there's a very high probability that the habits that you try and form will achieve this context dependence and that it will take progressively less and less limbic friction to perform them. Thus far, we've almost exclusively been discussing how to form habits. But what about breaking habits? Certainly many people out there would like to break habits that they feel don't serve them well. One of the challenges in breaking habits is that many habits occur very, very quickly. And so there isn't an opportunity to intervene until the habit has already been initiated and in some cases completed. Well, there are a couple of tools that neuroscience and psychology tell us can be very beneficial. Some of those things are somewhat intuitive and relate to what I call foundational practices, meaning things that set the overall tone in your body and brain such that you would be less likely. To engage in a particular habit or that would raise your level of awareness, both of your situation and to how you feel inside. So things like stress reduction, things like getting good sleep, things like quality nutrition, things like having positive routines arranged throughout your day. All of those, of course, will support you in trying to break particular habits. And while that can be very useful, it's admittedly very generic advice. It doesn't point to any one specific protocol. In order to identify a specific protocol that one could apply in order to break habits, we have to look at the mirror image of the sort of neuroplasticity that we talked about at the beginning of the episode. At the beginning of the episode, we talked about a form of neuroplasticity called long term potentiation involving the NMDA receptor. Just to refresh your memory a little bit, it basically says that if a set of neurons is very electrically active, it's likely that over time those neurons will communicate with themselves more easily because of changes in things like NMDA receptor activity, the recruitment of additional receptors, et cetera. It's essentially a cellular and molecular explanation for how something goes from unlearned to learned to reflexive. Now, in order to break synapses or to break apart neural connections that are serving a habit that you don't want to engage in, we need to engage the process called long term depression and long term depression has nothing to do with a state of mental depression or a reduction in mood. So I really want to be clear that when I say depression in this context, it has nothing to do with psychological depression has nothing to do with mood. It's simply called long term depression because just as long term potentiation says if neuron a triggers the firing of neuron B and it does so very robustly over and over and over again, then neuron a will not have to fire as intensely or as frequently in order to activate neuron B in the future because they become patentiated. So the threshold for co activation has been reduced. There's a much higher probability that they will be activated together at low levels of intensity. That's essentially what long term potentiation is long term depression says that if neuron a is active and neuron B is not active within a particular time window, then the connection between neuron a and B will weaken over time, even if they started off very strongly connected. So I want to repeat that because this is pretty detailed neurobiological mechanism whereby if neuron a is active and neuron B is active, but at a different time or outside of particular what we call temporal window, meaning outside of particular time window, then through long term depression, the connection between neuron a and neuron B will weaken. As a point of interest, the NMDA receptor is also involved in long term depression, although there are other molecular components involved as well. So how do you take two neurons that underlie a habit out of synchrony? How do you get them to fire asynchronously? This is pretty interesting with respect to the cellar molecular biology, but at the behavioral level, it's especially interesting. The way that one would do this is let's say for instance you have a habit of picking up your phone mid work session. That's a reflexive habit I think that most people have experienced and we often hear the idea that, oh, you know, the phone is so filled with access to dopamine and incredible things that were just drawn to it. But if you notice what's happened with phone use over time, most people, including myself sometimes I admit, find ourselves just looking at our phone or find ourselves in a particular app without actually having engaged in the conscious set of steps of, oh, I'm really curious what's going on in this particular app. I'm really curious what's going on in this particular website and you just kind of find yourself in air quotes for those of you listening, I'm making air quotes. You just sort of find yourself doing it because the behavior of picking up your phone is sort of reflexive or as it become fully reflexive. You see this a lot at meals where multiple people are there and no one's looking at their phone and then all of a sudden someone takes out their phone and you'll notice that other people just naturally take out their phone. It's this kind of observed observation induced reflex and I would wager that most people aren't consciously aware of the immediate steps involved. So the literature says there are a number of ways to break these sorts of habitual behaviors or reflexive behaviors. Most of those approaches involve establishing some sort of reward for not performing the activity or some sort of punishment for forming the activity. I've heard of some basic things that people do like they'll even put like a rubber band on their wrist and every time they complain or every time they do some behavior like pick up their phone, they'll give themselves a snap on the wrist. The rationale there is that you're trying to create a somatic, a very physical representation of something that makes it very real and harder to overlook. Other people will just do a tick mark on a piece of paper. The sort of what gets measured is what gets managed kind of mindset where if every time you do something you take away the judgment, this is very new age here I realize, but this is what you find out there with you search the literature and even on PubMed peer reviewed articles that every time you engage in a behavior you just measure the fact that you did that behavior you just market down at the end of the day people are supposed to look at that and say oh my goodness I can't believe that I spent you know three hours doing something or I did it 46 times. In fact a lot of app social media apps will start to give you warnings now if you opt in that you've been on the app for an hour would you like to leave most people just click right past and go back in I think very few people say oh my goodness it's been an hour and therefore you're right I absolutely shouldn't engage in this anymore. It's just far too easy to just blow past those reminders. Well the literature on habit formation and habit reduction breaking habits has been analyzed there's a beautiful meta analysis which involves looking at a number of different studies altogether comparing the statistical strength of each of those studies looking in different conditions what sorts of habits were trying to be made or broken. The first author on this review is Fritz F R I T Z I'll certainly put a link to this it's Heather Fritz and it's intervention to modify habits a scoping review and it is indeed a very broad scale review it's from the journal of occupation participation and health is published in 2020 it's a really nice article a couple of things I learned from this article and then I'll get into the specific tool for breaking habits perhaps the most interesting thing that I took from this review was the finding that. Notifications to either engage in habits or to not engage in habits actually were not very effective over time they were effective in the immediate period when people started using these notifications as were little sticky notes like don't go into the refrigerator between the hours of whatever and whatever or just visual reminders physical reminders or electronic reminders were effective in the immediate term but in the long term did not predict whether or not people would effectively stick to habits that are effective. Stick to habits they were trying to stick to or break habits that they were trying to break so sadly that doesn't seem to work very well and perhaps they just need to come up with more robust reminders I don't know my electric shock or something like that because what we do know only sort of kidding about my electric shock but we do know from both human and animal studies is that things like electric shock things like monetary penalties right having to pay out every time you engage in a particular behavior those are pretty effective ways to do it. Pretty effective ways to break habits the problem is when people are not being monitored for habit use for instance you can imagine a situation where you say I'm not going to pick up my phone for the four hours in the early part of the day so that I can get you know real dedicated focus work done unless someone's monitoring them then people don't tend to monitor themselves completely enough that they punish themselves completely enough that they break the behavior in other words the punishment isn't bad enough in order to break the habit which just so. How powerful these habits are once they become reflexive they're just very very hard to override so turns out that the key to generating long term depression in these pathways is actually to take the period immediately following the bad habit execution meaning let's say you tell yourself you're not going to pick up your phone you're not going to bite your nails you're not going to reflexively walk to the refrigerator particular time of day but you find yourself doing it anyway and what actually has to be a good example of the way you're doing it. Actually has to happen is bringing conscious awareness to the period immediately afterward which I think most people recognize they realize I just did it again I just did it again and in that moment capture the sequence of events not that led to the bad habit execution but actually to take advantage of the fact that the neurons that were responsible for generating that bad habit were active a moment to go and to actually engage in a replacement behavior immediately afterward. Now this is really interesting and I think powerful because I would have thought that you have to engage in a replacement behavior that truly replaces the bad habit behavior right that you would have to be able to identify your state of mind or the sequence of events leading into the bad habit but rather the stage or the period immediately after the bad habit execution is a unique opportunity to insert a different type of what we would call adaptive behavior but that could be any behavior that's not the same as the other behavior that's not the same. That's not in line with the bad behavior so let's give an example let's say you find yourself you're trying to do focused work you pick up your phone you're disappointed yourself for for picking up your phone you could of course just put it down or you and re engage and the work behavior but if you were good at that then you probably wouldn't have done it in the first place and so what turns out to be very effective is to go engage in some other positive habit now this has two major effects the first one is you start to link in time the execution of a bad behavior to this other good behavior and in doing so you start to recruit other neural circuits other neurons that can start to somewhat dismantle the sequence of firing associated with the bad behavior in other words you start to create a kind of a double habit that starts with a bad habit and then ends with a good habit and that seems to create a good habit. So I'm not enough of a temporal mismatch so that then recognizing when you're heading toward the bad habit becomes more apparent to you so again I want to make this very very concrete let's say that the behavior is reflexively picking up one's phone you do that you think goodness I did it again here's what I'm going to do you would set that down and then you engage in some other positive behavior that you've deemed positive and here it's very subjective so it's hard for me to give an example that will necessarily make sense to everybody but perhaps you're working on hydration so maybe you go have a glass of water maybe you you are trying to do breath work or something maybe you're you are trying to enhance your language speaking skills and so you go and you spend five minutes doing a particular type of language learning you literally exit whatever you are doing and perform that other new positive habit in the immediate period right after that even for a short period of time it's a little bit counterintuitive but what this does is it creates a kind of a cognitive and a temporal mismatch between the initial bad behavior which before is what we would call sort of a closed loop in the engineers out there will know what I'm talking about but in closed loop is a one behavior one set of neural firings leads to another leads to another and then just kind of sets the same thing in motion it can be kind of a self perpetuating system by changing the number of features that are in that loop it disrupts the closed nature of that loop it creates what we call an open loop and in an open loop you are better able to intervene so as I mentioned before this might seem counterintuitive and I think why would I want to reward the execution of a bad habit with a good habit I don't want to reward myself for the bad habit but really what you're trying to do is you're trying to change the nature of the neural circuits that are firing so that you can rewrite the script for that bad habit a different way to put it would be imagine that the bad habit is like a chord on the piano that you play or a chord of notes or a sequence of notes that you would play and it comes very easily you can play it every single time but let's say as you're trying to learn a new piece of music you just constantly inserting that at the inappropriate times that was it you know I think it's a decent enough analogy for a bad habit because it involves some motor execution you just find yourself doing it rather than trying to prevent yourself from doing it the next time you do it add in a new quarter sequence that you're trying to learn what this does then is it changes the whole nature of the sequence of neurons that are firing from bad habit through to the end of this newly applied good habit so this is the way in which you start to dismantle or when I say dismantle really weaken the likelihood that if neuron a fires neuron b will fire because as you're starting off in the mode of very reflexively performing a bad habit those neurons are firing together without you consciously being aware of it it's almost impossible for you to intervene in yourself without a number of other features like severe punishment, severe consequence type outcomes rather tacking on some additional sequences like if neuron a fires neuron b fires and then you're saying okay well if neuron b fires I'm going to start inserting neuron c d e f to fire right that's the c d e f being the positive behavior that you're going to insert and in doing so you create a chain of neuronal activation that then is very easy to dismantle and so when people have applied this kind of approach it removes the need to have constant conscious awareness of one's own behavior prior to that behavior which is very very difficult to achieve rather what they find is that they are able to engage in remapping of the neural circuits associated with bad habits in ways that are very very straightforward because you can always identify when you've done the thing you don't want to do and then attack on to that something additional that's positive. Now the nature of that positive thing is important you don't want it to be something that's very hard to execute you want it to be something that's positive and fairly easy to execute so that you're not struggling all the time to insert this on top of this bad behavior whatever that bad behavior might happen to be but again this is rooted in the biology of long term depression it maps very well to the behavioral change literature that I was able to glean that really shows that rather than just get reminders rather than trying and still punishment rather than setting up reward for breaking bad habits that perhaps the simplest way to approach this is to tack on additional behaviors to the bad habits make sure those behaviors are good behaviors or behaviors that are adaptive for you and in doing so you will soon find that the initiation of the bad habit takes on a whole new form or that you're not even inspired to do it at all and of course I want to acknowledge that breaking bad habits is really hard we had an episode all about addiction with Dr. Anna Lemke from Stanford Medical School she's a colleague of mine who runs the dual diagnosis addiction clinic at Stanford and in that episode we talked a lot about how addicts for drugs alcohol people have addictions to certain types of behaviors or avoidance behaviors even that in the case of addiction there has to be a tremendous kind of full scale a campaign for them to be able to intervene in their behavior so for those of you that are thinking about bad habit breaking in the context of addictive type behaviors definitely check out that episode addiction does employ some of these principles around habit making and habit breaking as it were but of course because the consequences of certain habits in addiction can be so severe there's other sets of protocols and there's a kind of a psychological backdrop to it that's very important it also relates to the biology of dopamine and you can find all of that in the episode with Dr. Anna Lemke so today we've covered a lot about the biology and psychology of habit formation and habit breaking we talked about why certain habits are so hard to wire in why certain habits are so hard to break down and eliminate and how we can determine which habits are going to be easier for us to access and which habits are going to be harder for us to access and break we talked a lot about this notion of limbic friction and we talked about context dependence and we talked about a number of different things as it relates to neural circuits and the formation of new connections in the brain and strengthening and weakening of connections in the brain we also discussed two programs programs designed specifically for you on the basis of the neurobiology literature and the literature on the psychology of habit formation and habit breaking just a briefly recap one program it involves dividing the 24 hour day into three phases phase one phase two phase three and to try and tackle specific habits at particular phases of the 24 hour cycle the second program involved a 21 day process of engaging approximately six new habits per day although the expectation as I mentioned earlier is that you're not going to perform all six of those and an assessment in the following 21 days as to whether or not you have indeed formed those new habits or not and there were a number of other features that I mentioned that were related to those two general programs phase one phase two phase three and the 21 day program and how those could be meshed together so I'm guessing some of you will probably have questions about those programs and how to apply them but hopefully they were clear enough for you to get started this is a good opportunity for me to mention that the Huberman Lab podcast has something called the neural network newsletter that is sent out approximately once a month for the next newsletter I will release a on paper version of these two systems and how they meshed together for habit formation and habit breaking and if you'd like to access that you can go to Huberman Lab.com you go to the menu you can sign up for the newsletter first of all it's zero cost second of all we have our privacy policy there but I can tell you right now we don't share your email with any vendors or any other sources those email state internal to us and if you'd like to see what the sort of flavor of those newsletters is the previous newsletters for instance one on tools for sleep that I mentioned earlier or tools for neuroplasticity in the classroom and outside the classroom as well for teachers and for students of various kinds those are also posted there so you can access any of the previous newsletters my hope is that today you've learned both the biological mechanisms and the practical tools by which you can start to establish habits that for you you deem adaptive healthy and that are going to support you and your goals and that you can start to dismantle some of the habits that you find to be unhealthy or maladaptive for you and for your goals if you're learning from and are enjoying this podcast please subscribe to our YouTube channel that's a terrific way to support us in addition on YouTube you can leave us feedback in the comment section you can also leave us suggestions for future guests that you'd like us to host on the Hubertman Lab podcast and please also subscribe to the podcast on Apple and or Spotify on Apple you can leave us up to a five star review and now Spotify has a feature by which you can also leave us review feedback please also check out the sponsors mentioned at the beginning of this podcast episode that's perhaps the best way to support our podcast in addition we have a patreon it's patreon.com slash Andrew Hubertman and there you can support the podcast at any level that you like during today's podcast and in many previous episodes of the Hubertman Lab podcast I mentioned supplements while supplements aren't necessary for everybody many people derived tremendous benefit from supplements supplements for sleep supplements for focus supplements for various other things related to mental and physical health and performance one key issue anytime there's a discussion about supplements is you have to be sure that the supplements you are taking are of the very highest quality and for that reason we've partnered with Thorn because Thorn has the very highest stringency with respect to the quality of the ingredients they include and the precision of the amounts of the ingredients that they include in their supplements if you'd like to see the supplements that I take and get 20% off any of those supplements you can go to Thorn THRIN.com slash letter U slash Hubertman and in addition to being able to get 20% off any of those supplements if you navigate deeper into the Thorn site through that web portal Thorn.com slash U slash Hubertman you can also get 20% off any of the other supplements that Thorn makes if you're not already following us on Instagram and Twitter please feel free to do so there I teach neuroscience and neuroscience related tools in short format some of that material overlaps with what you hear on the podcast some of it is unique and different from what's on the podcast and once again I want to thank you for going on this journey of exploring the neuroscience and the psychology of habit formation and habit breaking I hope it supports you in your goals and last but certainly not least thank you for your interest in science.