



Embodied Brain - Yoga, Neuroplasticity, and the New Scientific Paradigm

Towards a Science of Embodied Mind: Neuroplasticity, Contemplative Practice and the New Scientific Paradigm

PDF Transcript

Joe Loizzo: Hello. Welcome. This is Dr. Joe Loizzo with the Nalanda Institute for Contemplative Science. And I'm just thrilled to be meeting you and sharing in the key note talk opening this amazing conference that Jacob Kyle and his colleagues at Embodied Philosophy have developed on the embodied brain. And, I'm so happy and honored that Nalanda Institute is co-hosting this amazing convergence of science and spirituality in this conference. And let's just begin. I'll try to give you sort of a brief overview with my talk to what's my particular angle of interests here, but also maybe hopefully touch on some of the many areas that our eminent speakers will be addressing on later classes. So, when they begin first by getting into my presentation. Let's begin.

Towards a science of embodied mind, this is sort of my take: neuroplasticity, contemplative practice and the new scientific paradigm. So, what do we what we talk about today? First of all, I want to just set the stage for the new science of mind. I think something incredibly exciting is happening in the convergence between science and spirituality or science and contemplative practice that's allowing us, finally, to really approach the mind in a much more robust, and authentic way. I want to introduce the revolution of neuroplasticity, which is a key part of this sort of the meeting ground of this conference that helps us understand how mind may be connecting to brain. I'm going to survey the impact of meditation research, incredibly promising work showing that my training practices can really promote neuroplasticity and guide it in consciously intended ways. I am going to explore the new contemplative psychotherapy, which is one of the first disciplines to have integrated the science of mind with some of its a special contemplative psychotherapy practices that show a kind of high level of integration between mindfulness or other kinds of contemplative approaches and traditional modern neuroscience and psychology. And finally, I'm going to show how that new

integration and the research behind it is sparking applications in much more far-flung fields in our modern culture, including health care in general, education, and business.

So first I want to just set the stage by talking about why is this such a big revolution? I want everybody to understand what's so exciting and what's so unprecedented historically in terms of the meeting between contemplative approaches or experiential approaches to the mind and modern science. The hard problem is a term coined by philosopher David Chalmers and he was really talking about the mind body problem and you say, I love this little diagram here shows you really that this sort of strange, ethereal, or ghost-like place that the mind is occupied in our modern view of science, since science has been so deeply invested in and exploring the more molecular and material parts of the world.

So how do we bridge the gap between sciences between the growing science of neural processing. What we're really starting to understand how the brain works in a much more robust way than anyone ever has in history. But there's a real gulf between that and the lived experience of mind, the way we just feel like, "Okay, I'm aware. And here's a little this slide really suggests that talking about how there's the experience of Green,' and then there's this sort of neural stuff that's supporting it. Those are not the same things. And modern science, unfortunately, hasn't really evolved a way to integrate the study of the lived experience of mind, with its profound study of the material structure of the brain and neural processing.

Why is that well most people trace this problem to Rene Descartes, who was one of the Enlightenment founders, father of modern science, who proposed that mind and body are two completely independent realities that may interact in very specific ways. And this model is traditionally call dualism. So, we have him here, we quote him, explaining, "It's certain that this so much I wish I am what I am is entirely an absolutely distinct from my body and can exist without it." But we don't necessarily believe that nowadays. But he had a whole elaborate of set of reflections of trying to prove that to people or make that plausible. And, of course, what followed what where we really got into the hard problem was the sort of reaction to that dualism exemplified by British philosopher Thomas Hobbes, who argued with Descartes, and basically said mind and body are two words for one physical reality. And so, this model, which is nowadays called materialist monism or physicalism, as some people call it, is really kind of the consensus model that people have about the brain, which is about the mind, which is the mind is really just what the brain does, it's not its own thing. It's not separate, just another word for what the brain does. A thinking thing is something corporeal, said Hobbes. The subjects of all actions are comprehensible only if they're conceived as corporeal or material. So here he is writing in the 16th century or 17th century, and the reality is, this is really what were people most scientists and most philosophers of science today actually agree with that.

There really were some sort of deep minds who tried to sort of bridge the gap in a different way and Spinoza is a particularly interesting and perhaps influential one. We don't know much about him, but the fact is he had been steeped in the sort of the Spanish, Andalusian, and Portuguese Renaissance where Arab and Western scholars were reviving the study of Aristotle and others came up with this very distinctive solution to the mind body problem. He said they're one of the same individual conceived now under the attribute of thought and now on to the attribute of senses. So, he's saying, really know that actually find a body really both something both belong to something else, which is deeper, more subtle, and less kind of dualistically, less diverse or radically different than they appear to be in our normal experience.

Unfortunately, Spinoza's solution didn't work. Some people call it a neutral monism, as I said, and science kept on really trying to break everything down to its little material elements as kind of our way of understanding what nature was. And part of the reason I think it didn't work is that Spinoza really wasn't challenging the fundamental assumption that locked us into this sense that we have to choose one explanation or another—either mind or mind and body, or something else that's neither. And that's the sort of monism of Western thought. Whether we conceive of nature is extension or thought we shall find one in the same order one of the same connection of cause is that the same things following one another. So this is a kind of belief that we all commonly share in some sense and science certainly does. And final sort of historical figure I'm going to introduce, I believe, is Francis Bacon who was really thought of as the father of scientific method. And so basically, he tipped the balance further again toward the physical dimension and introduced his method of breaking things down into the smallest physical components and said, basically, we can understand how they work. Then we can sort of extrapolate and understand them. That he also is famous for saying, "We really have to kind of hound nature," and we shouldn't worry about it. It's almost like an inquisition, income shared the way we kind of break nature down try to understand how it works and control it or master it. And actually, he's responsible for the famous model over the London School of Economics, which maybe embodies a kind of ethos of the modern world, "knowledge is power." Right? So, the idea is, we're going to get this knowledge by breaking things down into pieces and specifically their material pieces.

So we have this view science that emerged in the modern world which science is kind of a hierarchy. We have the soft stuff up top, but it's all resting on things that get more and more solid until we get down to the bottom, which is physics, where matter is thought it was a bunch of billiard balls bouncing into each other. So, that's sort of why you can see what that's pretty far from mind, isn't it? Right? You can see how that might actually make it hard for science to take mind very seriously or know what to do with it. There were major paradigm shifts in the 10th century that really helped us sort of open the door a little bit to our understanding of nature. Albert Einstein will know his relativity theory, uncertainly principle by Heisenberg; quantum mechanics by Schrödinger. And some of these all really led to a kind of

breaking down on the notion that there were these solid building blocks and that the physical world was actually so fundamentally much more solid than mind so much more obvious so tangible. The physical reality started ending up dissolving, so it didn't really look so different from mind.

Other approaches in biology were developed specifically Ludwig von Bertalanffy developed this systems theory, which many of you may have heard of is a new way of approaching how everything fits together, and the understanding is it's the parts are not enough information. We have to understand how everything works together in order to understand the whole. And that allows us to really look at living things and complexity. So, they both the science of complexity and the science of living systems comes from Bertalanffy.

So essentially, these paradigm shifts were really thought of as wow this is big. How does science work? Maybe it doesn't have this just this one monolithic structure. We have modern science. We have Newtonian science, Maybe you know, we have Darwinian biology. We have this new social biology. Maybe there is more than one way to look at everything and we have to really be more open minded, right? And specifically, philosopher of science Thomas Kuhn really challenges monolithic theory and really talked about his groundbreaking work structure of scientific evolutions, talked about how science can only yield knowledge and power relative to chosen cultural aims and values. Right? That's really important. The idea is that science isn't just discovering nature. It's following up on hunches that we have, needs that we have as humans. It's a part of our practice of gathering information. We shouldn't think of it as absolute, as if sort of it's the secret revealed to us from nature. And so we have to really kind of start thinking carefully about what we really need and how we really want to go about studying it. And maybe there's more than one way to do that.

David Bohm was an extremely important physicist who really try to sort of bring this newer open, systemic, fields-like approach to the world, which was much more compatible with the idea of consciousness together with the sort of solid model that relates to, say, Newton and most modern science. And he developed this notion of an implicit reality that is kind of like cribbing on our old friend Baruch Spinoza saying that maybe the quantum reality is that deeper unified reality and mind and matter are actually two expressions of that deeper reality. Interesting approach and, of course, even in philosophy of science with somebody like Karl Popper saying, science can't be monolith. The best we're doing is just we have hunches and we think of them as truth or proven as long as we haven't falsified them. So long as we haven't disproved in them. But then, of course, inevitably, there's going to be an adjustment or we're going to throw the whole thing out altogether for something else. So, there's a notion that we have to—ultimately, science has to require on open mindedness rather than this kind of inquisitorial, let's-nail-it-down approach that that Bacon suggested.

In terms of the issue of mind, for example, one the son of a very influential modern analytic philosopher, Galen Strawson proposed recently again another explicit modern form of Spinoza's monism where he says, well, maybe actually mind or awareness is actually just part of nature. It's part of the fundamental, say, quantum fabric of information so that living things congested express it. Bohm started dialoging here. He's dialoging with Krishnamurti and started being open to spirituality approaches and actually in Eastern thought there isn't an understanding of non-duality. Many of you I'm sure you're aware of, where there's a deeper understanding that there's a unifying reality, or at least a kind of deeply interconnected reality underlying the appearance of everything as very different. But engaging with other cultures, engaging with other disciplines, Bohm was one of these people is really trying to open science up in the modern era, so that it could really start to address the very vague or ethereal reality of experience.

But the guy who really sort of took us to the next level was a Chilean cognitive science named Francesca Carella, who, unfortunately, died early. And he brought us really though in his in his a very powerful work, a very interesting complex living systems model with in which he combined connection as neuroscience and the idea of meditation research as a unique multi-disciplinary way to explore the embodied mind.

All right, he's saying we're not just interested in mind as a function of the brain, we're interested in how it actually feels and operates on this very subtle level. And expert meditators can be our guides in that because they have a kind of scientific control over the way their mind is operating and their observation of it.

So, this set the stage for a whole new approach to the mind. And it's not like the materialist. It challenges not just the monism that we believe in, that everything's just matter, but also the premise that there's only one true knowledge system and that knowledge in reality must be like a monolith, right? And Bohm and Carella and others. And here's Richard Davidson with neuroscientists from University of Wisconsin from Madison, along with a Buddhist monk ex-biologist, Matthieu Ricard, a French biologist turned Buddhist monk and really looking at this unique kind of dialogues now between especially Indian culture, Tibetan culture, and modern science as a way to kind of development, interdisciplinary science that allows us to do justice to the mind and to the complexity of the brain. So, neuroplasticity, I would argue, is really the kind of the last straw neuroplasticity. Neuroplasticity has kind of been the catalyst or the acid that's really sort of dissolved the old approach to mind because it's shown very specifically that mind really does matter.

Okay, so let's talk a little bit about neuroplasticity and how it works. Of course, there's a beautiful little diagram from Descartes that shows a kind of very mechanical model that he took toward the body and the brain. He believed as most moderns or enlightenment thinkers did that the body is really like a machine, that it's really sort of inanimate or lifeless or whatever. And then it's just determined by these very rigid causal laws like billiard balls, kind

of mechanics. And that awareness is really sort of just somehow floating up there, connected. One philosopher called it the ghost in the machine. So that's the kind of metaphor. Part of that philosophy is that the brain is like a fixed switchboard. It's got this neural wiring, then it's just fixed. So you know, this is which is where we began a modern neuroscience. The model really gained traction with when we discovered bioelectricity, right? So, the idea that the brain is really kind of an electrical apparatus. It kind of has neural circuits that run in the same kind of electricity that machines do.

And Freud was one of the first to sort of pick up on this. He was in a lab where they were studying squid axons and how neural messages were transmitted. There's a little diagram from one of his early books. But he sort of gave up on the idea that really wasn't enough neuroscience at the time to even try to explain the complicated workings of the mind. So, he decided to go for a more Cartesian split and talked about the mind as something separate that interacts with the brain and the body that's a more mechanical system. And, of course, neuroscience has just really exploded and since Floyd but the mechanistic view of the nervous system as hardwired based on genetic blueprint didn't change until very recently.

So here we go with neuroplasticity, in the late 80's and 90's there is some research that started to appear that really suggested that neurons were not hardwired as we thought, but they were plastic that was shaped and reshaped by the neural activity that supported any lived experience or learning. So, whenever we're attending to something or doing something, the neurons that support that get more activated, they fire. And when they fire, they wire together. Neurons that fire together wire together, is a famous mantra now of neuroplasticity. So that network that we're using with our tension grows much as muscles when we're exercising them in the gym, grow and sculpt based on how we use them.

So, here's some micrographs from Dr. Bruce McEwan, who you will hear of representing this conference probably the world's foremost stress researcher and research on how the brain is impacted by stress. And it's just showing that there are many different ways in which nerves are constantly being remodeled at the level of dendrites, synapses where the two nerves come together, and they send each other messages, and neurogenesis, that is to say, new nerve cells themselves actually grow when there's particular kinds of new learning happening.

So, it's all very promising to think that, well, maybe our brains are growing, and maybe the way we think or use them use our attention can actually transform our brains. But of course, the reality is that the way we use our attention can sculpt our brains in very different ways it's not always for the better. So, it's a mixed bag. Chronic stress, if we're thinking negative thoughts, feeling negative feelings, acting in stress-reactive, highly charged, self-protective ways, that actually can wear down healthy brain structures networks that we need to get along with people to think clearly, while growing stress-reacted structures and networks that

actually just make us more and more ready to filter to look for stress and react to stress so it can be kind of vicious cycle, and lead to chronic reactivity and stress-related illnesses we'll see later in our talk.

So in fact, what we discovered and Bruce explained this clearly is that chronic stress actually shrinks the circuits that help us manage our normal activities of life and stay well and stay ready to connect. It grows reactive trauma circuits, that is to say, grows this circuits there solely for self-protection and assuming the worst and reacting to the worst. Eric Candell had approach to the brain and the mind that he basically felt that all of mental health was going to transformed by this new understanding of plasticity. Because it finally explains that learning actually changes the brain and in fact we use it to understand how psychotherapy works, which we've sort of really recently discovered by the sculpting connections.

And he showed, as I mentioned this mixed bag on the left of your slide, he showed how in these three different conditions: Cushing's disease, chronic stress, PTSD sufferers, and so on, that the same kind of wear and tear happens in this part of brink hippocampus, which stores a lot of our emotional memory. Whereas if we use our fingers to play a string instrument that part of our brain grows. So, stress shrinks a lot of the parts are brain we need to live well, whereas a you know, intentional practice that's of a constructive nature can help grow those other parts of the brain that helps us live. And Chris McEwen also really talked about the chronic impact of stress in his notion of allostasis. That is the idea that we don't just have to be in homeostasis internally, but we have to be in balance with our environment, that's *allo-* or other people. And when we don't feel in balance, we get stressed and that stress, if it's chronic, wears and tears us. And this is his way of looking at how many different kinds of stress, from adversity, poverty and so on, and abuse, can make us much more reactive to stressing in present day and have a cumulative impact in our systems.

So, this has begun to shift our whole model of a brain and mind. It's like a wrenching breakthroughs in science and psychology. We know that in neuroscience now that the brain is not hardwired, and we know that the mental functions cut across different networks in the brain. We've been able to study some of those using functional scanning like MRI scanning. We've been able to look at the developmental, the evolutionary development of the brain and how it's made of different layers that come from different parts of our evolutionary past. And we see how that's informed by parent-child interactions or later, relationships like psychotherapy, and that essentially, we've evolved these integrative regions that allow us to function as a healthy, well-adjusted whole person, as opposed to the stress-reactive parts of our brain that just aren't there just for survival. So, it's thriving: the integrated structure allows us to thrive, whereas the stress-reacted structures just here for survival.

So, we have this whole new approach to understanding stress and its impact on the brain that we now can really begin to look at how stress reduction might be relevant. So, this is

another really fascinating way to understand how important neuroplasticity is and how somehow contemplation or meditation starts to work itself in as a potential remedy to the way stress impacts us and a potential answer to how we can become more resilient or more adapted to civilized living. So, we know we have the three elements of our brain and get the little diagrams here to show the reptile as the older part of the brain. That's an opossum, I think, the early mammal brain, which is really the emotional or limbic brain and then the monkey, is more like the new cortex, the neocortex, which is our so higher social brain. The dolphin is there really, specifically addressing our prefrontal cortex, which is part of our neocortex, that it's the most highly evolved or socially engaged.

So, we have these three parts of her brain, but they're not a hierarchy. It's not all top down. The sort of smarter, wiser animal doesn't always get in charge. If that is the sort of older, more, maybe simpler or more basic part of our nature that if that animal gets stimulated by certain kinds of challenges in the environment, then it will actually jump into the driver's seat of our brain and start running the brain from these older centers. Right? So that's what happens when we have amygdala hijacking or other kinds of really powerful stress reactions. So, what our brains are supposed to do is the neocortex, the newer part of the brain that's in yellow is supposed to be there for our role engagement are being part of big systems, big cultural systems that do cultural work. The limbic system is social. It's for relationships one on one or small groups. It's there for us as early mammals to help us survive were so vulnerable. We need to connect to parents and other family members. And the brain stem goes back to reptilian ancestors just there to help us stay in balance internally and survive within our environment.

We also know that there are many kinds of neural networks that cut across the different parts of the brain. So, it's not like the neocortex operates as a unit. It has different networks within it and different modes that it can be run in. It can be run in different modes by those different networks, right? So, the neocortex can be in socially engaged mode if it's run by the prefrontal cortex, or it can be in self-enclosed mode, if it's run by the Default Mode network. We'll talk a little bit about that. The other key insight into stress has been Stephen Porges' work, and you'll be hearing from Stephen Porges, is really the leader in our autonomic research internationally, and his unique way of understanding how the autonomic nervous system evolved and became mammals to help us stay more socially engaged and connected into manage our stresses much better and become more resilient.

So, he described this perceived safety hierarchy. The sort of wise is kind of part of our brain only stays in charge when we feel safe, we feel we belong, we're engaged in what we're doing. If we don't feel engaged or we don't feel we belong in start to shift into what's called the default mode, which is like an autopilot of, you know, you've all experienced this. Oh, here I am. And I don't know, you know, maybe these people don't like me, but I don't really belong here. Maybe I'll never do. It tends to drift into negativity, but it's there to make us vigilant. And

that's a sort of self-protective network on the level of limbic system likewise, the emotional brain with early mammal brain can be socially engaged in love and care, but also could be aversive and reactive. And that happens whenever we feel disliked by someone or disappointed by someone. We feel deeply traumatized or threatened by that, and we want to pull away or fight with them in a fight-or-flight kind of way. And then, finally, on a physical level, if we feel that we're really in a life-threatening situation. We feel in peril or menaced. The brainstem kicks in with these primitive survival reactions, and they could be of even more powerful fight-or-flight or often this primal parasympathetic or vagal response, which is a faint or freeze. So, we have to fight or flight, faint or freeze, primitive response, is coming from the brainstem if we really feel our lives are in danger.

So we got these different networks that every part of our brain, and they have these opposing functions. So, the neocortex, we can be more socially engaged if we're feeling safe. But if we're feeling alienated, we're going to get into this self-preoccupation that like this woman is describing at the emotional level with feeling safe and loved and connected to others we could be emotionally tearing present. But if we feel unloved or rejected, we get reactive and maybe angry or panicked triggered. On the visceral level, we could be in the mammalian part of our brainstem social engagement system. The oldest evolutionary changes in our autonomic nervous system affected the brainstem and the way our cranial nerves, including the vagus, are wired in such a way that they allow us to stay calm and connected even in difficult situations, so that we can be kind of unconditionally present with people that matter to us.

But if that's not working and we're not engaged on a deep, visceral level loving and caring others, we're going to be reactive and either fight-or-flight or faint-or-freeze. Attachment theory fits in here is well because we understand that as little infants, we feel our lives depend on the love of others. So if we feel in any way that they're not there for us, we have many traumas, or we couldn't have it. There are really trouble parents. We could have actual traumas in the capital T if we're in a trauma zone or a difficult neighborhood or part of the world where there's a lot of adversity, we might feel traumatized in our development in a way that sort of prevents our brain in developing the equipment it needs to thrive and polyvagal theory, the autonomic approach of Stephen Porges, factors in there because it essentially says our mammalian system is designed to protect us from these kinds of disconnections and threats and traumas.

Bessel van der Kolk, renowned now for his work on trauma because he shows the that trauma actually works *because* under stress the brain fragments. So, the brain can integrate when it's safe and connected and all the brain works together to help us be passionately engaged in our lives or when it feels threatened. It's like these older systems kick in and they really fragment us. And part of that experience is the experience of trauma, where we can't even really connect to things that our body, our emotions are feeling. Here's his book, which

is classic. I recommend it to anyone who has any work with trauma or experiences with trauma or is just curious. So here we go. This is the structure now that we're dealing with is we've got the brain of these three levels. And it can be run by an engaged mode by one of the networks that support that presence network prefrontal cortex, the empathy system, as a way of running the limbic emotional brain. And then the brainstem social engagement system, which keeps us socially resilient. We can play we can we can hang in there with people, or we could be in enclosed mode of each of those, when the default mode network kicks in, because we don't feel we belong, the aversion system kicks in because you don't feel we're loved. And then the survival reflexes kick in because we don't feel we stay.

We have to decide which of these if we understand that this in the context of Neuroplasticity, both of these options can be grown. We can become more and more stress-reactive, isolated, alienated or precarious, or we become more and more socially engaged, which will we feed? This is the sort of famous Cherokee proverb, you know. We've got the wolf of anger in the wolf of love. And which one are we going to feed?

So, we're sort of on defense. We're prepared to live in the wild, we're prepared to survive, but we're also prepared to thrive with others. So which do we lean toward? And the problem is actually more complicated than we have a choice. So, that way, have both options. We tend to lean to into the negative. This is called negativity bias and part of the reason Rick Hansen talks about the survival has wired our brains to be like Velcro for suffering but like Teflon for happiness. We have a bias to hold on to things that might threaten us much more than things that might please us. And you can see how that would be evolutionarily helpful. Right? If we forget where the honey is, we're fine, but if we forget where the bear lives, we're in deep trouble.

So, what's the mammalian strategy that all of us now we're really talking about including Stephen Porges, Rick Hansen, Dan Siegel, and others is that there are these integrated structures in the brain, and these integrated structures support the socially engaged parts of our nature. They're the kind of newer equipment that allows us to connect with people, work things out, stay present, stay caring, and be fearless. And you can see him in the brain that tend to be in the midline of the brain, right down the middle of it. And they go from the very newest part of the brain to the oldest part of the brain, right? So our whole brain is ready to be integrated and engaged. But because of the negativity bias, it's not going to be in that mode unless we work it. Right? Unless we choose and practice to train and strengthen that part through neuroplasticity, then we have essentially negative neuroplasticity, which is our default setting to lean into the worst, makes us more and more reactive, more and more stressed, more and more in survival mode, and we're all familiar with this bind in life.

So, where does meditation come in? So, people began to think early, after the discovery of Neuroplasticity that somehow contemplative practices like mind faults must be involved.

Richard Davidson talked about it, and some of the researchers in his lab decided so let's put some Tibetan meditators through an MRI and see what their brains are doing and particularly we also do an EEG while we're there and what they found totally shocked them. They found something that almost you never see on an EEG, which is something called high frequency gamma wave. This is the highest brainwave, the highest frequency brainwave that you can see in a living brain. And essentially it seems to be like a eureka moment or a moment of intense learning. So, normally it's not even seen, because how many times you have one of these moments? These meditators, it turned out they can actually turn these gamma wave states on at will and run them for minutes and minutes long and turn them on and off. And also they could spread them across their whole brain. So that maybe explains the sort of extreme nature that discovery, that this is where there's kind of biological link between meditative practice and neuroplasticity. Right?

And you can see why that might have been the first paper on meditation. It was the first paper and meditation ever published in the prestigious Proceedings of the National Academy of Sciences because it really put meditation on the crossroads of the new neuroscience. We got this neuroscience of plasticity. And then there's this weird thing people been studying called meditation. And guess what: it turns out that meditation is one of the best things for consciously cultivating and sculpting or directing the natural process of neuroplasticity that allows us to change the brain. So wow. And here's the actual research study showing the meditators with more of that kind of reddish zone up there is the sort of more activity, higher levels of activity. The normals, non-meditators have lower activity, almost none.

And so, of course, remember that that meditation is not just mindfulness and there's many in practice in fact, those monks were not practicing mind. They were practicing a kind of compassion practice. But in any case, the way I like to teach is that, I think the research is sort of plan of falling out on this way, it said the neocortex may be especially sensitive or well matched to the practice of mindfulness, which is just essentially attention-training.

The limbic system is may be very sensitive to something called compassion training. This is really the kind of rubber-meets-the-road version of emotional intelligence. How do I learn to work through negative emotions to not over react to them not to trigger, so that could be resilient and get back to caring and connecting. Embodied practices or those practices that speak to the oldest part of the brain and they actually are different kinds. There are top-down practices that speak to the older part of the brain through imagery or affirmations, and then there are bottom-up practices speak to the oldest part of the brain through breath work and movement, those we recognize from yoga. So these are things were now heading more into the direction that this is an embodied philosophy or embodied contemplative practice.

There are just some interesting studies showing that, actually, this basic format that I shared with you about the balance of neural networks between the self-engaged networks and the

self-enclosed networks actually does pan out in some very interesting studies, one by Jud Brewer, who's also was going to be speaking with you, who did some amazing work showing that the default mode network is less operative in meditators. And it's not just while they meditate but it's also in between, so that means less slipping into this potentially negative self-enclosed mode. Meanwhile, Sarah Lazar showed the sort of flipside of this, which is mindfulness meditators have much more active in prefrontal cortex and the way in which the prefrontal cortex connects to the internal awareness. The interception of the physical body, your feeling of being in your body the insular, these are two things that grow significantly even just eight weeks of mindfulness practice with novices. So, this is really showing that the balance in the neocortex can be shifted by minds for us from the self enclosed default mode to the socially engaged presence mode.

On the limbic system a lot of work done by a range of different people later than a lot of the mindfulness work, just within the last few years has shown this is a slide from Tania Singer's work and Olga Klimecki's work, showing that in a limbic system, compassion training can also very, very quickly shift the way we react to others. So, normally we're wired into others like you see somebody in the subway and you kind of go, oh they were looking at me. And you can see why that would work if your fellow deer was getting chased by a lion, you would want to know it. So we have a kind of basic connection to others. But that can be as upsetting as it is validating. And if we if we mindlessly react to negative things that other people are experiencing, then we get negative. They're negative, we're negative. It's called social contagion, and that could be a real sign of burnout and it can be kind of traumatizing vicariously.

The training will actually shift the way the brain works so that people spend much more time in this proactive mode of compassion, which is the one that we want, where we're more connected to others. We know where safe, but we feel we're caring about the other person's suffering. What can I do for you. We feel ready to engage and we feel more connected and more sociable? And actually, really, here's the kicker, a beautiful study done by Wang at [inaudible] lab showing that there's a very strong connection between the executive system, which is thinking about how we can help the other person in compassion training and the internal reward system, the nucleus comments which is one of the parts of the internal reward system in the limbic brain.

So essentially, this explains why I'm feeling good and I want to help. I'm getting ready to help when I practice compassion. That's the mode that is actually not only doesn't cost us but actually rejuvenates us. And if you look at the positive psychology research, this is the thing that really allows us to live well with others and thrive, heal quicker higher quality of life and so on. Even with the basic embodied practices. So let me just go back briefly. So what this shows is that we've got these two modes here, right? So, we've got the mode of self-protective enclosure that's reactive aversion. We got the mode of social engagement where I

feel safe enough to really emotionally be open to you. So that kind of tipping point or optionality is present in our emotional brain as well. And then even in the brainstem, it turns out we have these, what Stephen Porges calls, the brainstem social engagement system, which hopefully he will explain to you in his talk. But this very old part of our brainstem grew when we became mammals to help us support a new branch of the coming nerve the vagal; that we call the smart vagal nerve or the myelinated vagal nerve that allows us to consciously breathe and helps us to stay connected to others whenever we hear friendly faces [sic] or feel that we're having cues of safety.

So the break from social engagement system seems to be involved in our integrating and affecting the autonomic nervous system. And it turns out that people who practice intensive breath meditations like Kundalini practices, for example, or Tummo in the Tibetan tradition, actually, use this neural part of the vagal they're probably to stimulate an unusual state of mixed autonomic arousal where you you're not so calm, you're aroused, but in a totally pleasant even blissful way. So it's kind of like a flow state. Very interesting practice, which we can really go into. But it does show that the social part of the brain of the smart vagal nervous system grows. And some of these embodied awareness practices, like non-dual awareness, helps to really even grow gray cells there. So we're assuming that that has something to do with the extra use of the fearless immobilization system where the breaks down social education system is essentially telling our older frightened little reptile, "Calm down. I'm with friends. I'm connecting. So let's be fearless and play or help or connect on the very deepest level we can."

Okay. So, wow, this is amazing that neuroplasticity has allowed us to not just you see that the brain really want the mind really might matter to the brain, but also allowed us to connect with stress and meditation to help us understand kind of what we're up against and how we need to face the challenge of stress and our negativity bias. It's really put the mind back on the map in modern science as a key causal factor in brain structure and function and as a critical variable in shaping our responses to lived experience. So living great is an intelligent interface. I'm not going to go into this in great depth, but you see the mark the brain is connecting us to the upper realm to our mental experience, to what we can consciously be aware of on the sort of subliminal realm, connecting us intuitively to the natural world, our social interactions with others, and then even in the visceral realm, our internal perception homeostasis connecting us to how our organs are doing, how body is doing. And all of that is mixed with the mind and our attention. How we are experiencing all of these things, how interpreting them, and how we're choosing to respond to them.

So, this has led us, really, to a whole new way of approaching the mind that's kind of multidisciplinary science. That's like that Freud and Bowman [phonetic] brother envisioned. Here is sort of my take on that. I've put it in the context of a mandala, but you see at the heart of the thing this phenomenology which means how attending to my lived experience, which is

really kind of a Western word for contemplative awareness or mindfulness, and the other side of that is self-regulation. And that allows us, if we understand how that's impacting on neurobiology. It's impacting our health. It makes us more prepared to be educable, or to learn, makes us more prepared to connect with others sociologically, or be ethical in our concerns for ourselves and others. And it allows us to understand ourselves better and communicate better. So it's really powerful. These practices are like at the heart of this whole new approach rather than putting the mind off in some vague place and there's a lot of people interested in this, Bruce McEwen in this picture. He actually shared it with me his Holiness, the Dalai Lama and his translator or dialogue Richard Davidson and Bruce and another colleague so these kinds of dialogues are really happening, and they're very excited.

So contemplative psychotherapy, the first multidisciplinary science of mind. So psychotherapy is a weird bird in Western science. It's kind of not as concerned with the body or with mechanics. It's more concerned with the person, but it sits within the world of medicine and neuroscience and developmental psychology. So, it's actually really a natural place for contemplative science or contemplative practice to bridge with. There's a lot of people, Dan Siegel, Roman Droid, Richard Davidson, who really consider neuroplasticity is going to the basis for a whole new approach to health and well-being and that the integrative structures that allow us to be well and connect with others could be trained and likewise that the practices that work for that include contemplative practices of various kinds.

So, all cultures have contemplative practices. Why is there so much interest in the contemplative practices: mindfulness, compassion training bio-techniques? Well, for one thing, Buddhism in particular has a very unique kind of affinity for psychotherapy in particular. So, I've looked here at Buddhism and psychotherapy and talked about the way in which they have some similar assumptions about the world that there's a developmental causality and a kind of evolutionary of ton course of understanding life, understanding the nature and development, and that the art of healing has to be a kind of human connection, right. So, they have that similar approach as well as they had these differences, which is obviously that Buddhist psychology is focused much more spiritual transformation and simply healing. Although healing and spiritual transformation are really considered to be inseparable in Buddhism in a way. The ultimate health is ultimate spiritual integration. Of course, they have a different approach to evolution, which is more Lamarckian, which is more in the direction of the inheritance of acquired characteristics that you become what you do. Where is the Western Darwinian approach is more like, survival. Nature selected you to become what you what you are. But in psychotherapy, of course, that's with a generational transmission. We're leaning more and more and even Freud and Jung lean more toward understanding the importance, our habit patterns and importance of the way we were nurture the habit patterns that the people have we learned from the people around us.

There are other differences not so relevant. Key point here is just that these are sister disciplines I think, you know, they're very far removed in space and time so there from complete different parts of the history. But there are key elements. And, of course, Buddhist psychology isn't just mindfulness psychology. There are other forms of Buddhist psychology just like Western psychotherapy isn't just like psychoanalysis. So I did my work, that I referred to some chapters from our advances in contemplative psychotherapy, I talked about some of the key disciplines that we have to look at to understand how these traditions, how we can help these traditions, dialogue and mutually fertilize one another or come together, including neuropsychology. But we'll have to understand the traditional science and practice of meditation. We have to understand neuroscience, obviously. And then we have to build them within the practice of therapy if we're going to do that integration.

And remember that each of side of the confluence that we're talking about is complicated. So, we have the mind, the heart, and the body. These are like the three levels that I've been talking about. They represent the neocortex, the limbic brain, and the brainstem. And we have different forms of psychology and practice that seem to be touching on all of them, including different kinds of psychotherapy. Interpersonal therapy, much more heart-centered compared to psychoanalytic therapy, which is more insight-focused. Transformational therapies like ADP and so on, we'll talk a little bit about that part much more, are body-centered, so you got these different approaches; mindfulness-based approaches, compassion-based approaches and contemplative therapy.

I'm just going to show you how does mindfulness work. Well it creates a space in or processing. It creates a gap, some people call about, we slow the mind down. We can see our impulses are habit patterns at work, and hence we can intervene with wiser assessments and responses and look, guess what? It looks like it actually works. Integrate mindfulness into cognitive therapy, and we show we have a technique that works much better for a number of different things, including stopping the ruminations that lead to relapse and depression. Guilty or frightened negative ruminations, essentially probably acting on the default mode network in some way, right? So, really does work and works on major depression. It's more effective than anti-depressants in preventing relapse, a very powerful little of boost for the mind. That's just, that study that shows the effectiveness. There's another approach called dialectal behavior therapy, which includes not just mindfulness but also emotional intelligence. And it's really actually, in a way a lot closer to Buddhist learning because it uses group learning a lot, and it actually helped us deal with the self-injurious behavior and self-destructiveness that happens in many trauma survivors. But also is extremely effective at working with PTSD.

So, this is far more effective, this kind of Zen-inspired approach, far more effective than conventional psychotherapy because it brings in these in tools of awareness and compassionate emotional retraining. And it works even in older folks, addictions, it has a variety of different applications. Compassion training is also key. We have to accept who we

are, the most important thing, before we can be compassionate to others, and that helps us feel safe. And then we can start to have a surplus to engage with others in positive way. And it turns out that self-compassion really is helpful. It's powerful in decreasing PTSD symptoms. It helps promote resilience and well-being. A lot of these studies really show depression and so on. Maybe even some physical markers, like hemoglobin-A1C, are impacted by this kind of practice. It's just a model of how self-compassion helps change negative affect into positive and make us more resilient and also more responsive to others.

Paul Gilbert developed a compassion-focused therapy, which also operates in a similar way trains people using Tibetan practices to change the reactivity to their own minds, and then hence be less self-attacking, or self-critical and be more present and to connect with others essentially. It seems to be working well, on a variety of problems, including anorexia, bulimia. But depression and isolation are extremely responsive to this kind of approach, as you could imagine some people use it with personality disorders. So, it really seems to sort of have an impact. This is part of his theoretical framework for how it helps. But essentially, he's really talking about how it helps promote the soothing system and hence helps us balance the threat in the drive system, which we could see as connected to our three principles of using the neocortex to calm the emotional brain, which is the drive system, and to help transform the threat system into a thriving system.

Now embodied practices where meditation and meditative psychotherapy most connect with yoga, and the idea is we have these top-down approached using imagery. We're trying to re envision our sense of ourselves because their self habit are habitual perception of ourselves is the kind of most limiting pattern that we have as people. And if we haven't met a small worst-case, negative perception of ourselves, which kind of evolutionarily we must because we are negatively biased, we want to be prepared for the worst, including the worst news about ourselves. If we expand that with a hero image and expend our normal default-mode story—poor me, they don't like me, nobody loves me, everybody hates me—then we can really supplant that with a heroic narrative of well, I have this potential and I really care. So maybe I can actually make a difference and connect with the world. Then we can, when we sort of do that top that work to kind of calm our fundamental inner animal if you will. To make our inner reptile, a happy reptile or friendly or curious reptile, then we can also work from the body up, using intensive posture and breath control to give the messages through the vagal nerve and through our chemistry to our brainstem that our body really is safe. So, it's okay to really let go of almost those autonomic defenses and this can extremely beneficial with trauma.

Because remember what we talked about we mentioned Bessel van der Kolk is how important, dissociated or implicit, like nonverbal, very early experiences deeply emotional experiences stored in the old reports to the brain, how important they are in trauma. So, these practices can really help us connect with those. It really seems to turn out that the top-

down and bottom-up practices together can help us really transform the way our nervous system is operating at the very deepest levels and help us work through traumatic patterns and survival reflexes.

And there's some work that I've done with a program that in some context I would call compassion based resilience training in therapy context I will refer to it as a body contemplative trauma recovery. This is a practice using these all these together: mindfulness, compassion. But then changing your self-image, changing your energy and your movement patterns are a way of being in your body, and it seems to really have an impact on post cancer patients increasing their capacity to function well, or their well-being, boosting mental health, normalizing cortisol and heart rate from a kind of stress reactive mode, and most importantly reducing traumatic flashbacks and avoidance, so there's two studies that show that this really helped reduce trauma symptoms in a pretty significant way. And there are other studies that show breath work and so on have similar impact.

Here's the graph from the last study that showed the decreased intrusive thoughts after ten weeks of this body embodied contemplative trauma recovery. So, yeah, so we have these different practices that work on our different parts of the nervous system. And they helped the balance of our networks from the self-enclosing mode to the socially engage mode and what we get out of that of the qualities of presence, resonance, and resilience. So that's the way you think about contemplative psychotherapy. Finally, when just say very brief few words about where else this new evolution in going in health education and business.

Psychotherapy was the first kind of western discipline, I think, to really take this up, but obviously people are paying attention and we're seeing their health impacts not just mental health impacts and also obviously stress and learning, or plasticity, are important to everything we do, including education and business.

So we learned that actually the stress responses that affect us generally don't just affect our mind and nervous system, but they affect our whole body. And so many of the diseases of civilization so-called—addiction, heart disease, obesity, diabetes, cancer—actually really maybe very highly related to stress and know that these impacts of stress psychology don't just live in our minds. But they actually impact all the way down toward genomes, our whole body. And that's partly through the transmission that the neural network of the fight-or-flight/faint-or-freeze reflexes sympathetic in the parasympathetic parts of our autonomic nervous system. They kind of give the message about how we think we're doing to our whole body. And what happens there, of course, is that if we feel stressed, it changes the way our metabolism works. We have inflammatory cytokines, atherosclerosis, and metabolic disease. There are all kinds of syndromes that seemed very, very sensitive to stress and that decrease our immunity, make us more vulnerable to cancer, to infections, and even perceived social isolation. There's a very elegant study by Steve Cole showing that even

perceived social isolation changes the way the genes are read. This is called epigenetics. The genes could be read based on what we perceived to be the situation we're in.

So, if we perceive ourselves as alone and threatened, we're going to shift to what's going pro-inflammatory mode of our immune system, which would prepare us for battle. It would work well in battle if we have a cut or something. But it won't work if we have infection or cancer. But most of time we're not in battle. So this is really archaic a reflex that's very bad for our health. It actually makes us more prone to tumorigenesis, the rise of tumors. This is something I worked with a lot in the press center at Cornell and even actually wears down the telomeres, which are the little tails on the end of our of our chromosomes that keep them together and help keep cells healthy. So, under stress, people have less of an enzyme called telomerase, and hence the ends of chromosomes fray and the cells don't we produce properly. So, there we go. This is really bad news.

But here's the good news! Long-term meditators can actually integrate the whole brain and including autonomic nervous system and including even down to the epigenetic level, it turns out that our brains are more efficient as a whole when we practice. All parts of our brain can get tuned in to a well-being network and integrated it that way and that we can actually mix our autonomic arousal in such a way, as I mentioned, that we're in a kind of a flow state of arousal. We can have clean energy in our brainstem rather than the dirty energy of stress. We can actually also reverse the pro-inflammatory shift. Long-term meditators in as little as, I think, a three-hour meditation, were able to shift out of pro-inflammatory mode in their immune system into cellular immunity mode, which is what we really need. And even the study from [phonetic: Kallimon?] an elegant study on also there's elegant study from Epel, who worked with Elizabeth Blackburn about showing that mindfulness helps protect our chromosomes, be increasing telomerase and keeping them well together. So medicine is really getting it. That stress is not fluffy and that are even our perceived stress. Even the way our mind experiences or lives in stress is fundamental. So, there are inroads clearly in to bring Michael's into different of meditative practices as and I work in a lot of cancer care. But there are many other approaches.

Educators are getting interested, obviously, because we understand the signs of stress blocks learning and plasticity and promote learning on. So, they're really turning to mindfulness, compassion, and embodied methods to enhance attention, empathy and embody social engagements of presence in the classroom. And we know stress impacts our students, ruins a lot of their potential to learn well, and it impacts us as parents or educators. We're all stuck in this digital overload realm. But we also have the mindfulness, compassion, breath and movement, promote attention and learning. So recent studies really powerfully suggest that and some arguments as that is in the study from [phonetic: sample] that mindfulness, compassion really need to be integrated in schools in a more systematic way.

And that might include yoga and breath work because of how that impacts the body and finally we're going to look a little bit about work life, right? So essentially the modern approach from the modern enlightenment era is the thing that really gets us through its stress and grit, competitiveness is what work. Stress is good, and all these qualities that we're discussing, like mindfulness, compassion, they just make us weak and losers. We now really beginning to understand that daily stress impairs performance. That survival-based moods like envy, greed, rage, hijacker function and obviously undermine our ability to work together or persistently. It leads to burnout as we may have fleeting bursts of performance, but long-term burnout and loss of talent.

And on the other hand, things like self-awareness, authentic engagement, and fearless embodiment really allow us to sustain performance in an organic and clean way. And hence there's a number of studies that it really promoting this and I do some work in this area as well. Mindfulness really helps boost attention, emotional intelligence and present tiers and people feeling ready to be at work, to reconnect and have fun. It boosts problem solving, innovation and corrects for the negativity bites that comes into business like, "No, I don't want to take a risk. I don't want to change; I'm going to lose everything." Self-compassion is important for dealing with the inner critic, which gets in our way in terms of our work. Compassion helps us give and take in an easy way out of the work of Adam Grant really was powerfully effective in this and bottom of practice again helps us sustain that athletic quality of flow that we need to have a clean energy or playful approach to our work environment. So here, and we come back to the same qualities and the same strategy for cultivating health and well-being in the workplace.

So that's my take. And I hope you've enjoyed, and I'm just going to try to come back to say a warm goodbye to you. So, yes. Thank you so much for bearing with me through this talk. And I hope you got a perspective on how important and promising this area is, how neuroplasticity has really become like the catalyst that's opened a whole new approach to the mind and led to this powerful urgency or understanding that contemplative practices need to be integrated into many areas of our lives in order to really promote well-being and learning and creativity. So, you have some wonderful things lying ahead of you in this in this conference, including talks from many of the people that I touched on in this review. And I hope you definitely enjoy it. It has been an honor and a privilege to share this time with you.