Shrink Rap Radio #274 October 9th, 2011 "The Secret Lives of the Brain"
David Van Nuys Ph.d."Dr. Dave" interviews David Eagleman

Introduction: Do you really know why you do the things that you do? You probably think that you do. I think most of us think that or at least that's how we behave most of the time. Even though we have heard that Freud had this notion of unconscious motivation. In fact he gave the illustration of an iceberg that only maybe 5 percent is above the surface and the remaining 95 percent is below the surface of consciousness in this case. And even though he was trained as a neurologist, he didn't really have the tools that exist today. For example, he didn't have the FMRI or functional magnetic resonance imaging machine. So maybe you think you know why you do the things you do or maybe you think that the whole business about the unconscious is just for people with emotional problems. Well, today's guest offers a much expanded view of the unconscious using the modern tools that are available today. My guest is brain scientist David Eagleman Ph.d and he holds joint appointments under the Departments of Neuroscience and Psychiatry at the Baylor College of Medicine in Houston, Texas. Dr. Eagleman's areas of research include time perception, vision, synesthesia, and the intersection of neuroscience and the legal system. He directs the laboratory for perception and action and is the founder and director of Baylor College of Medicine's "Initiative on Neuroscience and the Law". Now I got onto Dr. Eagleman as the result of a fascinating profile of the man and his work in the New Yorker magazine. Which led me to his newly released book, "Incognito: The Secret Lives of the Brain". I feel fortunate to been able to speak to this very busy and prolific scientist. Now here is our conversation.

Dr. Dave: Dr. David Eagleman, welcome to Shrink Rap Radio.

Eagleman: Thank you, good to be here.

Dr. Dave: Well, I am so pleased to have this opportunity to speak with you. I enjoyed your interview with Terry Gross, the profile of you and of your work in the New Yorker, and so I'm really pleased to be able to grab a bit of your time. And I've been reading your rather wonderful book, "Incognito: The Secret Lives of the Brain". So what do you mean by the 'secret lives of the brain'.

Eagleman: Well, it turns out that pretty much everything your brain is doing is running under the hood of conscious awareness; your brain is constantly performing these tremendously complex operations that you have no access to or no acquaintance with so you know, when you do something really simple like pick up a telephone to your ear, it's underpinned by a lightening storm of neural activity but you don't detect any of that and if it weren't for biology, we wouldn't even have any reason to suspect the existence of muscles or nerves or electrical signals because it's all totally invisible to us and of course it's not just motor acts like picking up the telephone, but it's recognizing a friends face or falling in love or making any of the decisions we do or the beliefs we have or the actions we chose to make. All of these things are underpinned by these massive operations that we are just not aware of. All we ever receive is the sort of end product and this is what we think of as the conscious mind but the conscious mind it turns out is the smallest bit of what is happening. . .

Dr. Dave: . . . didn't Freud . . .

Eagleman: . . . in the brain . . .

Dr. Dave: . . .yeah, didn't Freud say something very similar to that, that we're mostly unaware of the processes that drive us?

Eagleman: Exactly right. You know, I went back and I did a historical analysis. Freud is really the first person to nail this and get this idea right. There are little hints about the unconscious starting from even St. Augustine who realized that he had sort of a full model of how humans act and with their rational behavior but he realized there was a little flaw in his model when people would do things like laugh suddenly at a joke or sneeze or hiccup or something he couldn't quite explain in his model. And so he started suspecting something but then the idea kind of got dropped for many decades and then it got picked up sort of every hundred years. Somebody started to suspecting that maybe in order to understand human behavior, we'd have to imagine that there is a part we don't have access to but Freud was really the first person to nail that idea and he was right. He of course lived before the blossoming of modern neuroscience so we know a lot more now about the details and the possibilities there. He was only able to speculate on things. Of course many particular ideas he had about what the subconscious represented, many of those have fallen out of favor. I my view of it, I just I find it so weird, it's essentially that the subconscious speaks a completely alien kind of programming language that wouldn't make sense to us even if we could understand it. As opposed to the view that the subconscious is speaking some sort of language that we get but it's speaking in metaphors or something. It really seems like it's, it's just a completely foreign thing going on down there. I like to think that in some ways it's analogous to what happens with, let's say, with the quantum mechanics which is the physics of what happens at the very small level, the subatomic scale.

Dr. Dave: Yeah, well, there are different levels as you are alluding to and I think that one level may be suitable for one kind of understanding or explanation and another level for another because I know there is a section in your book on reductionism and that'll probably take us way off in a direction that we don't need to go right

now.

Eagleman: Okay. But that is exactly right. There are different levels. It turns out that the fabric of reality that we come to understand either in physics or in neuroscience, can be very distant and in some sense not even related to the sort of reality that we experience at our spatial-temporal scales where we care about, apples and rabbits and mates and rivers, that's all we really have evolved to care about but it turns out that all the underling stuff that makes that true is totally different language.

Dr. Dave: Yes, and your book is so rich with examples of that and one that I particularly loved was the example of the men who looked at photos of women and were asked to choose the prettiest ones. Maybe you can tell us about that experiment.

Eagleman: Yes, so men were looking at these 8 x 10 photographs of women's faces and what they didn't know was that there were two sets of photographs that had the same women in them but in ones that the women's eyes had been dilated. And it turns out that the men were uniformly more attracted to the women with dilated eyes. And the interesting part is that the men, none of them identified that, none of them said, oh, I noticed her pupils were larger over here, but more importantly, none of the men had any conscious access to this issue that dilated eyes is a sign of sexual readiness in women. So their brains were picking up on the signals loud and clear and driving their behavior and making them think that these women were more attractive. Their brains were running these deeply imbedded evolutionary programs that drove the men towards the right sort of behavior but the men, the conscious men had no access to what was going on, they just felt more attracted over here.

Dr. Dave: Yeah, I thought that was just a wonderful demonstration of what you're talking about. Most of us think our senses are a window

to the real world, to the world outside ourselves. But that is not exactly the case, is it?

Eagleman: That's exactly right. When we start deconstructing what's going on out there, it comes clear that everything you -- take vision. It's a construction of the brain, I mean, your brain is ensconced in darkness, inside of your scull and all it ever sees are electrical signals. And of course, the electrical signals that it sees that represent the information coming in through your eyes, is the same electrical signals that you have coming in from your ears, your fingertips, or any other part. And your brain has to take these signals and depending on their different features and so on, it constructs vision or hearing or so on but it's all an internal model of what you believe you're seeing out there. Just as one example, that I think illustrates it usually is take the fact that your eyes are constantly jumping around the scene and yet your vision doesn't feel the way it does when somebody is holding a jerky video camera, right? I mean, if somebody were moving the video camera around the way your eyes actually move, you'd barf. So the reason that our visual world doesn't appear to be moving around, is because all we're actually seeing is an internal model of what we believe is out there and we're just updating that model with different information depending on where we are casting our central vision and collecting more information. But you don't need your eyes at all to see of course, when you're dreaming, and your eyes are closed, you're having full, rich visual experience and what this illustrates is that it's not even about the eyes. When your eyes open, you're pulling in data through these 2 holes in your skull and you're updating your model a little bit better, but it's essentially the same process as awake dreaming.

Dr. Dave: You know, your observation that the brain is encased in darkness within the skull seems so obvious and basic but I have to say, I never thought of it that way before.

Eagleman: (laughs) Yeah.

Dr. Dave: So that's kind of interesting. And you also say that vision's job is to create a useful narrative at our scale of interaction.

Eagleman: That's exactly right. That's all it's trying to do. This is proposed to be the basis of why we have consciousness and memory is simply to upgrade predictions so the whole key is we want to be better prepared the next time we come across a situation and so we have all these mechanisms that sort of take their time and write down a story and tell us what they think just happened out there so that we'll be better prepared the next time. Now we come around to it but it turns out that it's not necessarily the correct story and of course we know that memory is quite fallible.

Dr. Dave: Yes.

Eagleman: Yeah, but . . .

Dr. Dave: . . . yeah and also it may not really be the current story because you say we're living in the past because it actually takes time for our senses to send their messages to the brain and some senses are further away than others and so there are sort of these different time frames.

Eagleman: Exactly. This is what my lab discovered over the last 11 years or so is this really deep problem that information gets to the brain at different speeds through different senses and it's processed very differently. Your visual system has a very different architecture than your auditory system for example. And a signal from your big toe arrives at your brain much later than a signal from your nose. And so it turns out that the challenge the brain has to deal with is it's trying to put together this narrative about what the heck is going on in the outside world and yet the problem it's confronted with is that the

signals are streaming at very different times and so the only solution is-- this is what we've figured out over the last decade-- the only solution is that your brain has to wait and collect up all the information and then stitch together a story about what it thinks it just saw and the consequence is that you're living in the past. By the time you believe the moment now occurs, it's already happened a long time ago.

Dr. Dave: Yeah. One of my listeners just so happens coincidentally yesterday, sent me an email saying he was asking various people the question, "what is consciousness?" And I just read your book and I think, oh, what did Eagleman say? I didn't quite remember, I had to come up with my own but what is consciousness?

Eagleman: (laughs) Well, people debate a lot about the definition but I think it's easy to understand that it's the thing that flickers to life when you wake up in the morning. So your brain is the same when you're in a deep sleep and when you're awake in the morning but there's some different algorithms, some different software program that running that makes you conscious now and not conscious in the middle of the night. So that's what we're talking about is that bit, that bit of having experience, private subjective experience that's going on. That's what we mean by consciousness. And . . .

Dr. Dave: . . .and what the role of consciousness?

Eagleman: Well, I think that consciousness is essentially like the CEO of a company. So once a company reaches sufficient complexity, it needs a CEO to organize things and that's seems to be the job of consciousness. In a same way that a CEO doesn't know about all the details of how this department actually runs and where the sockets are in the cubicles, and who's doing what and how they're getting paid, the CEO doesn't want to know about all that. In the same way you don't want to know about the lightening storm of neural activity when

you pick up the telephone. You just want to know that its worked. The CEO also sets the long-terms goals for the company and says okay, look, here's where I think our company needs to go over the next 5 years and the CEO passes that mandate and then all the rest of the machinery of the company adjusts itself to match that goal. And it takes time. But of course this is what we do. If you say that you decide you want to be a better tennis player and you hire a coach so the coach tells you all this advice like okay, step forward into the serve and grip your racket lower and so on, so consciously the CEO, the conscious you says okay, step forward, grip the racket lower and so on and you do that a bunch of times and what you are doing is you're training up the rest of the machinery of your unconscious brain, your training all that up you're forcing it to meet that goal and it eventually becomes good at it, it becomes automatized and then you no longer even have conscious access to it. You don't know how you are hitting the tennis ball, you're just doing it. And it's the same way that the CEO set the long-term goals and the rest of the company adjusts and all the CEO ever really wants is to high-level summary, headlines of how things are going.

Dr. Dave: Yes, I guest that's what you meant when you wrote that consciousness is useful in limited amounts and so it really doesn't serve us to be aware of everything down to the most minute levels and to automatize as much as can be made automatic as is useful. And also, it's interesting to reflect that how much is going on around us that our senses don't even pick up on. For example, we're both probably bathed in radio waves and TV waves and gamma radiation and who know what else and that's not even fitting into the picture of our internal experience.

Eagleman: Exactly right. So all that stuff, the radio waves, TV and cell phone all that, is electromagnetic radiation which is exactly what visible light is. What we call visible light is just a very small slice of that spectrum of electromagnetic radiation but it just so happens

that we have biological receptors that can detect that stuff so that we treat that very especially and we think that represents reality. But as it turns out, the part of the spectrum that we call visible light, is only one 10 billionth of the spectrum. So most of the stuff happening we don't have biological receptors for and so we would have no reason to even suspect its existence if it weren't for building of machines and the understanding of physics and so on.

Dr. Dave: Okay, well, talking about a consciousness, were does attention fit in? There's some kind of tight relationship there I think between consciousness and attention. How would you describe that?

Eagleman: I think what attention is is this thing that pulls more detail into your internal model.

Dr. Dave: Um humm

Eagleman: For example, let's say you are looking at a scene in front of you, you're not actually seeing most of the details even though they're sitting right on your retina. But if I were to ask you, okay, what exactly is the color of your coffee mug? Then you can turn your eyes to that and attention is the process of saying, okay, I'm going to now pull that detail into my internal model even though it wasn't there a moment ago. But similarly, if I were to ask you the position of your tongue in your mouth right now, you could answer that question but you weren't aware of it a moment ago. You attend to it, you pay attention to it and that's how it becomes part of what your aware of .

Dr. Dave: . . .and now I'm gagging on my tongue.

Eagleman: (laughs)

Dr. Dave: Once I become aware of it. (laughs)

Eagleman: Exactly. Well, then I won't talk about blinking or breathing, because that would be terrible.
Dr. Dave: Right.

Eagleman: But it turns out that, when the company is running itself perfectly, the CEO doesn't need to know anything. If the CEO has everything set up so things are going perfectly, you don't need any action out of the CEO. In other words, when you're driving to work, it's just a normal morning, you're essentially not very conscious of what's going on. Because you don't need to be. And what happens is it's only when there's a violation of your expectations, that attention comes online and feeds information to consciousness. So it's only when suddenly something's different, or there's an overturned car in front of you or something, then suddenly, your attending to that because it's a violation of your expectations and you have conscious awareness of that situation.

Dr. Dave: What's the relationship between attention and memory?

Eagleman: Interesting question. It turns out there's at least two different forms of memory. And so normal memory is a function of what you're attending to so it is possible to get stuff into the system without even attending to it but that's sort of a rare, more rare thing that happens. Normally, what you remember are the things you'd paid attention to. If you didn't pay attention to the number of cracks in the sidewalk this morning, then it's unlikely you're going to have any memory of that. But it turns out that when something is really salient, really emotionally salient, let's say a car accident. Then you are attending to that with a completely different level of focus and there's another part of your brain that comes online and lays down memory on a secondary memory tract. And this is the amygdala comes online and you're essentially laying down memories on a different way that are unerasable. So these are the memories of post traumatic stress . .

Dr. Dave: . . .um hmmm

Eagleman: , , , disorder . . .

Dr. Dave: . . . right, right . . .

Eagleman: . . .yeah

Dr. Dave: And what about meditation and mindfulness as tools for developing more awareness of some of these underlying processes?

Eagleman: Well, I'm a big proponent of meditation and mindfulness. I've noticed in the literature and even in discussion that no one has ever has anything bad to say about these things. So I think that . . .

Dr. Dave: . . .right . .

Eagleman: You know, everything else is debated, right? Should you have carbs or protein or not but not meditation or mindfulness. These seem to be just really good things and in fact [undecipherable name] in Germany is trying to get legislation passed to make meditation mandatory for all elementary school students.

Dr. Dave: Um hmm

Eagleman: Because he argues that it's an important part of the brain tool kit and you don't get a user's guide to your brain but in fact especially in this era, everybody's trying to get your attention with advertising in the Internet, text messages, and so on and here is what children need more than ever now is a way of just being able to turn inward and not be so reactive to the outside world. And this is what meditation gives you is an ability to sort of see the outside world but not be as reactive to it. Every time a text message dings it changes

your trajectory for the next minute. So now that said, I do think that even people who are expert meditators, they're getting slightly down deeper into their unconscious but I don't think it's very far at all. I think it's essentially just dipping their toes into the water. They're doing it a lot better than the rest of us but in fact these are such vast waters and deep caverns that I think they are not actually getting that far because as I said at the beginning, I don't actually think that we would understand the language down there.

Dr. Dave: Yes. Now, one of the things that you spend a fair amount of time on is the idea of multiple selves that were again going back to the subtitle of the book "the secret lives of the brain" that there are sort of autonomous subsystems and subroutines that are running sort of beneath the surface of consciousness and I'm just wondering about the possible relationship to things like multiple personality, automatic writing, channeled personality, some of that far-out stuff.

Eagleman: Yeah, I mean, the interesting part about the multiple selves is that the only way to really think about the brain is to think about; you got these competing networks that are always battling out in the brain to control your behavior. And this is because evolution doesn't sort of come up with one solution and stop there but she's constantly, chronically, reinventing solutions to things. And so it turns out that you end up with all these different parts of your brain and it's just like a neuro parliament where you have different political parties that are fighting it out to control the ship of state, to steer where things are going. And you don't have any central leader that makes these decisions about the parliament and instead they debate and until they come to some sort of solution. And so as a result, people can argue with themselves, and feel conflicted with themselves, and contract with themselves, cajole themselves, and I think this gives us a much more nuanced view of who we are when you realize that you are not one thing you're more like a multiplicity and some of those people who got back on their behavior and they think, how did I, how

could I have been the one to do that? Well, the answer is you are not one thing. As Walt Whitman correctly surmised, he said, "I am large, I contain multitudes" and that's exactly right.

Dr. Dave: Well, there are people who report for example, writing whole books that they claim it really wasn't them, it just came through them. Do you think there might be some kind of a subsystem that spun off . . . ?

Eagleman: . . .yeah . . .

Dr. Dave: . . .that it's coming from . . .?

Eagleman: I mean, so okay here's what I think. I think it's a little bit of an exaggeration when people say they wrote things without having any part of themselves in them. But it is the case that all of our ideas are served up from the subterranean caverns and we don't know where these ideas come from, right? So pay attention to your next time you have a good idea and you say, oh, I'm a genius, I just had an idea that I'll invite so-and-so to be on my show. Well, it wasn't really you that thought of it, right? Your brain has been working on this for hours or weeks or months, it's been consolidating information, you've seen that speaker before, at some point, your brain puts it together and serves it up and then you take credit for it. But it's not clear who the credit actually belongs to. It belongs to you as a person with a brain, but it doesn't necessarily belong to your conscious mind.

Dr. Dave: Right. I totally identify with that. What do we learn from the example of Charles Whitman the former Eagle scout and high IQ. bank teller who shot and killed 48 people from the University of Texas tower in Austin.

Eagleman: Well, he had detected that things were changing inside of him for about a year. He was writing in his diary about this,

he went to see a psychiatrist about this, he felt like something was changing inside of him. And he wrote in his suicide note the night before, the night before he went up on the Texas tower and shot everybody, he said when this is all over, I want an autopsy to be performed. And that is exactly what happened and it turned out that he had a brain tumor. The brain tumor had been growing and pressing against the part of his brain called the amygdala which is involved in fear and aggression. And so we, there are hundreds of cases like this. It turns out of course, when your brain changes, you change and if you get a brain tumor which is of course the not something you choose, any of us would choose to get, that can change your behavior and it leaves a strain part of these very deep questions about culpability, right?

Dr. Dave: Yes.

Eagleman: Because Whitman didn't choose to get a brain tumor and yet this is what happened. And of course Whitman is not a one-off example. There's so many I state another case in my book also about this guy who at 40 years old started becoming a pedophile. And started collecting child pornography and he eventually made an inappropriate move on his prepubescent step-daughter and his wife had him arrested. And the night before his sentencing, he was having these terrible headaches and he finally went to get a scan and turned out he had a massive frontal lobe tumor. So they did an emergency surgery on him and they removed the tumor and his sexual behavior returned completely to normal. And then about 6 months later, he started becoming a pedophile again. And he went back to the neurologist and it turns out the surgeons had missed a section of the tumor which was now regrowing and they resecting the tumor a second time and then his behavior returned completely to normal. So this is just another illustration of hundreds that you are your brain and the reason that this becomes so difficult about these issues of culpability, is because we are naturally very rettributive, we say, okay,

if you did this thing, then you deserve the punishment. But who's the 'you'? If things change in your brain, and it wasn't your choice, does it still make sense to punish you in the same way? So what I argue for in the book is a forward-looking legal system which is to say, instead of imagining that all brains are created equal, have equal capacity for decision making and so on, and therefore, it's okay to punish everybody equally instead of forward-looking legal system that takes a very different approach and says look, what do we do with the person from here, it there anything that we can do to help? And if not, how can we modulate sentencing based on future dangerousness? So in other words, you do risk assessments on people. Some people's brains are not created equal, some people are very dangerous and need to be taken off the streets for a long time. At the other end of the spectrum, some people are not very dangerous and they ended up in some situation that is very unlikely to repeat. And so a tailored customized legal system will be one in which we treat people as individuals, we try to understand what is going on with their brains, if there is anything to do to help them, and if there's not, we sentence them appropriately instead of imagining that there is sort of a one size fits all solution in terms of incarceration, of prison terms. This is not only more humane and neuro-compatible, but it's also most cost-effective.

Dr. Dave: Well, this fits in with one of the themes of the book which is essentially, that we're not driving the bus, in other words, the thing that we identify with the 'I' when I say me and you talk about things like rabies. and narcotics, and genes, and brain injuries, which you just talked about, and toxins and diseases. I particularly liked the rabies example. Maybe you could quickly touch on that.

Eagleman: Yeah, rabies is also one of my favorite examples which is ah, essentially you get bitten and the rabies virus works its way up your nerves, up into your central nervous system, up to your brain. And once it's there, it goes to a couple of different places, it goes to

your areas of your temporal lobe one of the lobes of your brain. And it also goes to your salivary glands. And what it does in your temporal lobe is that it essentially controls your behavior and makes you more aggressive and more prone to bite somebody. And its positioned itself in your salivary glands that when you bite somebody, it passes itself on. I mean this is crazy but this is how rabies gets into wild animals and passes itself to the next wild animal. And the reason its so remarkable is because what's it is doing is this very tiny little thing is controlling a creature billion of times larger than it. It's like its stepping into the cockpit and driving this creature around. I just have always found it an amazing thing. That's in the point of view of the rabies. We get to see how it jumps in the cockpit and passes itself on that way. From the point of view of us, what it makes is very obvious and clear, is that we are able to be controlled. We got out all these lock and key mechanisms in our brains and all it takes is something getting in there and then we become a very different kind of person. We become aggressive . .

Dr. Dave: Yes, its amazing. It's like the Transformers or Iron Man. Somebody gets inside there and controls very large person.

Eagleman: Exactly.

Dr. Dave: Well, I know you're short on time. You've just come off a thirty-day book tour and I know you got a lot that you are trying to catch up on. I would really love to talk to you at greater length. As we wind down here, is there anything you'd like to add?

Eagleman: Umm, well, I mean, I'd, just to finish off the neuro law thing. I think that this is one of the real directions that neuroscience is going is in navigating our social policy. I think that neuroscience is at a point where it can really, in a meaningful way, step out of the laboratory and change the way that we run our society. And there's no reason that social policy should not be run as rigorously as we do

scientific experiments were we base it on data, and every once in awhile somebody will say to me, gosh, don't you think that sounds creepy to bring science into let's say sentencing decisions? And the important question though is: compared to what?

Dr. Dave: Yes,

Eagleman: And the way it stands now, ugly people get much longer sentences than pretty people because there is all this extra-legal influences that go on. So if we brought data to the table, and saw who is actually the ones who go off and commit more crime, and understanding the biological basis of behavior, and understanding what can go wrong with people's brains and so on, and how we might help them, that seems to be a much more enlightened way to run our legal system.

Dr. Dave: Well, that certainly makes sense to me. I support it strongly. Dr. David Eagleman, I want to thank you for being my guest today on Shrink Rap Radio.

Eagleman: Thank you so much for having me.