Welcome to the Huberman Lab podcast where we discuss science and science-based tools for everyday life. I'm Andrew Huberman and I'm a professor of neurobiology and ophthalmology at Stanford School of Medicine. Today we are discussing creativity. Creativity is a topic that to many people is very abstract. That is, we know when something seems creative, some of us know people who are creative or perhaps are creative, and yet the ability to be creative resides in everybody. And we know that because the neural circuits that underlie creativity have been somewhat defined, and the steps and processes within the brain and body that lead to creativity are well known. That said, most people don't know how to access creativity, and if they do know how to access creativity, they are only able to access creativity in a fairly limited number of domains of life, for instance, in the visual arts or in music or within science or engineering, or any number of different domains ranging from the kitchen to sport to childhood interactions, that is, childhood games. In other words, some adults are able to access their creative spirit when engaging in childlike play with children, or for that matter, with adults. But as it turns out, all of creativity stems from just a small subset of neural structures in the brain that need to be activated in a particular sequence or order. Today we'll talk about what those neural structures are, what particular order they need to be activated in in order to come up with, for instance, new ideas that are creative, and then how to implement those creative strategies. We will also talk about different ways to access creativity that include narrative and storytelling, as well as applying new rule sets or even entirely new world views, and we will do this in a structured way that will allow anyone, whether or not you consider yourself creative or not, to be able to apply these tools in different domains of life, work, family, play, and on and on. By the end of today's episode, you will have a better understanding of what creativity is, and how to access it, and if you like, to bring others into your creative endeavors, which, as you'll soon learn, can massively expand the extent to which you yourself can express your creative talents. As is the case with all episodes of the Heberman Lab podcast. Today we will discuss both scientific mechanisms and nomenclature, and I promise to make all of that clear to you, even if you don't have a background in biology or psychology. But we will also, of course, discuss tools, that is specific steps that you can take in order to be more creative. One particular tool that I'm excited to share with you involves a meditation, but this is a very unusual meditation. This is not sitting with eyes closed, focusing on your breath, or focusing on a chime, or some other feature in your sensory environment or even in your body. Later we will talk about open monitoring meditations. Open monitoring meditations are very distinct from other forms of meditation, and involve learning how to sit back and simply observe your thoughts, while intentionally varying where your thoughts go. So for those of you that find it a struggle to focus or to refocus in more traditional forms of meditation, or maybe even in your work, and even for those of you that may suffer from things like ADHD or similar, open monitoring meditation can be an extremely valuable tool for accessing your creative abilities. Because of the ways that it allows you to tap into specific circuits within the frontal networks of your brain, so these are networks of the brain that include the areas just behind your forehead, and that allow you to evaluate new and novel rule sets in a very unconstrained way. Because if you think about it, creativity is really the ability to take existing elements from the physical world, or from the thought world, if you will, or from any domain of life, mood, thinking, and information, and to reorder those into novel combinations that are useful for something. And as we'll also find out later, creativity has this incredible aspect to it, which is that when we see or create or experience something that is truly creative, it reveals to us something fundamental about the way that the natural world, and indeed the way that our brains work. If that sounds very mysterious and abstract to you now, I promise that by the end of today's episode, you will not only understand what that means, but you will also understand how to use open monitoring meditations, as well as other forms of tools, in order to access your creative ability. 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 creativity. Now on the face of it, the word creativity and creative acts might seem somewhat abstract to us. That is, we know when we see something that we consider creative and we know when we see something that is not creative. Things that aren't creative are things that we see every day, a car with four tires, for instance, say bicycle with two tires, not creative. However, we also see things that are novel, that are different, and that we don't really think of as creative. In fact, they can be downright trivial. For instance, if I were to take a fish tank and put wings on it, that's a novel combination of things, which is one of the key criteria for an act or an object or a piece of music. That is creative. And yet, neither of us, I believe, would find it very creative or very interesting that a fish tank has wings on it. Why? Or why not, I should say? Well, it turns out that for something to be creative, it actually has to reveal to us something fundamental about the world or about how we work. And I must say that oftentimes, the most creative and the most interesting and the most beloved creative acts reveal to us something fundamental about the world or the way that we work in a way that delights and thrills and surprises us, but that we aren't even aware what that fundamental rule is. I'll return to this in a few minutes, but the time being, let's just build up from first principles, what constitutes something creative and what does not constitute something creative. Creativity is a way of interacting with the world or combining or recombining things in the world in a way that appears novel to us and to other people. My example of a fish tank with wings on it is novel, but frankly, it's not very creative and it's not very interesting. It doesn't reveal anything new to us. Sure, they're flying fish, although they just kind of jump far, they don't really fly. And as a consequence, putting wings on a fish tank could be used as a metaphor for the fact that fish don't fly, but you already knew, and I already knew that fish don't fly. And so there's nothing novel revealed to us about the world except something we already knew. But creative acts, on the other hand, of course involve novel combinations of existing rule sets. That could be different combinations of music or colors or shapes or technology, et cetera. But it does so in a way that tells us something fundamental and different. Let me give an example of a few truly creative artistic acts. And I'll do that in the domain of visual arts, but of course, there are many examples that could come from music or from other domain sport, et cetera. Examples I'll give rather than a fish tank with wings are, for instance, the comparison between a drawing or a very accurate painting of a face, an Escher painting and a Banksy. Okay, if you don't know what those are, I'll explain. First of all, let's talk about an accurate representation of a face. If I were to sit you down or if you were to send me a photograph and then I were to paint or draw a picture of your face in a way that faithfully represented the position and shape of your nose relative to the eyes, maybe a curl of the lip, maybe a few hairs of your eyebrows in a particular way that really captured you accurately. I think most people would say, okay, it's accurate. It looks a lot like the photograph or the person. And on the one hand, why that could be interesting. It's not particularly creative because it faithfully represents what's already there. In contrast, a painting or a picture like an Escher, and for those of you that aren't familiar with Escher's, involves a lot of repeating patterns. For instance, a bird image that's repeated over and over and over and over again, sometimes in partially overlapping manner, and perhaps a building that's repeated over and over and over again, or stones repeated over and over again, or staircases over and over again. Escher's capture elements from the outside world and faithfully represent them, but faithfully represent them over and over and over again, which is not typically seen in the natural world. Most of what our visual system does is to eliminate repetitive patterns when we see them. In fact, most of what our visual system does is try and make us blind to repetitive patterns in our visual environment, and only allow us to see things that are unusual in that visual environment. Now, this is especially true at visual scales. What I mean by that is if you were to go to the beach and lie on your towel and look down at the sand, you would start to notice that the sand is a very, very repetitive pattern. So, at very small scales, and in particular, molecular scales, when you get down to the level of atoms and so forth, everything is repetitive. It's the same thing as just reproduced in different combinations over and over again. But as we move through our world, typically we're not looking down at pebbles on the ground or little grains of sand, or the pattern of leaves in a particular clover or something of that sort. Most of the time, we're looking out on landscapes or at people's faces, et cetera. And very seldom do we see highly repetitive patterns at that scale. So, what Escher's do is they essentially reveal to us a fundamental feature about the way that our visual system works, which is that repetitive patterns tend to become noise in our visual system. That is, our brain encodes repetition as things not to be interested in, and the things that stand out against that repetition as the things to be interested in, so called signal to noise. What Escher's do is they invert the relationship between signal and noise, and they make the repetitive patterns the signal, and the unusual patterns the noise. In fact, in every Escher, there are unusual patterns, and those completely disappear to us. Now, when you look at an Escher, what you probably see and what I see are just a bunch of birds repeated over and over again, or buildings or staircases repeated over and over again. And you may like Escher's and you may not. That's not the point. Today, we're not talking about taste in particular creative acts, what we're trying to identify here are the rules and mechanisms of what constitutes something creative and why it's creative. And the key element here is that what's revealed by an Escher through these repetition patterns is an inversion of the way that our brain normally encodes visual images, and therefore the rule that repetition is suppressed in our visual system, and that unusual visual features are revealed to us. That rule is what pops out to us when we look at an Escher. Now, when I say pops out, I don't mean that you look at an Escher and go, oh, normally I don't see repetition, normally I see the unusual stuff, et cetera, et cetera. But there seems to be something about truly creative acts that capture the attention, and sometimes the delight of many, many people, is that they reveal a fundamental rule about how the brain or the world work. Let me give you a different example, also from the visual art world. Let me give you the example of Banksy. Banksy is an artist that many of you are probably familiar with, and probably some of you are not familiar with. So for those of you that are not familiar with Banksy, Banksy is an artist that most often does two-dimensional artwork, so these would be stencils or paintings or drawings, like many artists, and does them in an urban landscape, an actual city or suburban landscape. That is, he draws or stencils or graffiti in a very cryptic way, I should say, known really knows who Banksy is, or when he does his art, he just reveals his art by putting it up. But he does this in the context of cities and on three-dimensional objects. So a good example would be he will stencil next to a phone booth, a police officer, or he will graffiti next to an actual fire hydrant, a dog lifting its leg to urinate on that fire hydrant. Now, what's interesting about Banksy is not simply the fact that he puts two-dimensional art onto three-dimensional surfaces in the urban and suburban landscape, because if you think about it, that's been done many, many times before. All graffiti is that. All city art and murals is that. So what's unique about Banksy? What's unique about Banksy, or I should say Banksy's, the actual art, is that he combines two-dimensional art with a three-dimensional art. With a three-dimensional landscape in a way that the concept pops out at you. What do I mean by that? Well, in the case of the dog lifting its leg to urinate on the fire hydrant, that's a scene that most people, and in fact most children are familiar with, from cartoons or from our basic understanding of the stereotype of dogs, and I must tell you having owned a male dog, a bulldog, Costello, for many years. Hydrants were a particular target for Costello. Of course, everything was a particular target for Costello urinating outdoors. Nonetheless, he liked to pee on fire hydrants. That itself is not interesting. Seeing a photograph of a dog raising its leg to pee on a fire hydrant is not interesting. Seeing a painting of that isn't interesting. Seeing an actual dog urinating on a fire hydrant isn't interesting. In fact, seeing a painting in two dimensions of a dog raising its leg to, of course it can't actually urinate, but give you the impression that it would urinate on that fire hydrant isn't particularly interesting except for the fact that it reveals to us something fundamental, which is that we tend to pair visual relationships between different objects that share a common theme. And then the theme tends to pop out of us. So for instance, the dog raising its leg next to a fire hydrant, even if the dog is drawn in two dimensions and the fire hydrant is in three dimensions, allows the concept of dog and fire hydrant to emerge or pop out at us, which reveals to us something fundamental about how our brain works, which is that our brain encodes concepts and entire stories as symbols of interaction between different objects. Let me give you a different example just to make sure that this hits home. One of Banksy's more famous paintings is a rather politically charged one, which is of a girl holding a bouquet of balloons and this two dimensional drawing was put on to the West wall, dividing territories in the Middle East. A very controversial issue. The controversies of that issue are not what I want to get into, but I don't think anyone would doubt that it is a controversial issue. The two dimensional drawing of the girl with the balloons on the actual wall turns out to be quite interesting as an art piece because what it reveals to us is the entire controversy around the presence of that wall and the desire for certain people to breach that wall and the desire for other people to insist that that wall not be breached for whatever reason. Again, this is not about the particular controversy. The point is that a two dimensional image combined with a three dimensional structure allows the purpose of that three dimensional structure and the controversy around that three dimensional structure to pop out at us in a way that if, for instance, we had just seen a photograph of somebody next to that wall or with a ladder or if we just seen a drawing of a girl holding a bouquet of balloons on a drawing of that wall to not emerge. In other words, it captures two fundamental features of the visual system. Our ability to encode things in two dimensions and understand symbols and our ability to understand things in three dimensions and in particular the wall as a three dimensional object is really interesting because it's an actual physical barrier. So showing it as the actual physical barrier that it is in real space in three dimensions turns out to allow the interaction between those two things, the concept, the controversy to pop out at us and make us think about that particular controversy and perhaps where we each individually stand on that controversy. Now, there are many examples of what I just gave in the visual domain. For instance, Rothko's, which are just color on canvas, are particularly interesting source of information about the way that the brain encodes color. Later on, fill in exactly what that information is. You may like Rothko's, you may not, but I'll tell you one thing. When you look at a Rothko, you are seeing colors in a very different way than you would ever see colors in any other context. The fact that they don't have a frame typically and the fact that there's no white canvas allows the colors that you see to be novel hues of those colors that you will not see in any other context and in doing so reveals to you what your brain does in order to understand and extract color. Now, in the context of music, for instance, you will sometimes hear a street musician play a song, maybe a Bob Dylan song or Led Zeppelin song or Pink Floyd song pretty closely, pretty accurately to the way that song is played. But of course, that's not creative. That's just like the photograph or the accurate portrait of somebody's face. Or you may hear an acoustic version of what's normally an electric guitar song or electrical song or vice versa. Somewhat creative, sometimes sound even better than the original, but not particularly creative. However, each and every one of us has a particular taste in music. Maybe it's classical, maybe it's rock, maybe it's punk, maybe it's hip hop. Within each of those genres, I think all of us are familiar with hearing something for the first time and maybe even every time. And there's something about the combination of the words and the music or sometimes just the music or just the words that allows some feature of it to pop out at us as per the music. And when we feel that excitement and we feel that it's really novel, it's different than what we've heard before. I assure you what it's revealing to you is the way that your auditory system and often your auditory and your emotional system encodes information that you hear. And again, the rule that it's revealing is not spayed out for you. For instance, it's not told to you, oh, this is the way you normally hear and now you're hearing things differently. Sometimes it's the change in, for instance, in the way that words are accented or the way that sentences are constructed. This often you'll hear and hip hop the way that sentences are constructed can be divided up not as normal declarative sentences the way that they're typically written, but the way that sentences are chopped up and fractured reveals to us new meaning and in fact enhanced meaning about particular words that we wouldn't see if it was written out as a paragraph and then sung as a script that would be the same as the one we would read. Again, the point is that what is exciting and novel to you is just the way that you hear it, but it's exciting and novel to you because there are circuits within the brain that when we hear or see or feel or experience known elements in new ways that are truly creative. The way that those neural circuits function is changed and when neural circuits change the way that they function simply by way of what comes into our eyes our ears and the way that we experience our feelings. There is the release of chemicals, including the release of the chemical dopamine and other neuromodulators as well that make us feel both surprised, delighted and this is very key. Excited in anticipation that we might see it again. So with the understanding in mind that true creativity involves the novel combination of some elements could be notes of music, could be numbers, could be visual elements like lines or colors, could be physical movements, etc. But novel combinations of some things that reveal to us something fundamental about the way that our brain and or the world work. And of course, as I mentioned before, that fundamental thing may or may not be consciously accessible to us. We may not know what exactly it is that's novel to us, but it feels novel and it feels true. Well, with that understanding in mind, we therefore can ask what are the underlying principles and neural circuits that underlie the creative process. And the word process here is especially important. In fact, if there's one thing I'd really like to impress on everybody is that when thinking about biology, it's almost always better to think about verbs as opposed to nouns. So rather than think of creativity as a noun or somebody being creative as an adjective, think about the verb creativity. That is what are the steps required and therefore what are the cells and circuits and thoughts, etc. required in order to be creative. This element of thinking about verbs then allows us to say, okay, what are the various steps in coming up with a creative idea in testing a creative idea and then implementing that creative idea. And in doing so, we find, based on the scientific literature, that there are basically three major networks within the brain, each of which is responsible for each of the three steps to arrive at something truly creative. The first neural circuit involved in creativity is the so-called executive network. This is kind of a goofy name because the neural circuits that I'm about to describe do a bunch of other things as well. But they certainly control what are called executive functions. Executive functions are functions that you and I both have, which is our ability to govern our thinking and our behavior in very deliberate ways. So largely accomplished through the use of the neural circuitry that sits right behind the four brain, the so-called prefrontal cortex. Now the prefrontal cortex involves many different subregions. It has a bunch of different parts, just like any country has different states, etc. and provinces. Executive function involves the prefrontal cortex and some other neural structures. But for sake of this discussion, executive function and the prefrontal cortex are mainly responsible for suppressing action. That is for eliminating choices. Among the infinite number of choices that exist, for instance, of what colors to combine on a painting or what lines to draw or what notes to play or what movements to make in a sports endeavor, or what numbers to include in a mathematics endeavor, or what words and letters and syllables and sentences to include in writing a creative passage. The second network is the so-called default mode network. There's a lot of discussion nowadays about the default mode network as it relates to consciousness and meditation, etc. The default mode network does many different things. But in the context of our discussion about creativity, the default mode network is really the network that starts being engaged when you close your eyes and start paying attention to what's going on in terms of your thinking as opposed to the sensory outside world. The default mode network is especially important for what's called spontaneous imagination. Spontaneous imagination is something that you can try at any moment if you were to close your eyes and to try not pay attention to the sounds around you, but even if you do, to just pay attention to whatever thoughts or feelings emerge when your eyes are closed. By closing your eyes and shutting yourself off to the outside sensory world, you start to engage much more of your brain machinery dedicated towards what's going on inside you, so-called interoception, but also what you're thinking about your thinking, whether or not your thoughts are complete or incomplete, whether or not they are fragmentarian away that goes from one thought to another, distantly in the past or present, a future, etc. Depending on time of day, how well rested you are, how stressed you are, how happy you are, the default mode network will take you through a journey of different types of thoughts, different types of feelings, etc. The specific types of thoughts and feelings are not as interesting as the fact that when you close your eyes, you're essentially engaging this default mode network, which is essentially the network associated with imagination and imagination based on elements that exist only within your head, that is within your brain. And therefore, must rely on memory of previous experiences. As soon as you close your eyes, you are shutting yourself off from the sensory world, so by definition you can no longer be bringing in novel experiences in that moment, you're relying on your library of existing experiences and your memory of those in order to imagine new things. And you're doing this in a very free associative way. You're not trying to imagine new things, it's just whatever geysers to the surface. So we've got the executive network, which is involved in suppressing particular thoughts or actions. We have the default mode network, which is involved in imagination. And the default mode network I should mention also involves a subregion of the prefrontal cortex, it's called the medial prefrontal cortex, but other brain regions as well. And then the final element within the circuits underlying creativity is the so-called salience network. The salience network is a network of brain regions that involves areas such as the insula, which actually has a complete map of your body surface as well as some information mapped there about what's going on in the outside world and how those combine with what's going on in your internal landscape that is within your body. Also a brain region called the ACC or until excuse me, anterior, singulate cortex and the amygdala. So a lot of information is mapped within the salience network about how we feel and how we feel in relation to things that are happening around us and within us. And the salience network has one main job, which is to pay attention to what's most interesting, either in the world or inside us in terms of feelings or experiences. Okay, so we've got three networks, executive network, which is there to suppress choices in terms of actions we could take but decide not to or things we could think about but choose not to or try not to. The default mode network, which is basically the catalog or library of previous experiences that we have available to us that would act as sort of the paints on a palette or the possible ingredients that could go into a recipe. All of that has to again arise from previous experience, right? We can't close our eyes and suddenly be able to access all the melodies that we've never heard before or all our ideas and concepts and knowledge about music if we don't have musical understanding or visual understanding. So we're really drawing up the library and that library tends to be rather disorganized, it kind of swirls around. It's not very structured unless we're actively trying to think about something. And then we have the salience network, which is the networks within the brain that decide or make choices about what's most interesting to pay attention to in a given moment. Okay, so those three networks work together to create things. And when I say create things, we again have to really underscore our definition of creativity. Creativity is a rearrangement of existing elements into novel combinations that reveal something fundamental about how we or the world works. And this is very important. It tends to be things that are useful. Now they can merely be useful because they're entertaining or thrilling. They can also have a particular utility or use in the world like a piece of technology that is actually useful like an app or a smartphone or a computer actually has utility or a vehicle. You know, there are creative acts that led to the formation of vehicles and computers, etc. But the point is that just merely coming up with novel combinations of things like wings on a fish tank, that's not creative or it's not creative in any kind of meaningful way because it's simply not useful. It doesn't reveal anything fundamental new or purposeful. It doesn't allow us to think about or interact with the world or ourselves in novel ways, whereas things, people, actions and ideas that are truly creative really change the way that we are able to access the world. They act as portals to the world and to ourselves. I'd like to take a quick break and acknowledge one of our sponsors, Athletic Greens. Athletic Greens now called AG1 is a vitamin mineral probiotic drink that covers all of your foundational nutritional needs. I've been taking Athletic Greens since 2012, so I'm delighted that they're sponsoring the podcast. The reason I started taking Athletic Greens and the reason I still take Athletic Greens once or usually twice a day is that it gets to be the probiotics that I need for gut health. Our gut is very important. It's populated by gut microbiota that communicate with the brain, the immune system and basically all the biological systems of our body to strongly impact our immediate and long term health. And those probiotics and Athletic Greens are optimal and vital for microbiotic health. In addition, Athletic Greens contains a number of adaptogens, vitamins and minerals that make sure that all of my foundational nutritional needs are met. And it tastes great. If you'd like to try Athletic Greens, you can go to Athletic Greens.com slash Huberman. And they'll give you five free travel packs that make it really easy to mix up Athletic Greens while you're on the road and the car on the plane, etc. And they'll give you a year supply of vitamin D3K2. Again, that's Athletic Greens.com slash Huberman to get the five free travel packs and the year supply of vitamin D3K2. So now you have some idea about the brain areas and networks involved in creativity. But I want to be very clear that anytime we talk about mechanisms and brain areas, what's far more important than the names of those brain areas is an understanding of what they do. So if you couldn't remember the interior, single late cortex or the fact that the prefrontal cortex is involved in executive function, etc. That's fine. It's less important that you know the names of things that you understand the action steps that those things take. That is the verb actions that those particular brain areas engage in order to arrive at a particular endpoint. And the endpoint we're talking about today is creativity. I want to discuss creativity in terms of what actually goes into being creative and it turns out there are just two elements and those two elements are now well understood from the perspective of psychology. And fortunately, the neuroscience well supports what the psychology says and vice versa. And those two elements that go into coming up with a creative idea and then implementing or developing that creative idea into something real that you and the rest of the world can experience are divergent thinking and convergent thinking and divergent thinking and convergent thinking are very straightforward to understand. Divergent thinking is taking some known object or event in the world or sport or concept. It could be running. It could be a musical note. It could be jumping. It could be a particular color on a piece of paper. And asking yourself how many different things could that thing actually be you might say well running is running but let's use divergent thinking as a way to illustrate what divergent thinking is if I show you a picture of somebody running. I say what do you see and you say I see somebody running and then I might give you a divergent thinking task and these tasks are the same ones used in various experiments and I'd say how many different things can you think about based on this picture that you see of somebody running. Now if you are able to engage divergent thinking you could say running to the store running away from a lion running towards somebody I love or maybe you have a more elaborate imagination and you could say running in front of a bus to grab a kid so the kid doesn't get hit by the bus or running toward a concert because I'm so excited about the particular concert and then it starts to spool into a story in other words. Divergent thinking involves taking one simple what we would call a neuroscience or psychology stimulus one image or sound etc and trying to radiate out from that as many different divergent situations properties characteristics events things from that one specific element so any divergent thinking task would involve exactly that I'd show you pictures or play you sounds or words or notes or describe to you events in history and trying to see how many things can radiate out from that into diverse diverse even distant types of concepts and pictures. Divergent thinking is really the process that underlies idea generation and the basis of divergent thinking is that more than one idea is correct in fact the more ideas that you have about one thing the better your diversion thinking. So if I were to give you three minutes to list off all the things you can think about related to this pen that I'm holding up for those you listening I'm just holding up a pen in front of me you just write them out or say them out over the next three minutes that would be an example of divergent thinking however if you just said black pen red pen white pen green pen etc that's not very divergent thing is only divergent in the context of color space. I say space that's just a kind of nerd speak for one particular domain of thinking whereas if you said red pen white pen essay pen in a door to hold the door open so that someone can return to a building and you started spooling off a story related to that and why that was important well there you go. Divergent thinking is essentially taking one element and coming up with many many answers and in the context of divergent thinking any answer goes but as we'll soon learn not every answer is interesting and relevant that is not every answer help solve something or reveal something fundamental and therefore not every divergent answer is truly creative. The other aspect of divergent thinking that's really important to understand is that the selection criteria are extremely vague and vast that is there are no constraints on what you come up with so if I hold up this pen and you say orangutan that's a perfectly valid divergent idea from this pen because you thought of it and it's distantly related however we have to remember our earlier rule if black pen and orangutan are not linked up in our brain and the observer's brain in any kind of meaningful way it's only interesting to you because you are the only one that understands the rule that underlies the link between this pen and orangutan whereas if you come up with something different that somehow tells me and everybody else something interesting about pens or orangutans now that's a truly creative. I don't have such an example in mind but later I'll give you some examples of how you can actually march down the path of divergent thinking and use that executive network to suppress certain options across off certain answers is again and answers valid but not all valid answers are interesting or useful and you can cross those off and arrive at the most interesting and truly creative answer. A couple more things about divergent thinking divergent thinking largely taps into the networks of the brain they're involved in mental flexibility so this is a different aspect of our prefrontal cortex is which is not based on executive function and our ability to reduce options but rather areas of the prefrontal cortex that are available to generate multiple options and actually suppress context right to forget that pens are just for writing for instance and that pens can do other things like hold up. It's really an unusual use of a pen again none of these examples that I'm giving are particularly interesting they're just designed to get you to understand the underlying concept of divergent thinking and then the last thing that like you know about divergent thinking is that divergent thinking involves a sort of exploration it's a wandering through of ideas that you already had in your library in your memory banks about pens and what pens could be related to and what pens could be related to and what is going on. And what pens ought not to be related to so again what's really important about creativity is that there has to be the basic building blocks already existing within us this is why it's so important to understand that if you are somebody who really seeks to be creative. You really do need to be somebody who forages for information and structured information in particular if you are to be creative the architect simply can't come up with incredible drawings or plans for buildings with the ability to be creative. And then you can't do any of these things without understanding how buildings are put together in the various rules that govern buildings in other words you can't break rules that you don't understand. I think in movies especially we have this idea in mind that of this limitless concept that or that we have these hidden geniuses that somehow have access to all the math knowledge without ever having done any formal math. I was flying back from Texas recently and goodwill hunting was on somebody's screen. I don't tend to watch movies on the plane very often sometimes but not often. And I was remembering in that movie you know you've got this math genius who is a janitor at MIT et cetera and apparently just has access to all this knowledge. It's a wonderful concept very very I would say even exceedingly rare thing to occur in the world sure there are people who seem to have a natural talent for mathematics or for something else. And this idea that there are incredible geniuses among us that just spontaneously have so much knowledge that by far the exception rather than the rule of course and may not even actually exist. I'm sure someone put in the comments examples where this actually exists more often than not what you find is that people who have extreme virtuosity in a given area put many many years into developing the basic substrates the basic building blocks of whatever it is their craft happens to be where they demonstrate virtuosity. So this is very important to understand nonetheless divergent thinking is the critical element for initiating the creative process again thinking about creativity as a verb and divergent thinking involves taking some starting point in this case of pen and then radiating out from that in a fairly unconstrained what biology was called a random walk just kind of wandering through your thought space and memory space about what could be related to this pen. Now on the flip side of creativity is the implementation of specific combinations of things and testing those to see whether or not they are interesting relevant or delight us or other people or scare us or other people or thrill us or other people in other words. A testing of whether or not there's some fundamental rule to emerge again I am going to repeat this many many times throughout this episode and I'm not going to apologize for that because I think it's so important to understand that creativity is not just novel combinations there novel combinations of things that reveal something fundamental and that often pop out to us. If not every time certainly most of the time that we see that thing it almost never seems to be the case is something truly creative dolls in its expression and that's because what it's repeating to us over and over again is this fundamental rule that normally we can't see or hear or experience in the absence of this creative act. So the second part of creativity where things are tested and where truly creative elements are discovered is in convergent thinking and convergent thinking as as the name suggests just the opposite of divergent thinking convergent thinking would be for example if I give you an image or I tell you the following things I say wing water and engine. The concept that I happened to have in mind is that of a plane that can land on water right most planes don't land on water or not intended to land on water one would hope that their plane doesn't land on water unless it's a plane designed to land on water but in this case a plane that can land on water is one of the very few answers that can combine wing water and engine right I'm sure there are other answers there are other convergence. There are other convergent thinking modes that can take you to an answer that would be valid but there are not many and here what's really most important is that I'm not asking you to spool out or to radiate out from these three things rather I'm asking you to combine them in some way that makes sense in the real world and indeed there are planes that can land on water and wing water and engine combined within those things they are fundamental features they are in fact necessary but not sufficient for having a plane that can be in a plane that can land on water. So that's just one example of convergent thinking and a convergent thinking task would involve you being given a list of two or three or maybe even five different things and then for each of those two or three or five different things as quickly as you can to come up with a single answer that binds all of those in a real world concept that obey the laws of nature or physics in some way for instance you can just come up with some you know answer that said a bird that swallowed an engine and that happens to be a seabird. You could come up with that but that actually is not something that happens or is that very typical at all and so it seems like kind of a a mishmash of things that are really just designed for you to try and accomplish an answer rather than something real such as a plane that lands on water. Okay. The point here is that divergent thinking is one aspect of our cognition of our thinking and convergent thinking is a very distinct aspect of our cognition. In fact, one of the critical requirements for convergent thinking is also to access our memory banks and our understanding about the outside world just as it were with divergent thinking but it requires more focus and more persistence. In fact, if we were to come up with a key rule for divergent thinking it would be you almost want to have just enough focus to remember what the initial object or thing that was mentioned was to keep that in mind so that your answers don't become completely random. But the more distant and everywhere in between that you can generate answers that is the things that are very close to pens, you know, black pen red pen versus you know pen and door stop pen acting as a door stop. Those are one is very close red pen is very close to black pen door stop is pretty far from black pen. So that's the idea is that you want to explore and undergo a range of exploration of different ideas whereas with conversion thinking you're really trying to bind these things together and so the key element for conversion thinking is the aspect of persistence and focus. And that's why convergent thinking in many ways feels harder than divergent thinking it feels like there's an answer and I want to get the answer right and I can't solve it. It's a puzzle and it's a puzzle that relies on very distinct brain circuits from divergent thinking which brain circuits. Well, that's what we're going to describe next and again this is not just going to be a list of different brain circuits with different names doing different things that wouldn't be useful to you or to me. Rather what you're about to learn is truly incredible what it is is we're going to talk about one single molecule dopamine which is a molecule most typically associated with motivation and desire and drive and feelings of pleasure in some cases but that actually resides within four different networks in the brain today we're going to talk about two of those networks and dopamine acting in one network. Directly underlies divergent thinking whereas dopamine in another brain network underlies convergent thinking and if at this point in this episode you're thinking okay when am I going to get the tools to understand creativity and how to be creative what I can assure you is that if you understand divergent thinking which hopefully now you do and you can understand what convergent thinking is. And you can understand that dopamine is responsible for both divergent thinking and convergent thinking but through separate pathways well then if you can understand how those two separate pathways work and how to engage them differentially. Therein lie the tools that you can use both to explore ideas in other words find what it is that could be creative and then systematically test each of those ideas for what is truly creative that is what meets the criteria for something that is novel and truly useful and informs us about something that we've never seen heard or felt before. Let's just take a moment to talk about the incredible molecule that is dopamine many people are familiar with dopamine from the concept of quote unquote dopamine hits which is popular language describing the feeling of pleasure that we get from pretty much anything that we like or that we continue to engage in repeatedly so some people talk about the dopamine hit that they get from somebody attractive that they like texting them back or the dopamine hit that they get from social media or the dopamine hit that they get from sugar or the dopamine hit that they get from this or from that to be honest the concept of dopamine hits is not one that I favor because in general whenever people talk about dopamine hits typically they're talking about activities such as social media which dopamine may be involved at some level but often it's the case that the behavior associated with that thing in this case social media is more of the compulsive nature rather than an active seeking of something with positive anticipation and that's really what dopamine is about. At least in the context of one of its major functions in the brain dopamine is really about motivation and desire and movement and it makes sense why motivation desire and movement would be linked up through a common in this case in a modulator chemical like dopamine because throughout evolution if we were excited for or motivated to pursue something we had to move in order to get it to obtain it. And in general we can frame dopamine under the umbrella of dopamine tends to be involved in neural circuits in the brain that are involved in processes that are taking us beyond the confines of our skin that is that motivate us to go do something in terms of action in the world. Now that statement might seem distantly placed from a discussion about creativity but as we'll learn a little bit later one of the most useful tools for engaging creativity and becoming more creative is to think about action elements within a narrative that is things that we and others can do in order to discover new rules through actual movement. That's a little bit cryptic forgive me but I promise I'll return to it later and I will make it crystal clear. There are four major circuits in the brain that use dopamine although I should mention there are additional circuits as well in fact your eye even contains neurons that release dopamine that control the sensitivity of your eye different times of day to light etc the four major circuits in the brain that utilize dopamine however are used for four major purposes and I'll describe what those are first of all is a neural circuit. So all is a neural circuit that uses dopamine among other things but certainly relies on dopamine in a critical way to engage movement including eye movements and we will return to eye movements why they are so important for understanding creativity and maybe even for generating creativity a little bit later the name of the circuit again is less important than what it does but the name of this circuit for those that want to know is the so called nigerostriatal pathway. So that's the brain area that is very dark that projects to an area called the dorsal striatum that contains a bunch of subregions so again for those of you that really geek out on this stuff great you can learn these names and retain them in your memory if you don't care about names don't worry about it just discard the names but areas of the brain like the caught dorsal striatum receive input from the substantial niger in neuro anatomy when we name something we say the origin of that thing and where it connects through so nigerostriatal tells you that there is a connection between the substantial niger because it came first nigerostriatal and then stradal is where it ends up so nigerostriatal pathway is involved in generating bodily movements it's involved in eye movements and it is actually a brain area that's engaged when you think about movement even just have a story in your mind about walking or story in your mind about running or story in your mind about driving this area is engaged very interesting brain area. So that's the first circuit very important to understand and I'll tell you right now that is the brain circuit that is engaged when you undergo divergent thinking. Now that itself should be interesting right even if you don't remember any of the names of the things I just told you that you have a brain circuit that even if you just think about walking it becomes more active and dopamine is involved in that brain activity and if you recall divergent thinking involves taking a concept as boring as a pen and thinking about other concepts that could link up with that pen in some sort of way logical or illogical right the bridge could be completely abstract and and really fantastical with a bunch of different ideas in between like a pen acting as a door stop because of some situation where you need to run down stairs in a fire and get back upstairs quickly to run down and back upstairs quickly to rescue somebody very divergent or as divergent as black pen to red pen. But what's amazing is that that same circuit is the one that's involved in physical movement in generating and thinking about physical movement that turns out to be vitally important for tapping into the creativity process really frame that up in your mind or commit it to memory. Now the second dopamine circuit associated with creativity is the one associated with convergent thinking which again is the kind of thinking where there's a specific correct answer requires focus and it requires persistence and the name of that circuit again the name isn't as important as what it does but the name of that circuit is the mesocortical pathway the mesocortical pathway is involved in motivation and it has an emotional component to now it will become clear in a few minutes why that emotional component is why it's like a specific component is what it is. This is a circuit that originates in a brain structure called the lateral ventral tegmental area again a bunch of words you can remember if you want lateral ventral tegmental area or you cannot worry about the name and it connects to the prefrontal cortex that area just behind the forehead and this mesocortical area is involved in motivation and emotion and is critical for focus and persistence. It is distinct from a very nearby area just sitting right next door this is called mesolimbic area which is involved in desire and feelings of reward and this is the area that is associated more typically with addictive behaviors or compulsive behaviors we're going to leave out the discussion about the mesolimbic pathway for now because it's not critical to divergent or convergent thinking and it's not critical to the process of creativity at least as far as we know. But I mention it because is the third and the fourth dopaminergic circuits and then the fourth circuit certainly one I've never talked about before in this podcast which is doesn't mean anything except that we haven't gotten to it yet is the two borough in front of your pathway and that is the pathway associated with dopamine and your pituitary gland and the release of hormones in particular that travel to the ovary if you have ovaries or to your testes if you have testes and trigger the release of things like estrogen and testosterone etc. So dopamine is intimately involved in that circuitry again not the topic of today's discussion for today's discussion we want to remember that there's a dopamine circuit called the niger straddle circuit which is involved in movement and divergent thinking and that alone should set a flag up for you like wow just thinking about new ideas has something to do with movement with physical movement and the dopamine circuit that is the mesocortical pathway which is the one that's associated with the motivation and emotion and that's the one required for persistence and focus for convergent thinking why am I telling you all of this about dopamine well it turns out that dopamine creates a certain number of responses in the brain and body when it is active in one or the other of these circuits and just for sake of simplicity so I don't have to keep saying niger straddle and mesocortical here going forward I'm going to talk about the dopamine circuit that's associated with divergent thinking or the dopamine circuit associated with convergent thinking and again divergent thinking and convergent thinking are the two processes that have to occur usually first divergent then kind of convergent thinking then back and forth and back and forth in order to arrive at something creative. divergent thinking is about exploration convergent thinking is about testing things and coming up with things that are the right answer that feel right and we will better define what right means a little bit later but you already sort of know right in this context is when you have some combination of elements or some idea or some written passage or some music or some physical action that you just know this is really novel and really cool or people see it or hear it. or taste it and say this is really novel and really cool and they don't necessarily know why it's just different in a way that feels true. I'd like to take a brief break and thank our sponsor inside tracker inside tracker is a personalized nutrition platform that analyzes data from your blood and DNA to help you better understand your body and help you reach your health goals. I've long been a believer in getting regular blood work done for the simple reason that many of the factors that impact your immediate and long term health can only be analyzed from a quality blood test. The problem with a lot of blood and DNA tests out there however is that you get data back about metabolic factors lipids and hormones and so forth but you don't know what to do with those data inside tracker solves that problem and makes it very easy for you to understand what sorts of nutritional behavioral maybe even supplementation based interventions. You might want to take on in order to adjust the numbers of those metabolic factors, hormones, lipids and other things that impact your immediate and long term health to bring those numbers into the ranges that are appropriate and indeed optimal for you. If you'd like to try inside tracker you can visit inside tracker.com slash huberman and get 20% off any of inside tracker's plans that's inside tracker.com slash huberman to get 20% off. I realized that for some of you listening to this episode we are probably at the point along the pathway of concept and definition and mechanism that leaves you in a place of real wanting a tool. And so I promise that I'm going to get into more tools but to satisfy you and to make sure that you do indeed understand that there are tools that can emerge from the information that you already now have in mind. I want to share with you one particular tool from the literature that has been demonstrated over and over again to support and build and enhance divergent thinking. And I also want to share with you a tool that has been shown from the scientific literature to enhance conversion thinking because both convergent and divergent thinking are critical for the creative process. Now I should emphasize that some people out there either by training or by genetics or by both will be naturally better at divergent or convergent thinking. And in fact we now know in a kind of almost poetic kind of way that naturally occurring variations in genes which underlie naturally occurring variations in the percentage of dopamine in one set of brain circuits versus another do seem to relate to whether or not people are naturally good at divergent thinking or convergent thinking. Now that's a very nature based explanation for why some people are better at divergent thinking and other people are better at convergent thinking. Nature and nurture is something that can never really be teased apart exactly because of course if someone has a natural proclivity for something based on their genes you can't often separate that from their parents because we inherit our genes from our parents. Although even in cases where people are raised away from their parents through adoption, etc. It's very hard to separate nature and nurture because somebody with a natural proclivity for things might engage in those things more, etc. The point is that for those of you that are very very good at divergent thinking or very very good at convergent thinking some of that might have been inherited but more than likely some of that depended on the kinds of activities that you engaged in in your early years in particular in the years between age five and 25 and for those of you that are aged between five and 25 all I can say is please learn to engage both divergent and convergent thinking as much as possible because you will enhance your ability for a better life. For those of you 25 and older you can still enhance your ability to engage divergent and convergent thinking and the fortunate news the equalizer I should say is that regardless of whether or not you are naturally better at divergent or convergent thinking or you acquired it through activities you need both in order to be creative. What we know is that in order to engage divergent thinking we need access to our memory banks we need to come up with possibilities and those possibilities can only come from what's contained within our memory systems of our brain areas like the hippocampus etc. But the names again don't matter we just know that if we are going to come up with novel combinations of things or novel uses of things or totally new ideas about how objects or notes of music or foods or tastes or whatever can be combined we have to do that with pre existing knowledge. And yet what we need to do in order to engage divergent thinking is suppress what is called autobiographical narratives and in particular autobiographical narratives we need to discard with judgements about how certain combinations of things impacted us in the past. This is what people mean when they encourage the exploration of creativity by so-called boundary exploration you hear about this a lot and the self-help and psychology literature and I'm not at all disparaging of that literature although rarely does it define exactly how and why to go about being more creative in this case to be more divergent in our thinking. So they'll say you have to take risks or you have to suppress judgment how do you actually do that there's a wonderful paper that talks about one way to do it one way to do it is what's called open monitoring meditation or even just open monitoring thinking and just to make what could otherwise be a somewhat complex section here very simple what I'll also tell you is that if you want to enhance convergent thinking you can do that a number of ways but you can do that in particular by doing a different type of. And a different type of meditation or thought process which is called focused attention meditation so let's talk about open monitoring meditation why it's so useful for enhancing divergent thinking this critical element of the creative process. First of all open monitoring meditation and focused attention meditation can be performed the exact same way physically you can sit there eyes closed I don't care if you're in a lotus position it doesn't really matter you're lying down you're standing up. You could in theory do open monitoring meditation with eyes open and that would be an interesting variant on it but for sake of the discussion right now let's just focus on the study that talks about the specific tools and the way that they were used in the study. The title of the paper that I'm essentially summarizing is called open monitoring meditation reduces the involvement of brain regions related to memory function now right off the bat that you cue you to something interesting something about divergent thinking and open monitoring is related to suppressing memory but as you recall just a few moments ago I said that in order to engage in divergent thinking you need to kind of kill off the narratives of what has to be related to what and come up with new narratives you still need to understand possibilities but you need to forget prior understanding of what those possibilities have to be and start thinking about what those possibilities could be and so that it turns out involves suppression of certain brain areas. Open monitoring meditation is typically done for about 10 to 30 minutes although it could be longer and unlike other forms of meditation where you sit and concentrate on your breathing and try and redirect your thinking back to your breathing or to your posture or to a chant or a mantra. And the monitoring meditation is simply a matter of having you sit there or lie down close your eyes and to allow whatever surfaces in your mind to surface and what you practice is the practice of non judgment now non judgment itself is a little bit of an abstract theme because of course the moment you say don't judge you and others start to judge is just the way that the brain works you say don't think about an elephant you think about an elephant that's a bit of a overly natural you go to an edge of a bridge or a cliff and you think about jumping off you know you don't please don't jump off and that's because it's part of the circuitry that's keeping you from jumping off as the thought about what would happen if you did. So open monitoring meditation involves dedicating a certain amount of time where you close your eyes and whatever thoughts arise whatever emotions arise whatever ideas arise to watch those and take an inventory of them to just merely watch them show up and pass or maybe you become fixated on the for some period of time or maybe even just one for a long period of time all of that is fine in other words whatever surfaces surfaces that's open monitoring meditation and that we know from brain imaging studies and we know from measurements of dopamine in particular brain circuits and we know from people who train with open monitoring meditation on a regular basis improves divergent thinking capability. So in terms of tools practicing open monitoring meditation or what I would just call open monitoring thinking is going to be immensely useful and this is actually an opportunity to queue up something that I mentioned in our episode on meditation which goes deep into the different kinds of meditation involving focus inward and outward et cetera you're welcome to check out that episode it's a Hubertman lab.com but the point is that rather than think about the word meditation which carries a bunch of ideas about what it is and what it isn't and how to do it meditation is really just a perceptual exercise for instance you could do a meditation where you look at a single point on a wall for five minutes and redirect your focus to that single point on a wall over and over again every time your mind drifts as it no doubt would or to a tone in the room you could attend to that and redirect to that rather than think about as a meditation it's really just a perceptual exercise that's all that meditation is so open monitoring meditation is really just a form of perception where you're paying attention you're perceiving your thoughts without laying judgment to those thoughts or trying not to lay judgment to those thoughts and what people find is that they very quickly within a few days get better at doing open monitoring meditation and fortunately within just a few days and certainly within about a week or more of practice and it doesn't even have to be daily practice although of course daily practice will accelerate the process further people become significantly better at divergent thinking. And that's because of the dopamine circuits and in particular along the nigrostriadle pathway becoming more active and the wonderful thing is that when you repeat a practice and a particular neural circuit is engaged over and over again deliberately that neural circuit becomes easier to engage so called neuroplasticity. So I would encourage any of you that want to explore the creative process for whatever reason or get better the creative process dedicate some amount of time maybe even just five minutes every other day to doing this open monitoring meditation I've tried this meditation it's actually quite fun to do because at least to me it feels a lot easier than the meditation associate with convergent thinking now the conversion thinking meditation is the so called focus attention to the meditation. And that's also described in the same study and other studies have explored which particular brain networks it involves and I can just tell you that focused attention meditation which you can think of or I'd prefer that you think of just as a perceptual exercise involves sitting or lying down closing your eyes focusing either on your breath or some element of your body could be the tops of your knees or the clasp of your hands it could be focusing on an auditory tone you could even do it. Eyes open and stare at a point on a wall or a flame of light whatever happens to be that allows you to redirect your focus to a particular location or idea or sound that is known to improve your ability to engage conversion thinking to quickly parse through or analyze a bunch of different choices and to persist in choice selection and therefore more rapidly arrive at the correct answer this is well established and in fact in the episode I did with a wonderful guest Dr Wendy Suzuki from New York University she talked about how a daily meditation of about 10 to 13 minutes performed for about eight weeks that's what they explored that study greatly increases people's ability to focus and in fact their memory and that's exactly the point which is that conversion thinking as I mentioned before requires persistence focus and access to specific memories so if you are somebody who wants to get better focusing that is the meditation for you however because today we're talking about creativity if for you. However, because today we're talking about creativity, if you are somebody who wants to get better at divergent thinking and convergent thinking, the two elements of creativity, that is, I would encourage you to do a dual meditation. That is a meditation that starts with open monitoring for maybe five to ten minutes and then transitions to focus detention for maybe five to ten minutes. Because the positioning of divergent thinking and then convergent thinking close together, more closely resembles what the creative process really is and what it typically involves. Most of us would love to have a situation where we can spend a morning or a day or a week brainstorming, just kind of brainstorming. Whatever we think about is fine. That's divergent thinking. Whatever elements just throw them up on the whiteboard. We sometimes see people and companies doing this at retreats, you bring people into a novel environment, you say, let's just forget all the rules and let's just come up with new ideas about some thing, new uses of something, new strategies in you and nothing is too crazy, nothing's off limits. Sure, that's a useful exercise, so-called brainstorming. But at some point, there's the requirement to cross off things. Typically, that's done later in the retreat or later in the meeting or later in the weekend. That's a wonderful way to approach creativity and to try and be creative, but not a lot of people train for that on a regular basis. What I just described to you are research tested tools for training for divergent thinking and convergent thinking. I would encourage people who are interested in being more creative to try and do these on a somewhat regular basis. If not every day, then certainly a few times a week or more. Certainly the more you do it, the better you're going to get it. That's well demonstrated in the literature. If you're somebody who's very consistent doing maybe five minutes of open monitoring meditation and five minutes immediately after a focus attention meditation daily, you can expect that you will get very, very good at these processes very, very quickly. Now, I'm not going to go into a lengthy description of the different lines of evidence that the corresponding areas of the brain are active in each of these different kinds of meditation. What I can tell you is that there have been some beautiful, what are called, loss of function studies where particular brain areas are either depleted of dopamine or where dopamine, in some cases, I guess what we would call gain of function studies, although not the kind of gain of function studies associated with virology, different gain of function studies, where you enhance the level of dopamine in the brain. What you find is that both divergent and convergent thinking are enhanced when levels of dopamine are elevated. Now, we're not necessarily talking about pharmacology here. It turns out that there are other ways to elevate dopamine that make us better at divergent and convergent thinking in particular by using mood. Now, I'd like to talk about what mood you are in when you happen to start a creative process or try and do a sort of training such as open monitoring meditation or focus meditation, how your mood relates to your level of dopamine at baseline, what we call your tonic, as it's called, meaning consistent or ongoing level of dopamine, how that dictates whether or not you are going to be better at one particular aspect of the creative process or another, and how you can enhance your creativity in the very short term, very quickly, using tools that are known to trigger additional release of dopamine, which in some cases is good, and in some cases is bad, I should mention. And in other words, determine how you feel in one moment should dictate what sort of tool you should use in order to become more creative. The relationship between mood and creativity is a fascinating one that is bridged by one main feature, which is the amount of dopamine present in this nigrostriadal pathway. And there's a really wonderful correlate or measure of the amount of dopamine that's active in that pathway that can be addressed non-invasively in the laboratory. As I mentioned, the nigrostriadal pathway is involved in movement and in eye blinking, which of course is a movement. It's not a movement of the sort that we typically think of when we think of movements, but nonetheless it relies on dopamine levels in this pathway. And in fact, we can state very confidently that when dopamine levels are elevated, the blinking reflex is more active. People just blink more when dopamine levels are lower or less active in this pathway, people tend to blink less. So, blink frequency is a common measure in studies of dopamine within this pathway that relate to creativity. The work that I'm about to describe is largely the work of two authors who have done wonderful work across several papers. Unfortunately, for me, their names are difficult to pronounce, so I apologize to them and their relatives for what is sure to be incorrect pronunciation. But the last names of these authors are Cher-Mahini and Homo. They're in the Netherlands. So, Cher-Mahini and Homo done a number of different papers or studies rather of the relationship between blinking, mood and creativity in particular, divergent thinking. What they found is that if people are blinking fairly often and they measure their mood through subjective tests and if they were to do brain imaging, which other studies have done, they find is that those people can engage in divergent thinking very easily. In other words, being in a good mood facilitates divergent thinking. Now, some of you might immediately say, well, duh, if you're in a good mood, you can kind of be more playful about the exploration about what could happen with these notes of music or these foods, etc. But it's not so obvious because it turns out that if your dopamine levels are very, very high and this can be measured non-invasively through the frequency of blinks or it can be measured more and basically through brain imaging, even through blood draws or other methods to measure dopamine. If dopamine levels are very, very high, what you observe is that divergent thinking is actually very, very poor. Now, a naturally occurring, truly pathological example of this would be something like manic bipolar disorder where somebody is in the manic phase or somebody who has taken methamphetamine or cocaine, what tends to happen is that they have lots and lots of ideas. All of those ideas seem really exciting to them. But if you were to talk to them for any given moment, they would be very fixated on one particular tunnel of ideas. And by being fixated on one particular tunnel of ideas like the idea that they're going to run for president tomorrow, this is unfortunately typical of people who have bipolar, which is not to say that everybody who runs for president is bipolar. Rather, people who are bipolar often have these delusions of grandeur that they're somehow going to be president simply because they decided to and that they were selected to do this, etc., etc. Ideas about themselves and other people that are very constrained. In other words, not very divergent. So, divergent thinking is favored by having elevated levels of dopamine, but not too high. Well, that of course creates a conundrum. How do you know how much dopamine you need and how to achieve those elevated levels of dopamine? Well, leaving aside people who are suffering from a manic episode, what Chermahenian homo have discovered is that if people are in sort of a low mood, they're not feeling great. Maybe they're depressed, but they're just not feeling that great. They feel on a scale of 1 to 10, around a 2 or a 3, maybe a 4. The probability that they will be able to engage effectively in divergent thinking is quite low. However, the good news is they are typically very susceptible to elevations in mood through observing or hearing positive stories, listening to music that they like, any kind of so-called inspirational stimuli. Now, this is good news. What this means is that if you're somebody who's not feeling very motivated to engage in divergent thinking, you're not feeling very creative, you're feeling a little low, the thing to do in that case is actually to take external stimuli, things that you know that you like, and start interacting with those stimuli to get your mood elevated and then to engage in divergent thinking. However, what Chermahenian and homo have also shown is that if people are already in a very good mood, elevating dopamine further is not conducive and in fact is detrimental to divergent thinking. And in that case, they would be better off, for example, not engaging in any activities or taking anything in the way of pharmacology that would further increase their dopamine and probably limiting the amount of external stimuli that are coming in through music and visual stimuli and really focusing on divergent thinking in the creative process immediately. Now this is important in an earlier episode, both on bipolar and on other forms of depression, I talked about how rates of bipolar manic episodes and dopamine levels and creativity tend to be correlated. Now, unfortunately, rates of suicide are 20 to 30 times higher in people who have bipolar disorder as well. And so there's a whole dark side too, but the bipolar disorder that makes it a very, very dangerous and important disorder to treat. But for sake of the discussion of creativity, what this means is that we all need to develop some sort of intuitive sense as to whether or not our mood is, suppose we could bend this into three categories, is kind of yes, happy, excited, positive mood. And of course, there are going to be levels to that low and I'm like, hmm, we're kind of meh kind of in the middle. So if you're in a low mood or kind of meh mood, by all means engage in something probably for about, you know, five to 30 minutes that elevates your mood before trying to engage in divergent thinking. However, if you happen to be in a pretty positive mood, even if you're not 10 out of 10 on mood, then bringing in additional stimuli to increase your levels of dopamine will not help you and in fact, can hurt the divergent thinking process. So in that case, I would also encourage you to think about something that was discussed on a previous episode, which is the particular effects of caffeine. I'll get into caffeine a little bit later, but just very briefly, caffeine increases levels of dopamine receptors. So it's not that caffeine is bad. In fact, caffeine can be neuroprotective. It can enhance focus and so forth. But divergent thinking is sort of anti-focus. It requires just enough focus to be able to come up with new ideas, but you actually don't want to be overly focused. Focus is more conducive to conversion thinking. In fact, that's exactly what the literature shows is that caffeine because it's effects on an epinephrine and related systems in the brain, like a denocene, but mainly because of its effects on persistence and focus is very conducive to conversion thinking. So if you're somebody who wants to explore creativity and wants to get better at creativity, you now know that you need to engage in divergent thinking and then afterwards, conversion thinking. I would recommend not using stimulants such as caffeine prior to divergent thinking, but rather use stimulants if you do want to use stimulants such as caffeine prior to convergent thinking. And in fact, in formulating the architecture of today's episode, which took me many hours across many different days, I confess, I actually decided to try this in trying to imagine the different configurations and ways that this information can be organized. I deliberately abstained from caffeine during those bouts of work. And when structuring everything according to the decisions I had already made, I purposely ingested caffeine prior to that. Now, of course, constructing a podcast episode is not really the ultimate example of a creative act because of course it's taking existing information, it's arranging it in all the ways, but it doesn't necessarily allow key concepts to pop out in the way that, for instance, a bank see or a Rothko or an Escher would pop out. Okay, I'm certainly not naive in thinking that it does. But the principle of is what's important here. You need divergent thinking, you need convergent thinking, you need some level of elevated dopamine in order to engage in divergent thinking, but not so high that it starts to inhibit that process. Now, if you were to come into the laboratory, this could be measured by your frequency of blinking. For better or for worse, we can't actually count the number of times that we blink unless we're actively paying attention to it. So I don't recommend that you pay attention to your blinking because that will take you off course from all the other important things of your life. And how many times you're blinking is rarely an important thing for you to pay attention to. You can, however, learn to calibrate your mood. That is to assess your mood, whether or not you're in low, medium or high mood. No problem using that broad binning, right? You could scale it on one to 10. And then decide whether or not you're going to use some dopamine elevating stimulus from the outside. Again, could be music, could be exercise is an excellent way to elevate dopamine. I'll talk about another well-established one from the from the research literature that is known to elevate dopamine by 65% in the particular pathway that's relevant for divergent thinking. And to do that without any pharmacology, I'll share that with you in a moment. But you need to decide for you in a given moment or in a given work attempt at creativity what you need and apply accordingly because as Cheramine and Homo have shown, whether or not you are in a low mood, medium mood or high mood really can determine whether or not you'll be able to access divergent thinking or not. Now, if you're somebody who already has an idea in mind, you're very excited about a creative idea and you want to hone it, you want to shape it, you want to pressure test it. We'll talk a little bit more about what that means in a three-step process in just a little bit. I would strongly encourage you to look at that process as a very linear process in which there are right and wrong answers. And there, the use of caffeine at appropriate dosages and dosages for caffeine that are safe and in fact performance enhancing recovered in the episode on caffeine turns out it's one to three milligrams per kilogram of body weight, by the way. And if you want to leverage caffeine or maybe even other forms of healthy legal stimulants, those are covered in the caffeine episode and I'll talk about a few more a little bit later. So to summarize this segment and also just to make a more general point, I think it's very useful for people to start to pay attention to what their tonic level, that is their baseline level of dopamine ought to be in this nitro strideal circuit and in other circuits. And to do that by learning to assess one's mood and pay attention to what kind of mood they happen to be in and then to leverage tools, behavioral tools, maybe pharmacologic tools provided their safe and their legal in order to either increase dopamine or to elect not to increase dopamine in order to access the creative process. Now I've mentioned pharmacology a few times and I'd like to talk about that just a little bit more in the context of dopamine. First of all, there is no supplement or drug that you or anyone else can take that will selectively elevate dopamine in only one of the four circuits that I described before. Okay, this is just the state of the technology nowadays. If you take a pill or even if you were to inject some substance, again, I hope there's a be legal and safe, etc. Whatever mode of delivery, there is no technology that exists at this time that would allow you to selectively amplify dopamine, for instance, just in the nitro strideal pathway or just in the mesocortical pathway. Again, the nitro strideal pathway associated with the divergent thinking, the mesocortical pathway associated with cognitive persistence and convergent thinking. If you were to amplify dopamine levels, for instance, by taking the amino acid precursor to dopamine L-tyrosine, something that I occasionally do to enhance dopamine levels for sake of work or energy, 500 milligrams or a thousand milligrams even of L-tyrosine. Sometimes I'll combine that with other things like alpha GPC. It's going to enhance dopamine transmission in the nitro strideal pathway, the mesocortical pathway, but also in the mesolimbic pathway and also for that matter in the tuberum-infraindedbular pathway associated with the pituitary. There is no way to direct dopamine activation to just one of those pathways. That's just a reflection of the existing technology. Now, this is also true if you rely on illicit drugs to increase dopamine. So if it's cocaine or methamphetamine, those will greatly increase dopamine, but nonselectively across all those different pathways. Likewise, with any drugs that inhibit or block or antagonizes, it's called dopamine. This is why people who, for instance, have schizophrenia and take drugs to suppress auditory hallucinations. Some of those drugs work because they block the so-called D2 receptor of the dopamine pathway, D2 receptors are present in all four of the dopamine-inergic pathways in the brain. Oftentimes, those drugs will, in fact, suppress psychotic symptoms, auditory hallucinations, etc. Because they reduce dopamine, but those people oftentimes will have problems with movement. They will express what's called in the clinical literature, tardive dyskinesia, kind of writhing of the face and the body from suppression of dopamine within the nitro strideal pathway, which is associated with movement. They will sometimes have deficits in eye blinking. People with Parkinson's who actually have selective deficits of dopamine within the substantial nigra, nigro strideal. Remember, substantial nigra show deficits in what? In movement, in the smoothness of movement. Oftentimes, they won't blink at all. They'll have kind of a blank stare and they have other issues as well. So if you're somebody who's interested in increasing dopamine through the use of legal safe pharmacology, as I would hope it would be the case, there are ways to do that reasonably safely. For most people, again, people with bipolar disorder issues with the dopamine-inergic pathway should not do this. I know nowadays there's a lot of use of drugs that increase dopamine, such as ridolin, aderol, modaphanil, armodaphanil, often prescribed for things like attention deficit hyperactivity disorder. We did an entire episode on ADHD and pharmacologic prescription supplement and behavioral nutritional tools for ADHD. You can find that episode at HubertmanLab.com. I know a number of people take those compounds in order to increase dopamine and focus for sake of studying or other activities, staying up long hours, etc. And the fact that they increase focus, they are effective, although they do have their side effects, sometimes severe, sometimes habit forming, sometimes even addicting as well. But the fact that they increase focus should automatically tell you something, that those drugs in particular increase dopamine in the so-called mesocortical and mesolimbic pathways. Why can I say that? How can I say that with any degree of confidence? Well, there are these four pathways. One's involved in movement, but these other ones are involved in motivation and desire and reward. And I told you that these things can be habit forming and addicting in some cases. And they can greatly increase focus and focus is supported by enhanced levels of dopamine within this mesolimbic and mesocortical pathway. So yes, those drugs increase dopamine across the board, but there does seem to be some waiting of dopamine toward the systems involved in motivation and reward and sometimes even leading to habit formation and addiction. That's why those drugs should only be taken with the close supervision of a very skilled psychiatrist or somebody else who's bored, certified who can really govern that. There are, however, ways to increase dopamine more evenly across the board using non-prescription approaches. And one, I already mentioned, which is L-tyrosine, taken typically in dosages of 500 to 1000 milligrams. L-tyrosine is not as potent in increasing dopamine, as are the prescriptions drugs that I referred to before. Tends to be milder. For some people, it can have a very amplified effect. They feel it right away. It's very intense in elevating focus and motivation and the desire to move. For other people, it's less potent. It really depends on a number of things. I should mention that regular consumption of caffeine of one to three milligrams per kilogram body weight per day also will increase dopamine receptor efficacy and density, which will make any existing dopamine more effective, whether or not that dopamine is triggered by things like L-tyrosine or if you're not taking anything to elevate dopamine, the dopamine that you do make will be more effective in elevating your mood, motivation and desire to move. And by extension, divergent thinking. If you are consuming caffeine, but again, caffeine should be taken prior to conversion thinking type tasks, probably more than it should be taken prior to diversion thinking tasks. And of course, there are other legal supplements that can elevate dopamine as well. In particular phenolethyl amine is very effective in doing that 600 milligrams with that. Has a brief effect lasting only about 30 to 45 minutes, but it is one that many people find beneficial for sake of studying or for creative thinking and so on and so forth. Now, that's pharmacology. And in fact, there's an extensive landscape of prescription and supplement-based pharmacology and indeed nutrition. For instance, the consumption of foods that are high in L-tyrosine, such as aged parmesan cheese, for instance, of all things, very, very high in L-tyrosine, the precursor to dopamine. Certain foods, you can look up online, which foods contain high levels of L-tyrosine, in which ones are compatible with your nutrition. But leaving pharmacology aside, there's a very exciting non-pharmacologic tool, a purely behavioral tool, that the research literature has told us can selectively increase dopamine within the nigrostriatal pathway, the pathway that's involved in divergent thinking and can do so very dramatically as much as 65% above baseline. And so this is a behavioral tool that is useful for a number of things, but that I find particularly interesting in leveraging towards the exploration and enhancement of creativity, because first of all, it's purely behavioral, so it's zero cost and it involves nipulation of brain neuromodulators or chemistry through pharmacology. So it's something that you can explore very safely and certainly not having the purchase anything. And what's really remarkable is the selectivity, or I think it's fair to say the immense selectivity that this particular behavioral intervention seems to exert on dopamine within this pathway associated with divergent thinking. So the study that I'm about to describe is a study that dates back 20 years. Now that should not concern you. In fact, the early arrival of this study, or what now seems to be early arrival, I mean, it wasn't that long ago, is really exciting, because the first line of this study really illustrates how important or how much of a landmark study this really is. And so I'll just read you the first line of the study. Then I'll tell you the title, then I'll tell you what they discovered in fairly top contour. And we will provide a link to the study if you want to prove it in more detail. The first line of the study is this is the first in vivo, just meaning in the organism. In this case, this was a study on humans. This is the first in vivo demonstration of an association between an endogenous neurotransmitter release. Endogenous means within us and conscious experience. So what this sentence essentially says is this is the first study exploring how a chemical that's naturally released in our body relates to a particular quality of conscious experience. This study was performed in Scandinavia in one of the hospitals in Denmark. Again, we'll provide a link. The first author is K.H.R., I think I'm pronouncing it correctly, although probably not K.J.A.E.R. at all. And the title of the study is increased dopamine tone during meditation induced change of consciousness. And I want to just highlight that the meditation used in this study isn't really a meditation at all. I don't know why they selected that for the title. The behavioral protocol used in this study was more akin to what is normally called yoga nidra or N.S.D.R. non-sleep depress. Now, yoga nidra and N.S.D.R. have been discussed many times before on this podcast. Yoga nidra, for instance, is a practice that's been around for hundreds, if not thousands of years, in which people deliberately lie still. So they're forcing themselves to be mostly motionless. Small movements are fine. And they're directing their attention to the surface of their body. They're doing long exhale breathing. Sometimes some intentions, sometimes some visualization, but it's really self-directed relaxation. And the key component is that people stay awake and engage in very little movement. And the key word there is movement. Now, non-sleep deep rest is an acronym, a term that I coined. It's not a term that I coined in order to try and wipe away or discard with yoga nidra. I'm a person who has great respect for yoga nidra and its traditions. It's a term that I coined in order to encompass a number of practices that don't include any mystical type language or scientific language for that matter. And that doesn't involve intentions, it involves deep relaxation, yet remaining wide awake and conscious. Sometimes people fall asleep and that's okay. But this is really an atypical brain state of being deeply relaxed, yet in general awake, and motionless. Again, motionless being the key. Very few brain states involve us being mostly, if not completely motionless, and yet awake. And it turns out that brain state, whether or not you call it yoga nidra, you call it NSDR, whether or not you call it meditation-induced shift in consciousness as they did in this study, although they do refer to yoga nidra, all refer to the same thing, which is being motionless and yet aware. And relaxed, I should mention. So in this study, what they did was they brought subjects into the laboratory. They had them either undergo this self-directed deep relaxation while they are motionless or mostly motionless, or they had them listen to an audio script, while also just lying there with eyes closed. And then they used a number of chemical tricks, and I don't want to get too deep into those now, because they can be a little bit distracting. For those of you that are interested, you can look at it in the study. This is a binding of a chemical in the brain that then they can image with brain imaging, which is what they did in the study, to evaluate how much dopamine changed in the brain and where specifically in the brain, dopamine changed its levels before, during and after this particular behavioral practice in one or the other group. And what they discovered is that people who did this deep relaxation, that is self-directed deep relaxation, lying there, eyes closed, relatively motionless, although small movements of the body or movements of the head are absolutely fine. What they observed was a 65% increase in dopamine release. Now here it's key, dopamine release, and they observed an increase in so-called theta activity. Theta activity is a pattern of brain wave activity that's commonly associated with creative states and divergent thinking in particular. So that's important. And they observed that across subjects, specifically in the Nygrostride, I'll pathway this pathway associated with divergent thinking. So this is very exciting. This is a study that really points to a behavioral tool that can be used to selectively elevate dopamine in the very pathway that one would want to if they wanted to engage divergent thinking for sake of creative exploration. There are also a number of key observations within this study. First of all, the reduction in bodily movement was essential. In fact, when people rated or in when the amount of readiness for action in their system, their body was evaluated, what people found was that immediately after this practice, they felt very still. In other words, they felt as if remaining still was natural. Now it's not the case that they couldn't move. In fact, the elevation in dopamine that occurred during this practice, this yoga-needral-like non-sleep or NSTR-like practice actually prepared them to be able to move in a much more dedicated and robust way afterwards. But during the practice, their readiness for action went way, way down, not surprising. They were pretty much motionless. But interestingly, as the level of readiness for movement went down, down, down, down, down, their degree of visual imagery, that is their internal landscape and their ability to imagine new things increased. And in fact, areas of the brain that are associated with visual imagery, such as the visual or so-called occipital cortex and the parietal cortex has been shown in other studies to ramp up when people are motionless. So there seems to be this inverse relationship between movement and visual imagery, which makes sense. When we're moving, we can pay attention to things in the outside world. We tend to be aware of our sensory environment to varying degrees. But we don't tend to be very focused on visual imagery within our head. Whereas when we lie down or sit down and close our eyes and we are motionless, the degree of visual imagery really increases. Hence, the increase in divergent thinking because what essentially is happening is the library of options, the library of possible interactions with whatever it is that you're thinking about. I give the example, which is a trivial one on purpose of a pen, but the bank of options that becomes available when we are motionless and when we are limiting our visualization of the external world, increases exponentially. So this is important and what it points to is the fact that this very simple, completely non-pharmacologic behavioral practice of lying down motionless for some period of time. And I confess, the amount of time that they use in this study was quite long. It was longer than 60 minutes. But all the data that I'm aware of in terms of NSTR and yoga knee-dra, and there's a growing body of literature on these practices, I should mention, show that even 10 minutes, or even better would be 20 or 30 minutes of lying motionless with eyes closed and allowing the mind to drift wherever it happens to go. But focusing on relaxing by doing long exhale breathing, perhaps doing a body scan of focusing your attention on particular body parts, but not keeping it focused on any one particular body part for that long. That general practice of deep relaxation while awake and being relatively motionless really favors the brain states associate with divergent thinking and actually represents an accessing of the various components that you would use during divergent thinking. And perhaps most excitingly, it's associated with this massive increase, 65% increase in dopamine release within the very pathway that underlies divergent thinking. So my recommendation would be for those of you that are trying to enhance divergent thinking and creative ability, that you would do this practice at a minimum once per week. And I should say if you were going to do it once per week, I'd recommend doing it for about 20 to 30 minutes. Some of you might be able to do it for as long as 60 minutes. I myself do such a practice on a daily basis anywhere from 10 minutes to 20 minutes, sometimes 30 minutes. There's an example of an NSTR script completely zero cost. I confess it does happen to be my voice. So forgive me in advance. There are other options of NSTR. You can go to YouTube, put NSTR and my name again completely zero cost. You can get a sample of what a 10 minute NSTR script looks like. That's through Virtusand. Put that out there. So thank you, Virtusand, for putting that out there at zero cost. There are examples of 20 and 30 minute NSTR scripts and Yogan-Eager scripts. Some that I particularly like, we will also provide a link to some of those. Again, those are completely zero cost for you to explore. But more important than you follow any one particular Yogan-Eager NSTR script is that you learn to take your body and brain into these states of limited motion, elevated dopamine within this particular pathway, and fairly deep relaxation. Again, if you happen to fall asleep, that's not necessarily a bad thing. Although the idea is that you stay in a shallow plane of consciousness or sleep, hence the term non-sleep deep rest. So in any event, I think this is a very useful practice that many people could benefit from. The fact that it's zero cost and purely behavioral, I think adds additional benefit because it's certainly one that people could explore depending on what amount of time you're willing to commit. And the research state on this now extend beyond this one individual paper. And I think it's really exciting because what it says is as the title and first line of the paper suggests is that we can increase dopamine using specific types of meditation-induced consciousness. And those increases in dopamine can be used to increase our ability to be more creative. Before moving forward, I want to make absolutely clear how it is that you would use NSTR aka Yogan-Eager or similar. The name doesn't really matter after all. The practice is what matters. In order to enhance dopamine in this NIGO-STRAIDLE pathway and enhance divergent thinking. The key thing to understand here is that the period of motionlessness and deep relaxation while awake increases dopamine in the NIGO-STRAIDLE pathway. It increases mental imagery. That is, it increases access to the bank or the library, if you will, of possible solutions or elements to engage in the divergent thinking process. But divergent thinking itself does not occur during NSTR aka Yogan-Eager. The NSTR and Yogan-Eager a deep relaxation meditation. Whatever it is you want to call it sets a dopaminergic tone. And that's actually the appropriate use of the word dopaminergic tone. It raises the baseline of dopamine transmission in that circuitry that then positions you to engage in divergent thinking more effectively. So the idea would be to do anywhere from 10 to 20, maybe 30 minutes, maybe even as much as an hour depending on how much time you had to dedicate of such a meditation and NSTR practice. And then, not necessarily immediately, but within the five to fifteen minutes following, then to go into a practice of divergent thinking and start doing creative exploration. That is to start thinking about different ways to combine existing elements in whatever domain it is that you want to achieve creativity. So the point is that the divergent thinking itself is not occurring during the NSTR or Yogan-Eager practice. The NSTR and Yogan-Eager practice prepares you for divergent thinking that you do in the hour or hours that follows. And just to contrast that with pharmacology, I am not aware of any specific dopamine-related pharmacology that would allow us to selectively increase dopamine in the very pathway associated with divergent thinking and creativity. Now, there are forms of pharmacology that can shift brain neurotransmitters and neuromodulators in ways that favor creativity. And this is certainly a topic that we will go into in more depth in a future episode. But there's an exciting study that was performed just this last year looking at the role of serotonin, another neuromodulator, in divergent and convergent thinking. And it turns out that serotonin underlies a lot of the brain activity that's responsible for both divergent and for convergent thinking. And there's one particular form of pharmacology which can enhance activation of the serotonergic pathways associated with the so-called 5HT that's serotonin, 5HT. That's the abbreviation, 5HT2A receptor, serotonin2A receptor, in particular brain areas in ways that favor both divergent and convergent thinking. And the pharmacologic agent in that case turns out to be very low dose, or as some of you may have heard of it referred to as microdosing of psilocybin. Now, I do want to say, because it would be entirely inappropriate for me to not say this, that in most areas of the world, and in particular in the United States, psilocybin is still illegal. It is not legal. In some areas, it has been decriminalized. And there are a number of different clinical trials occurring now at Johns Hopkins, at Stanford, at University of California, San Francisco, and elsewhere exploring psilocybin for the treatment of depression, for trauma, for eating disorders. Most of those studies focus on macrodosis of psilocybin, not microdosing. There are far fewer studies of microdosing of psilocybin. And I do have to point out that psilocybin use end possession, and of course, sale is still illegal. So I would be remiss if I didn't state that. However, I will provide a link to the study that shows that microdosing of psilocybin for a series of weeks on a daily basis. So these are dosages of psilocybin that do not induce hallucination, and do not massively shift mood or internal states in any way that has people feeling like they are acting or feeling that much different, although some people do report a subjective shift, does seem to increase divergent thinking ability. But I do want to put a big asterix, a highlight, and an underlying pen beneath the statement I'm about to make, which is that pharmacology of the serotonin system, just as pharmacology of the dopamine system is very broadband. It's a shotgun approach. You're going to hit all the circuits of the brain that involve serotonin with microdosing psilocybin, although it has some selectivity for the 5HT2A receptor, it can attach to other receptors as well and act there. This is the same reason why SSRI, selective serotonin reuptake inhibitors, can indeed shift mood and appetite, but can also shift libido and other things. It's because there are serotonin receptors everywhere, or I should say many places, not just in the areas of the brain that are associated with mood, for instance. And as I mentioned before, agents whether or not they are recreational or illicit drugs or prescription drugs or supplements that increased dopamine will also be broadband and hit a number of different circuits in parallel. So this is why I always say behavioral tools really should come first. I don't say that because I dislike pharmacology. I say that because in many cases behavioral tools are not only safer and easier to titrate to adjust the duration, etc. Then is pharmacology, but also because they can sometimes, as in the case of the study, would just describe, afford you more specificity, not less than pharmacology. Pharmacology has its place, can be wonderful, provided safe and legal, etc. But it can cause a lot of so-called off-target effects. So for those of you that are interested in increasing creativity through pharmacology, I would say stay tuned for the data on psilocybin and microdosing psilocybin. If you are absolutely obsessed with the idea of microdosing psilocybin for enhancing creativity and you'd like to go straight to the study, I will tell you what that study is and therefore you can access some of the specifics in terms of dosaging and protocols, etc. So since I can't help myself, I'll just very briefly summarize that microdosing psychedelic study. The title of the study, which was published in 2018, is exploring the effect of microdosing psychedelics on creativity in an open label natural setting. Interesting title. This was a microdosing event organized by the Dutch Psychedelic Society, the Exam in the Effects of Psychedelic Truffles, where they knew what sorts of psychedelic compounds were contained there on two creativity related problem solving tasks, the picture concept task, which I don't expect you to recognize or know, but it assesses convergent thinking and the alternative uses task, which I also don't expect you to know, but is a standard task for assessing divergent thinking. They tested once before taking in microdose and while the effects were expected to be manifested, they say, interesting, they use the word manifested in a study of psychedelics. Science is changing indeed. In any case, what they found was an enhancement of creative that is divergent and convergent thinking, not surprising giving the fact that the 5-HT2A receptor activity is increased by microdosing of psilocybin and 5-HT2A receptors are present both on the neural circuits to underlie divergent and convergent thinking. So again, this is not a plug for microdosing psilocybin. This is really in response to what I know will be a number of different questions about what sorts of pharmacologic agents can be used to increase creativity. So more on that later, and again, we'll provide a link if you want to read that study in more depth. I can imagine that a number of you are probably also wondering about the effects of alcohol and the effects of cannabis on creativity. We did a long in-depth episode all about alcohol and its effects on health. The bottom line on alcohol is that in excess of two drinks per week, you're starting to run into the cancer promoting and toxic effects of alcohol. I didn't choose for the answer to be that, but that's what the data tell us. I'm not telling you, you can't drink more than two drinks per week. I'm just saying that if you're going to do that, you should really consider offsetting that with some other behavioral measures all discussed in the episode of alcohol. And despite what people think, there is absolutely zero, zero evidence that alcohol increases creativity. However, by way of reducing activation of the prefrontal cortex, there is some evidence that alcohol and other substances that reduce what it's called autobiographical scripting, that is a narrative about ourselves or self-awareness that it can enhance divergent thinking at very low doses. Now, this makes sense. Divergent thinking involves remembering certain things that we can use as elements in the creative process, but suppressing narratives about what the use of those would mean. Will people like it? Will they not like it? Will it lead to the outcome we want? Will it won't? All of that autobiographical scripting involves the forebrain being very, very active, and specific regions of the forebrain in particular. And that all needs to be suppressed, which alcohol in very low doses can accomplish. But again, that's not a plug for alcohol. I think behavioral tools will be a much better route. But it therefore shouldn't be surprising why some people have used low dose alcohol in order to engage in the creative process because it involves less inhibition or sense of self that could be detrimental to the divergent thinking process. Now, with respect to cannabis, I went in depth into the biology and the various uses, misuses, dangers, and in some cases, benefits of cannabis use in certain, the key word there is certain populations. And I also dove into whether or not cannabis can be used to increase divergent and convergent thinking. So that's timestamped in that episode. I'll refer you to that episode. But the long and short of it is that many of the ideas that people come up with when under the influence of cannabis in particular high THC containing cannabis does lead to enhanced divergent thinking. But so enhanced, it turns out that oftentimes those ideas can't be constrained by the convergent thinking process. In other words, they have lots of ideas that make sense while under the influence of cannabis. But that later cannot be implemented into a coherent framework that leads to any actual creative endeavor or creative product. Or as is often the case with cannabis, they simply can't remember what they were thinking about. Anytime there's a discussion about dopamine, there seems to be a discussion about motivation, desire, and drive. And of course, that makes sense given the roles of dopamine. We did an entire episode on dopamine motivation and drive. It's one of our most popular episodes. Again, you can access that with timestamps and all formats at HubertmanLab.com. And anytime there's a discussion about dopamine and motivation, we also seem to have a lot of questions about attention and focus and ADHD or attention deficit hyperactivity disorder in particular. So just as a brief mention, there is a literature, although not terribly extensive, a small but strong literature on the relationship between ADHD and creativity. And the long and short of that literature is that people who have ADHD, regardless of age, do seem to have an ability to focus. I've mentioned that in the episode on ADHD, provided that they are interested in the thing that they are focusing on. So that runs counter to this idea that people with ADHD simply can't focus. They can, but it tends to be a focus that's selective for things that they are very excited about or interested in as opposed to a general ability to focus. What's also highly underappreciated is that people who have ADHD oftentimes are very effective at divergent thinking, but are less effective at convergent thinking. What this tells us is that people with ADHD can often have excellent novel and indeed creative ideas, but that the implementation of those creative ideas is sometimes challenged. And that's one reason to explore rational pharmacology, nutrition, supplementation, etc. Those are all things to explore in concert with or I should say in working closely with a board certified physician or ideally psychiatrist expert in ADHD. You can also check out the episode that we did on ADHD. There are a lot of tools there, a lot of science mentioned there to support those tools. Again, you can find that HubertmanLab.com. But I did think it was important to point out, even if briefly, that having ADHD is not a barrier to creativity. In fact, may actually be an enhanced portal to creativity, but that it doesn't allow people to access the convergent thinking that allows creative ideas to be implemented into specific strategies, pressure tested, and eventually delivered in the form of a final product of music art, etc. That is not to say that people with ADHD cannot accomplish that, but that it is going to require some additional steps and protocols in order to enhance convergent thinking in that episode and the episode that we did on focus, and in particular tools to enhance focus, is very much directed at ways to enhance convergent thinking. So if you have ADHD or know somebody who does and you're interested in the creative process, or focusing generally, please check out the episodes that I mentioned. Now, there's also a small but nonetheless very exciting literature on the relationship between physical movement and divergent thinking. This should come as no surprise to us. As mentioned many times now in this episode, the Niger-Straightle pathway involved in divergent thinking and then involves dopamine is also responsible for eye blinks and for movements of the limbs of the body in very deliberate ways. This tells us that there's some direct or maybe indirect relationship between movement of the body and divergent thinking. And despite the fact that it's only a few studies, there have been some studies of whether or not people are able to engage in divergent thinking more effectively when they are doing things like pacing or walking. And this could be on a treadmill or back and forth across the room. And in fact, that is absolutely the case. If you're somebody like myself who tends to have their best ideas, not saying that my ideas are always terrific, but among the ideas I have, some of the better ones arrived to me while on my long Sunday run, I tend to do a long run or hike on Sundays. Sometimes with a like weight vest or something of that sort. But when I'm in the state of essentially not directing my attention to any one thing in my external environment, this is extremely key for reasons that now should be obvious. Anytime we are directing our attention to a visual target or an auditory target, we are not as able to engage in divergent thinking. This is why I will sometimes listen to podcasts or to audiobooks while I go on these runs. But for portions of these runs or hikes, I tend to turn those off and just focus on the movement and focus on not focusing on anything in particular. And oftentimes I will stop and write down ideas that suddenly or seemingly suddenly appear to me or geyser to the surface. I'll have an idea. Sometimes those are good ideas, sometimes less good ideas. The fact that that happens for me and that the fact that many people are Pacers or Runners or come up with their best ideas while in the shower or while engaging in activities that don't require a lot of sensory attention to one specific location, either visual or auditory, etc. That is because it engages these nigrostriadal pathways through movement, which then opens up this library of ideas and allows the intersection of different ideas that normally would be constrained to separate categories. One way to think about this by analogy would be that when I was a kid you'd go to the library and nowadays you just go online, but the different pages of different books on different topics are kept distinct from one another. That is bound by different book covers and book ends, different shelves in the library. It's as if different pages and elements from those books are now being combined in a pseudo random, not random, but in a pseudo random way. In that combination new possibilities about ways that information could be combined and implemented start to arise. The tool that emerges from this is very simple and it won't necessarily apply to everybody. If you are somebody who finds that just sitting in a chair and trying to be creative is very challenging, some of you might benefit from, for instance, if you are engaging in writing or you want to write to talk into the voice recorder of your phone while walking or simply walking and not attending to any one specific thing visually or through headphones. Then as ideas surface seemingly out of nowhere, which is how it happens, that you could either put them into your phone by voice dictation or you could type them out if you like. The key thing is to not be distracted by other things in your phone, not to start going on to social media or doing phone calls or looking at text messages because that by definition is going to take you out of this, what the biologist call a pseudo random walk. This pseudo random element is extremely important. We know, for instance, that many circuits within the brain have what's called dedicated point to point wiring. For instance, the brain circuits that govern your breathing, the brain circuits that govern your heartbeat, the brain circuits that govern your specific movements once you are an adult and allow for smooth directed movement are very precise, very little slop if any in the wiring. However, there are aspects of your brain circuitry, yours and everybody else's, I should say, that are maintained into adulthood that include a lot of extra wiring. These are fine wires that are not the major highways between different areas, if you will. Google Maps has highways and streets and little passages and alleys, but it says if there's a little web of additional possible pathways cast over that entire thing, the human brain maintains such webs of possible passage and it's only during activities such as walking, running, cycling, swimming, hiking, pacing, etc. that the activation of those pseudo random pathways starts to ramp up. So this is a purely behavioral approach to engaging different elements within neural networks that normally would not communicate with one another when we are completely still. So again, the practices I talked about earlier of being completely still to raise dopamine and enhance divergent thinking, those I just want to re-emphasize are designed to position you to ready you to engage in the kinds of activities like walking and pacing, etc. that best facilitate divergent thinking. So if you are somebody who wants to enhance divergent thinking, I would encourage you to explore how different patterns of movement, in particular patterns of movement that don't require any conscious attention to any one specific thing, allow you to access new ideas and new ways of combining existing elements in whatever domain it is you want to be creative. Now, this is also an opportunity to underscore something I said back at the beginning, which is you are not going to come up with great works of music if you don't understand chords and melodies and notes and music. Those basic elements have to be built up through some sort of formal or at least rigorous or regular training. In the same way that you're not going to take a walk and then suddenly be able to paint an incredible picture if you have no painting ability. That is not going to happen. What I'm talking about here are ways to enhance your capacity for divergent thinking, such as NSTR, and ways to engage in divergent thinking, such as through certain forms of movement that don't require a lot of conscious attention to your surroundings or any one specific sensory target. In doing so, enhancing your ability to be more creative in a domain for which you already have some degree of skill or even mastery. Now, in keeping with the theme of how to enhance our creativity, there's a very exciting and yet parallel literature to the literature that I've been describing thus far. Now, I promise you that I'm not going to open up an entire library of new information related to neural circuits and so forth, but I would be remiss if I didn't mention this parallel literature because it speaks very specifically to some important practices that we can all use in order to enhance creativity and to do so the first time and every time. This is really because certain scientists out there have really gone through the trouble. I should even say the painstaking trouble of really trying to dissect what the creative process is both for individuals and in groups or even in pairs. What I'm about to tell you is beautifully encapsulated in an article entitled, a new method for training creativity, narrative as an alternative to divergent thinking. Again, we've been talking about divergent thinking that's one pathway into the creative process, but there are others as well. And as it turns out, they're not so distinct in terms of the underlying brain mechanisms. Nonetheless, let me describe briefly how narrative can be used to train creativity and to become more creative. And in order to do that, I'd like to just briefly paraphrase or read from the first paragraph of this paper. So what I'm about to read are the author's words, not mine. Quote, here's a paradox. According to current research, young children are more imaginatively creative than adults. And indeed, that is true, by the way. Yet also according to current research, creativity's main neural engine is divergent thinking, which relies on memory and logical association, two tasks that which young children underperform adults. That is, children are not as good at divergent thinking as adults are. So how could it be the authors are asking that children are more imaginative and thus more creative than adults? This can only mean that there are alternate pathways to creativity. And indeed, that is the case. And so what this paper really explores is other ways to access creativity. And what they describe is what's called narrative theory. And there's a number of different aspects to this narrative theory. But they agree that the standard definition of creativity is the same one that we were talking about before. So we're not saying about a different form of creativity here. We're talking about a different way to access creativity. They describe the standard definition of creativity as quote, the ability to generate novel ideas that are useful. So the commonly accepted one. And what they cite as the basis for narrative theory is this breakthrough finding in the 1950s. This is the work of Gilford. Some people out there might be familiar with it. I was not at the outset of researching this episode. What this theory is from Gilford essentially states is that there are different intellectual capacities that are not captured by standard IQ tests. I think that's generally accepted nowadays. We know there's emotional intelligence. We know there's a standard IQ, et cetera. But the important elements to understand is that these authors were able to trace back the idea of narrative training as a way to enhance creativity long before Gilford in the 1950s all the way back to Aristotle. So this is incredible. Narrative theory was actually birthed in 335 BCE in his writing called Poetics, which I think is incredible at least to me that people long before us were thinking about creativity and what goes into creativity. And what Aristotle said, what Gilford then elaborated on and what the authors of this paper further elaborate on and actually have developed training protocols for is the idea that there are three elements that we can use in order to enhance creativity. And those three elements are what's called world building. I'll explain what these are in a moment. Perspective shifting and action generating. And right off the bat, the word action should raise a flag for you. And by that, I mean a positive flag because once again, we are back into the world and therefore the neural circuits of movement and motion. Okay, so three elements of world building, perspective shifting and active generating or what make up this narrative approach to creativity. And I should mention that these authors and others are using such approach with companies, with groups, with individuals. So this is used in a bunch of different contexts to approach and enhance different forms of creativity. So let's talk first about world building techniques. This is going to be immediately familiar to you when you hear it. But one of the key elements of creativity is to at the outset come up with some idea that makes sense or is attractive to you about how the world is different inside of your creative endeavor. So for those that write science fiction or think about science fiction, there's some obvious aspects to this. But for those of you that don't, maybe you come up with a narrative, for instance, in the context of storytelling that in your world, we are the house cats and the cats are actually the ones that are the curators of the earth. Okay, so right there, there's a conceptual shift that the world in which whatever creative idea is going to emerge is entirely different than the one that we actually live in. So that sets a certain number of important constraints. It means certain things are now possible. Other things are not possible that are very different from the world that we live in. You can see the parallels here to childhood imagination where essentially anything can happen in the child's mind because they are unconstrained. The second element is this perspective shifting techniques. And the idea here is that not only are we supposed to have the reader or the listener or the observer or us explore for creativity and develop a creative idea by thinking differently, right, which is kind of a generic term. How do we actually think differently? But rather than just say, take the perspective of somebody else in terms of what they would see or do or say or think, rather we are supposed to think about their underlying motivation. So we could do the world shift. That is the world structure shift from step one. And then in step two, you would ask yourself, okay, rather than write about or think about or move from the perspective of myself. Let's say you're feeling particularly happy that day. You'd say, you know, I'm actually going to take the perspective of somebody who's angry. But rather than just act angry, I'm going to think about what their motivation for being angry is. Maybe they had a breakup. Maybe they were jealous. Maybe somebody had a wronged them in some way. Maybe they're just generally angry at the world for whatever reason. And then operate from that motivational stance. And this is a very interesting and powerful step because what it really captures, at least as viewed by me, the neuroscientist is that captures a whole set of neural circuits about what that motivational state means because motivational states dictate a huge number of possible different outcomes. But they really constrain the number of different actions and outcomes that any of us would engage in. Rather than saying, I'm going to view the world the way that someone else would view the world by stating that we are going to be motivated by their set of motivations and not our own. It includes a lot more possibilities and yet not an infinite number of possibilities. They are constrained in a logical way, which is one of the key elements of creativity. And then this third element, which is action generating techniques is a really cool one that you will immediately notice implications for the workplace, which is forced collaboration. So inside of this thing that we're building here, this kind of story, you create a novel rule for the world that your story is going to exist in or your music is going to exist in or your sport will exist in. Then you create this perspective shift where you take on the motivation of someone else different than you. And then you force collaboration between that person who has this alternate motivation different from you and someone else who has an entirely different motivation. And in doing so, you create these kind of what are called creative collisions. Now they're collisions because they're crossing one another and something new has to emerge from them. They could be antagonistic. They could be arguments fighting physical or verbal or otherwise. They could be synergistic. They could take on any number of different forms depending on the motivations and the individuals that are involved. But even though I just described this in fairly top contour, what I just described is actually the core elements of any story or any creative endeavor. It's just that many stories are from the perspective of what we already know and believe and think the world to be. And our own perspective and the actions that we would take given that world and that perspective, whereas if we want to be creative, we want to think outside of our usual framework and yet using elements that exist within us, no one has to tell us the creative narrative. We're trying to come up with it on our own. We want to essentially think in a childlike way, how do children think? Well, they have new, different or entirely novel concepts about how the world works, but they was are bounded. And this is a keyword. Those are bounded. They're not infinite. It's not that anything can happen. Some kids will say we can fly and you can shoot lasers out of your eyes. You can do all sorts of things. There's unicorns, a candy falling from the sky. At some point, if you don't bound the change in the world, it just becomes pure chaos and even children don't do that. So we need to bound the change and yet create some alternate universe, if you will, in which the story takes place or the creation of any kind doesn't have to be a story takes place. Then there has to be a perspective shift. And this is very useful. This is actually a tool that we can all use of trying to take the perspective of others, but not just asking what they would feel or think or do, but ask what is their motivation in life generally or what kind of mood stance or goal stance are they taking? Are they trying to extract from others? Are they trying to give to others? Are they very altruistic? Etc. Etc. And then you take that individual and you do that also for another individual or group of individuals. And you start thinking about how those different individuals, because of their different motivational states, would engage at the level of action, what they would do, what they would say, would they mate, would they fight, would they et cetera, et cetera. You think of any story, the story of Star Wars, the Greek myths, you think of any story that has been created, which we consider great and novel works. And you start to find these three elements, world building, perspective shifting and action generating techniques. And so, while this is again just a broad contour of what this narrative approach involves, I think it's a very important and very exciting one, because it gives us a formula, right? We already know that divergent thinking and convergent thinking are both elements of the creative process. This is suggesting that whether or not it involves divergent thinking or not, these authors seem to think this is distinct from divergent thinking, that capturing some of the elements of creativity that are present in childhood, but that then tend to disappear as we start to assume identity, build identity, and understand rules about the actual world we live in. All of those basic elements of early childhood creativity can be reawakened. And in fact, they have data to support the fact that they can be reawakened in adults in meaningful ways that can lead to new product design, new workplace interactions, and on and on. And that I find very exciting. And as a consequence, I do intend to do an entire episode at some point on narrative and storytelling and the role of narrative and storytelling, not just for sake of creativity, but also for accessing neural plasticity and for enhancing memory and so on. There's an entire landscape of literature and exciting tools and things to understand there. But in the meantime, we will provide a link to this paper. And for those of you that choose not to access the paper, simply understanding these three aspects of narrative as an alternative to accessing creativity, that is a dedicated and well understood or established world shift that you choose, perspective shifting and taking on the motivation of others, and creating some sort of landscape of exploration for what sorts of interactions would occur between that individual or groups of individuals and other individuals that have other motivations and yet are still living in this alternate world. Those three elements we now know can be combined into what you or I or anyone would consider important creative works. So today we discussed creativity, this absolutely fascinating aspect to human brain function that has allowed us as a species to develop everything from great works of art and music to technological innovations that allow us to fly and allow us to access people all over the world through little screen devices that we carry around in our pockets and on and on. As I mentioned at the beginning of today's episode, I find creativity to be one of the most fascinating aspects of brain function. And in particular, because we don't actually know what the upper limits of creativity are and yet we understand that there are certain bounds, there are certain requirements. And the key requirement for creativity is this aspect of utility. Now that doesn't necessarily mean that for something to be considered creative, it has to be useful in the practical sense. But it does seem that for something to be considered truly creative or especially creative in some cases, that it reveals to us something fundamental about the way that we or the world works. We discussed some of the neural circuits that underlie the different aspects of creativity in particular, divergent and convergent thinking, as well as narrative building and some of the tools and steps that can allow us to better access divergent thinking and convergent thinking and those tools include behavioral tools as well as pharmacology. And we talked about narrative building as a way to reawaken or I should say, re-access the childhood creativity that did indeed exist in all of us at some point in time. If you're learning from Ender and join this podcast, please subscribe to our YouTube channel. That's a terrific zero-cost way to support us. In addition, please subscribe to the podcast on Spotify and Apple. And on both Spotify and Apple, you can leave us up to a five-star review. 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If you're not already following us on Instagram, Twitter, Facebook, and or LinkedIn, please do so. It is Hubertman Lab on all platforms. On all those social media platforms, I describe science and science related tools, some of which overlap with the content of the Hubertman Lab podcast, but often which does not overlap with the content of the Hubertman Lab podcast. Again, it's Hubertman Lab on all platforms. So thank you once again for joining me for today's discussion all about the science and tools for creativity and last but certainly not least, thank you for your interest in science.