BRAIN SCIENCE PODCAST

With Ginger Campbell, MD

Episode #75

Originally Aired 7/8/2011

Interview with Dr. David Eagleman, Author of *Incognito: The Secret Lives of the Brain*

The *Brain Science Podcast* is part of sciencepodcasters.org, the website where you can find high-quality science podcasts from a wide variety of fields.

[music]

INTRODUCTION

This is Episode 75 of the *Brain Science Podcast*, and I am your host, Dr. Ginger Campbell. You can find detailed show notes and transcripts for every episode at brainsciencepodcast.com.

Today we will be returning to a subject that we haven't explored in a while: the role of the unconscious. Modern research techniques like functional brain imaging are revealing that most of what our brain does is outside our conscious awareness; and perhaps more importantly, largely outside our conscious control.

Today's guest is Dr. David Eagleman, from Baylor University, and we will be talking to him about his new book, *Incognito: The Secret Lives of the Brain*.

The *Brain Science Podcast* is sponsored by Audible.com, the world's largest provider of audiobook downloads. If you are new to Audible, you can download *Incognito* for free by going to audiblepodcast.com/brainscience.

[music]

INTERVIEW

Dr. Campbell: My guest today is David Eagleman, who is the author of *Incognito: The Secret Lives of the Brain*. David, I want to thank you for taking the time to come on the *Brain Science Podcast*.

Dr. Eagleman: It's my pleasure, Ginger.

Dr. Campbell: Would you mind starting out by telling us just a little bit about yourself?

Dr. Eagleman: I'm a neuroscientist at Baylor College of Medicine. I run a research lab there, and what I study is how the brain constructs reality. So, I study things like time perception and vision, and I study things like synesthesia, which is where people have a mixture of the senses; so, they might see a number and it triggers a color experience, or they might hear music and see colors and textures.

The other thing my lab studies is neuroscience in the legal system. I've been very interested for many years in how modern neuroscience will change the way we make laws and think about criminal behavior and criminal punishment, and will really update the legal system.

Dr. Campbell: So, you're a little different from the average neuroscientist, who's down there in the lab working on the nitty-gritty, but not necessarily worrying about the implications of what they're learning.

Dr. Eagleman: That's right. I mean people worry about the implications to different degrees, and it is the case that sometimes, depending on the level you're studying neuroscience, there may be more or fewer implications. But yes, to my

mind, the social policy payoff has always been forefront on my mind—about how it will actually change the way we run our societies.

Dr. Campbell: Is that why you wrote your book?

Dr. Eagleman: In part. So, my latest book is called *Incognito*, and it's about all the stuff that runs under the hood—all the stuff that your brain is doing that you don't have access to, or for the most part, acquaintance with. And that's been a very interesting topic to me since I first got into neuroscience many years ago: to really get a sense of all the massive operations happening that are just totally secret to you, or invisible to you. So, every single thing you do, whether lifting a telephone to your ear or whatever, is underpinned by these lightning storms of neural activity that we can study; but we're totally unaware of those.

And it's, of course, not just lifting a phone to your ear: it's speaking language—words spill out of your mouth faster than you can even know what you're saying; it's recognizing a friend's face, or walking, or falling in love, or any of these things that are part of our behavioral repertoire. They've got massive things going on that we just don't really know about. If it weren't for neurobiology, we would have no reason to even suspect the existence of neurons, and electrical signals, and chemical diffusion, and so on. There'd be no reason to even imagine that's part of what's going on inside our head.

Dr. Campbell: And I think at some point early on in the book you describe consciousness as being like a little stowaway. So, I guess that leads to the big question of, if we aren't the boss of own minds, what does that mean for how we see ourselves?

Dr. Eagleman: Part of what the book is really about is knowing ourselves. The analogy I used was that the conscious mind—which is the part of you that flickers to life when you wake up in the morning: that bit of you—it's like a stowaway on a

transatlantic steamship, that's taking credit for the journey, without acknowledging all the engineering underfoot.

I think what this means when we're talking about knowing ourselves is exactly what it meant when people were trying to understand our place in the cosmos, 400 years ago, when Galileo discovered the moons of Jupiter and realized that, in fact, we're not at the center of things, but instead we're way out on a distant edge. That's essentially the same situation we're in, where we've fallen from the center of ourselves.

But in Galileo's case, what that caused is we now have a much more nuanced view of the cosmos. As Carl Sagan was fond of saying, it's more wondrous and subtle than we could have ever imagined. And I think it's exactly the same thing going on with the brain: we're falling from the center of the brain, but what we're discovering is that it's much more amazing than we could have ever thought when we imagined that we were the ones sort of at the center of everything and driving the boat.

Dr. Campbell: I definitely agree with you. The more I do this podcast, the more interesting things I learn. I mean it just never seems to end.

But if we're going to talk about the fact that we're not really as in control as we think, maybe we should back up and consider some of the evidence. Is vision research a good place to sort of start with looking at that?

Dr. Eagleman: Yes, actually. So, in Chapter Two of the book I spend a lot of time just sort of deconstructing reality piece by piece, and showing that, as we want to go on this journey of exploring what the heck we're made out of, the first thing to do is to recognize that what you're seeing out there is not actually reality. You're not sort of opening your eyes, and voila, there's the world. Instead, your brain constructs the world. Your brain is trapped in darkness inside of your skull,

and all it ever sees are electrical and chemical signals. So all the colors you see, and so on, that doesn't really exist; that's an interpretation by your brain.

Just take as a quick example the fact that your eyes are always moving around in these rapid darting movements; and if you did that with a handheld video camera, it would look like a drunk person holding it, and the world would look very shaky. But our world doesn't look very shaky, because all we're actually doing is seeing an internal model of the world; we're not seeing what's out there, we're seeing just our internal model of it. And that's why, when you move your eyes around, all you're doing is updating that model.

And for that matter, when you blink your eyes and there are 80 milliseconds of blackness there, you don't notice that, either. Because it's not actually about what's coming in the eyes; it's about your internal construction. And, in fact, as I mention in the book, we don't even need our eyes to see. When you are asleep and dreaming, your eyes are closed, but you're having full, rich visual experience —because it's the same process of running your visual cortex, and then you believe that you are seeing.

Dr. Campbell: And then, of course, there are people like Paul Bach-y-Rita, who showed that you can actually learn to see through other senses, if you have the right inputs.

Dr. Eagleman: That's exactly right; because all the brain ever sees are these electrical and chemical signals, and it doesn't necessarily know or care which ones are coming in through the eyes, or the ears, or the fingertips, or smell, or taste. All these things get converted just to electrical signals.

And so, it turns out what the brain is really good at—and the cortex in particular —is in extracting information that has some sort of useful correlation with things in the outside world. And so, if you feed, let's say, visual input into your ears, you

will figure out how to see through your ears. Because the brain doesn't care how it gets there; all it cares about is, *Oh, there's structure to this data that I can extract*.

Dr. Campbell: Right. Where does the role of learning and brain plasticity come in to all of this?

Dr. Eagleman: Well, that's actually the topic of my next book. My next book is called *LiveWired*. Yes, I think it's sort of the most amazing thing about the way brains are built, is they're constantly reconfiguring their own circuitry. We don't build machines that way. We don't know how to build machines that way.

And my next book is a synthesis of everything we know about plasticity. I distill it down to seven fundamental principles of plasticity, but then the last part of the book is an appeal to start building machines like that—building bio-inspired machines that can have half their circuitry ripped out and they'll still figure out how to function just fine.

I mean as it stands now, if NASA sends up a Mars Rover and its wheel falls off, then that's the end of it—that's the end of a billion dollar project. But if you look at a wolf who gets his foot caught in a trap, he can chew his foot off, and then keep going—with a limp, but he still keeps going. We don't have robots that do that just yet.

Dr. Campbell: I'll have to talk to you again when you get that book out, because brain plasticity is one of my favorite subjects. But right now I'd like to talk a little bit about the role of expectation, since it has such a strong influence even on what we perceive. Could you talk a little bit about why that is?

Dr. Eagleman: Yes. It turns out that one of the main jobs of the brain is to save energy; and the way that it does this is by predicting what is going to come next. And if it sort of has a pretty good prediction of what's happening next, then

it doesn't need to burn a lot of energy when that thing happens, because it's already foreseen it; just like the way a military tries to foresee what's happening with the enemy, so that it doesn't have to scramble all the time to catch up. It wants to sort of be ahead of the game—right?

So, the job of the brain is to figure out what's coming next; and if you have successfully done it, then there's no point in consciousness being a part of what's going on. When you're driving to work and it's a drive you've made a million times, your brain sees everything that's coming next: you're hardly conscious; it's like you're a driving zombie. But when you're having to drive somewhere new and you don't know what to expect, your brain has to burn up a lot of energy, and then you're very conscious of everything.

That's the sense in which consciousness comes online when you are not able to predict what's coming next, or when expectations are violated: that suddenly there's a roadblock in the middle of the road you drive every day to work, then your conscious mind is going to suddenly come online. You'll say, 'Hey, what's going on?'

Dr. Campbell: Yes. It's really surprising what the experiments have shown about how little we're really actually consciously aware of. It's not as much as we think!

What about the construction of time; because that's one of the places where the brain really does fool us, isn't it?

Dr. Eagleman: Yes, that's one of the main areas that my lab has been working on for the last 11 years: time perception. And it turns out that you're not passively just watching the river of time flow by. Instead, just like with visual illusions, your brain is actively constructing time.

And so, in my laboratory we can easily make you think that something lasted longer or shorter than something else, or that something came before another thing, when in fact it was really the other way around—things like that. And on this first topic of duration distortions, it turns out that that has everything to do with novelty, and with how much energy your brain has to expend.

So, when you can predict something, not only does your consciousness not come online, but it feels like it goes very fast. So, driving to work is very fast; but the very first time you did it, it seemed to take very long time. And it's because of the novelty and the amount of energy you had to burn the first time you did it—before you were able to predict it.

Essentially what prediction means, if it's something you're doing a lot, is that you're actually reconfiguring the circuitry of the brain. You're actually getting stuff down into the circuitry, which gives you speed and efficiency, but at the cost of conscious access. So, if you're learning to do something new, like play tennis or ride a bicycle or something, at first you have to pay a lot of conscious attention, and after a while you don't have to, because you've changed the circuitry of your brain—but at the cost of being able to consciously know what you're doing.

Dr. Campbell: And that brings up an important point, which is the fact that this construction of the world by our brain, it's not just our perceptions; it goes into much more complex things that we do, doesn't it.

Dr. Eagleman: Exactly. It's not only the way we see vision and time, but it's all of our cognition: it's our morals, it's what we're attracted to, it's what we believe in. All of these things are served up from these subterranean caverns of the mind. We often don't have any access to what's going on down there, and why we believe the things we do, why we act the way we do. In the book I used perception as a warm-up to the bigger issue of cognition, and how you feel, and what you believe.

Dr. Campbell: Yes. One of the ones you mention, which I've read about before, that particularly disturbs me is what you call the "illusion of truth." I think that's the one where you think something's true just because you've heard it before.

Dr. Eagleman: Yes, exactly. You give people statements to rate the truth value of, and then you bring them back a while later and you give them more statements to say whether they're true or false, and so on. But it turns out that if you repeat some of the statements from the first time to the second time, just because the people have heard them before, whether or not it's true and whether or not they even marked it as false last time, because they're hearing it again—unconsciously they know they've heard it before—they're more likely to rate it as true now.

Dr. Campbell: I was thinking about that recently when I was interviewing a doctor about vaccine safety, and I decided not to bring up a bunch of things that the anti-vaccine people say that are false, because of that effect. I decided that I would concentrate on what was true. As a physician, I'm thinking of the effects of that in trying to get accurate information out; and when you know certain false ideas are out there, you worry about, *Well, if I bring it up, am I actually making the problem worse*?

Dr. Eagleman: Yes, I agree with you. I was just noticing the other day, *USA Today* had this giant article all over the front page that said something about cell phones and cancer; and it showed a picture of a person holding a cell phone to his head. And then you read the article carefully, and all it says is that a panel of experts convened to really try to address the issue of whether cell phones present any danger, and that they concluded that there's no evidence at the moment that it does.

And that's all the article was, was that a panel had convened to discuss the issue. And so, *USA Today* does this big article. There was a question mark at the end:

"Do Cell Phones Cause Cancer?" But that's all you need to do to get it into people's heads that it's already a solved problem.

Dr. Campbell: I don't know what we do about that. Does being aware of that help any? I mean since it's going on at such a low level in our brain, I don't know…

Dr. Eagleman: No; that is exactly the only thing we can do about it, is practice critical thinking and teach that to our children. There's nothing we're going to do that changes the way that newspapers try to make money. And the way they're going to do it is by sensationalizing anything they can. I think this is part of the brain toolbox that children need: to really practice and learn skepticism and critical thinking skills.

Dr. Campbell: What about hunches?

Dr. Eagleman: Hunches represent, essentially, your brain picking up on a lot of information that your conscious mind may or may not have access to. One example that I cite in the book—it's something I saw a while ago, and I just thought it was such an interesting study [1], because of how illustrative it was—men were rating the attractiveness of women's faces in photographs. In one set of the photographs the women had dilated eyes. And the men were uniformly more attracted to the women with the dilated eyes, even though they didn't know why. In fact, they didn't even notice that that was a difference in the photos. They just felt more attracted to those photos, and rated them higher.

Well, dilated eyes is a sign of sexual readiness in a woman; and the men's brains picked up on that and knew that, but the men, themselves, didn't—their conscious mind didn't. And so, when it comes to the attractions we have, or the

---

[1] The specific study was not cited in the book but Eagleman appears to be referring to a study done by Hess, E. H. (1959) In Nebraska Symposium on Motivation, University of Nebraska Press: Lincoln, p.44-77. Click this link for a description.

hunches we have, or the feelings we have, it's often that your brain is doing useful computations, and you just don't know what they are. And so, we usually summarize this sort of thing as a hunch.

The one thing I will say that's very important, though, is that a lot of people are tempted to say that we should always trust our hunches. And in fact, I don't think there's any good reason to think that they're any more trustworthy than any other thoughts we have.

Just as an example, consider something like xenophobia. People tend to be pretty hardwired to have a fear and distrust of people who don't look like them, talk like them, and act like them. So, that's a hunch that comes out right away—an instinct that comes out. But I don't think it's one that we would say is correct, or based on much of anything except for primitive instincts that maybe we've outgrown now.

[music]

Dr. Campbell: Let's go from talking about hunches to another subject that you devote a chapter to in your book: the idea that some thoughts aren't thinkable, because of the way that thoughts are constrained by our biology; and also, we are sort of hardwired to think in certain ways. That's a great example.

Dr. Eagleman: Yes. As far as thoughts that we're not able to think, that's an idea that I just love to explore, because there's all kinds of stuff we can't see. Just as an example, if you take the electromagnetic radiation spectrum, what we call visible light is just one ten-billionth of that spectrum. So, we're only seeing a very tiny sliver of that, because we have biological receptors that are tuned to that little part of the spectrum. But radio signals, and cell phone signals, and television signals, all that stuff is going right through your body, because you happen not to have biological receptors for that part of the spectrum.

So, what that means is that there's a particular slice of the world that you can see. And what I wanted to explore in the book is that there's also a slice of the world that you can think. In other words, because of evolutionary pressures, our psychology has been carved to think certain thoughts—this is the field known as evolutionary psychology—and that means there are other thoughts that are just like the cell phone signals, and radio signals, and so on, that we can't even access.

Just as an example, try being sexually attracted to something that you're not—like a chicken or a frog. But chickens and frogs find that to be the greatest thing in the world, to look at another chicken or frog. We only find that with humans. So, different species, which have otherwise pretty similar brains, have these very specific differences about the kinds of thoughts they can think.

Dr. Campbell: But it's surprising how some of these things that are really complex, the evidence is increasingly strong that these are things that are hardwired.

Dr. Eagleman: Well, as far as nature vs. nurture goes, the answer nowadays is always both. It's sort of a dead question to ask—nature vs. nurture—because it is absolutely true that we do not come to the table as a blank slate; we have a lot of stuff that we come to the table with predisposed. But the whole rest of the process is an unpacking of the brain by world experience.

So, the way your brain ends up in the end is a very complicated tangle of genetics and environment. And environment includes, not only all of your childhood experiences and so on, but your in utero environment, toxins in the air, the things that you eat, experiences of abuse, and all of that stuff—and your culture; your culture has a lot to do with the way your brain gets wired up.

Dr. Campbell: Going back to your example of xenophobia, if you have the opportunity to spend a lot of time with people from different races and different

parts of the world, you might still have that sort of gut reaction, but you also have learned circuits that tell you that those people are OK, and you can live with them. That's really important.

Dr. Eagleman: Well, that's right; although you might still have racist parts of your brain and nonracist parts of your brain. The strange part about human behavior is that that's OK; that's compatible, it turns out.

One of the culminating issues in the book is that your brain is really like a team of rivals, where you have these different neural subpopulations that are always battling it out to control the one-output channel of your behavior; and you've got all these different networks that are fighting it out. And so, there are parts of your brain that can be xenophobic, and other parts of your brain that maybe decide to overwrite that, and they're not xenophobic. And I think this gives us a much more nuanced view, in the end, of who we are, and also who other people are.

Dr. Campbell: Talking about the brain as the team of rivals, you used the analogy of thinking of reason and emotion as two sort of competing parties that are both essential for making good decisions. I found myself wondering whether, if we think of this as rational—this is what most people tend to do; they think of it as rational vs. emotional—that does kind of oversimplify, or distort what's really going on, doesn't it.

Dr. Eagleman: Well, yes and no. You have all of these competing networks in the brain, and sometimes it's not a terrible summary to think about these as rational vs. emotional. In fact, it's more complicated than that. But when people do neuroimaging studies, you can actually find situations where it looks like you have some parts that are doing essentially a math problem in the brain, and other parts that really care about how things feel, and how they'll make the body feel.

And you can image these different networks, and you can also see when they're fighting one another when trying to do some sort of moral decision-making.

So, probably the best way for us to look at it is that when we talk about reason vs. emotion, we're talking about sort of a summary—sort of a shorthand way of talking about these different neural networks. And, of course, decisions can be much more complicated than that, often. But sometimes they can be essentially boiled down to that.

It's funny; the ancient Greeks also felt that this was the right way to divide it. Again, it's an oversimplification, but the Greeks had this idea that life is like you're a charioteer, and you're holding the white horse of reason and the black horse of passion, and they're both always trying to pull you off the road in different directions, and your job is to keep down the middle. And that's about right. They had some insight there into that you do have these competing networks.

Dr. Campbell: Are some of the competing networks a result of the fact that our brain, from an evolutionary standpoint, has a lot of history built in there, and sometimes there are functions that can be performed at either the subcortical or the cortical level? Does conflict or competition come between those two levels?

Dr. Eagleman: That's interesting. Are you saying is there a conflict between cortical and subcortical?

Dr. Campbell: Well, for example, a reptile doesn't have a cortex, but it can see. But we have all these areas in the cortex devoted to vision, that really change and determine what we finally see consciously.

Dr. Eagleman: Yes. I'll tell you my view on this. What I argue in the book is that the field of artificial intelligence has become stuck, and I'm trying to figure out why. I think it's because when programmers are trying to make a robot do

something, they come up with solutions: like here's how you find the block of wood, here's how you grip the block of wood, here's how you stack the block of wood, and so on. And each time they make a little subroutine to take care of a little piece of the problem; then they say, OK, good; that part's done.

But Mother Nature never does that. Mother Nature chronically reinvents things all the time—accidentally. Just by mutation, there are always new ways to do things, like detect motion, or control muscles, or whatever it is that it's trying to do—pick up on new energy sources, and so on. And as a result, what you have are multiple ways of solving problems in real biological creatures.

They don't divide up neatly into little modules, the same way that a computer program does, but instead, for example, in the mammalian cortex it appears that Mother Nature probably came up with about three or four different ways to detect motion. And all of these act like parties in the neural parliament. They all sort of think that they know how to detect motion best, and they battle it out with the other parties.

And so, I think this is one of the main lessons that we get, when we look for it, in what happens when we see brain damage in people. You can lose aspects of your vision and not lose other aspects; or, often, you can get brain damage and you don't see a deficit at all, even though you've just sort of bombed out part of what you would expect to give a deficit.

In other words, you have this very complicated interaction of these different parties that are battling it out. And I think they, in general, don't divide neatly along the cortical and subcortical division, but instead, whether in lizard brains or in our brains, these networks can be made up of subcortical and cortical parts together.

Dr. Campbell: It's too bad we don't have more time, because that's a really interesting subject. Let's make sure that we leave enough time so that we'll be able to talk about some of the implications of what's been discovered. Before we do that, though, I want to talk a little bit more about this illusion of control that we have.

Dr. Eagleman: Right. At the beginning we mentioned this analogy that you're like a stowaway on a transatlantic steamship. In other places in the book I use the analogy of a young monarch who takes the throne of his country, and takes credit for the glory of the country without thinking about the thousands of workers who are making it all work. And that's essentially the situation we're in.

Take, just as an example, when you have an idea, you say, 'Oh, I just thought of something.' But it wasn't actually you that thought of it. Your brain has been working on that behind the scenes for hours or days, consolidating information, putting things together, and finally it serves up something to you. It serves up an idea; and then you take credit for it. But this whole things leads to this very interesting question about the illusion we have that we have control.

Dr. Campbell: The other question is why do we have consciousness at all?

Dr. Eagleman: Well, here's how I see it. When an organization reaches sufficient complexity it needs a CEO to not only direct its long-term visions, but also to arbitrate among the different parts and pieces of the organization, all of which might want to sort of steer where the company is going.

What a CEO does is, he or she is reactive to what's going on—so, when there are problems, the CEO says, 'OK, I'm going to allocate some resources here, I'm going to fix this here, I'm going to react to the situation'—and the CEO also sets long-term visions for the company, and says, 'OK, for the next several years this is where I want the company to go.'

And I think that's approximately what consciousness is about. When the operations of the company are running perfectly smoothly, the CEO doesn't need to do much of anything. But when things are sort of violating expectations, that's when the CEO needs to step in, and figure out what to do, and set the long-term visions to fix it.

And when the CEO sets the long-term visions for a company, the rest of the company reconfigures its machinery in order to meet that. And that's exactly what happens in the brain. You decide what you're going to do, and the rest of the brain reconfigures to match those expectations.

Dr. Campbell: That's a good analogy.

So, I do want to give you a little bit of time to talk about the area that I know you're very interested in, which is what all this means for personal responsibility. I'm going to take a quick break, and we'll come back and talk about that.

[music]

Before we listen to the rest of Dr. Eagleman's interview, I want to take a few minutes to review some key ideas. Obviously, the key idea is that most of what our brain does is outside our conscious awareness. This includes perception, decision-making, and motor control. Some of these things are hardwired and some of them are learned. And these processes include amazingly complex behaviors. We can neither access or control these processes, though our frontal lobes do have some ability to override certain impulses.

This idea is not entirely new to those of you who are longtime listeners; but I think *Incognito* provides a fresh approach. First, Dr. Eagleman reminds us that all the brain ever sees is electrical and chemical signals. From these signals the brain creates the world we experience. How we experience the world is

intimately tied to our biology, so the world you experience is different from the world that your dog or cat experiences.

Another idea he emphasized was thinking of the brain as a team of rivals vying for control and access to conscious awareness. This is a powerful metaphor for understanding why we often find ourselves facing inner conflict and turmoil. Part of us wants to exercise and eat healthy, and part of us wants to sit in front of the TV and eat junk food. Of course, the example of racism is more important. Once we understand how our brains function, perhaps we will be less quick to accuse others of hypocrisy, since internal contradictions are part of how we're wired. We will talk a little bit more about the practical consequences of this in the last part of the interview.

Another idea I want to review is how these unconscious processes come about. Dr. Eagleman says that when it comes to the question of nature vs. nurture, that answer is almost always both. Let's take visual perception for an example. While the lower levels appear to be totally hardwired, the upper levels are influenced by both learning and expectation. Learning leads to processes moving from the level of conscious effort to an automatic level. This has important implications. It taps into our brain plasticity, it allows the brain to save energy and speed up processing, but it also means that we lose both access and control.

Which brings me to the last thing I want to review before we listen to the rest of the interview: hunches. These are ideas or feelings that seem to come from someplace mysterious. Now we can appreciate that they are coming from areas of our brain that are not accessible to our conscious awareness; they did not come from a mystical or supernatural source.

Most importantly, even though there are situations in which it is important to trust our gut feelings, we can't assume that they are always right. For example, as an experienced emergency room physician, I might have an immediate gut

reaction about who is really sick; but I have to be constantly on the alert to make sure that I don't miss something. If a patient comes in saying, 'I'm having a heart attack,' even though they look fine, it's up to me to make sure. So, while much of what I do has become automatic, I must consciously reevaluate my decisions as I go through my day. I'm sure you can think of a similar example from your own life.

So, the bottom line is that we really do have an illusion of control, since most of what our brain is doing is outside of our awareness, and outside of our control. So, we did ask Dr. Eagleman, then what is consciousness for? In addition to providing what he called the 'CEO function,' our consciousness is very important for our ability to adapt to the unexpected. Although our brains are very good at predicting, there is a lot that goes on every day that is unexpected. In fact, that's, I think, part of what makes being a human fun.

Well, let's get back to the interview, so that we can consider some of the implications of these findings.

[music]

Dr. Campbell: David, we've been talking about the fact that most of what our brain does is not only outside of our conscious awareness, but pretty much outside of our control. So, what does this mean for responsibility?

Dr. Eagleman: I think what it means is that when we look at something like the legal system, something like blameworthiness is actually the wrong question for us to ask. I mentioned before that brains end up being an end result of a very complicated process of genes intertwining with environment. So, in the end, when there's a brain standing in front of the judge's bench, it doesn't matter for us to say, OK, well, are you blameworthy; to what extent are you blameworthy; to

what extent was it your biology vs. you; because it's not clear that there's any meaningful difference between those two things, anyway.

I'm not saying this forgives anybody. We still have to take people off the street if they're breaking the law. But what it means is that asking the question of blameworthiness isn't where we should be putting our time. Instead, all we need to be doing is having a forward-looking legal system, where we say what do we do with you from here?

We don't care how you got here, because we can't ever know. It might have been in utero cocaine poisoning, childhood abuse, lead paint on the walls, and all of these other things that influenced your brain development, but we can't untangle that. And it's not anybody's fault. It's not your fault or anybody else's. But we can't do anything about it.

So, all we need to do is say, given the kind of person you are now, what is the probability of recidivism. In other words, how likely are you to transfer this behavior to a future situation and re-offend? And then we can predicate sentence length on that probability of re-offense. And, equally as importantly, along with customized sentencing, we can have customized rehabilitation.

So, there are lots of things that can go wrong with people's brains that we can usefully address, and try to help people, instead of throwing everybody in jail. As it stands now, 30% of the prison population has mental illness. Not only is that not a humane way for us to treat our mentally ill and make a de facto healthcare system, but it's also not cost-effective.

And it's also criminogenic—meaning it causes more crime. Because everybody knows when you put people in jail, that limits their employment opportunities, it breaks their social circles, and they end up coming back to the jail, more often than not. So, it's very clear how the legal system should be straightening itself

out, just to make itself forward-looking, and saying, OK, all we need to do is get good at assessing risk into the future.

Now, one caveat I need to make very clear is we will never be able to predict people's behaviors, because life is too complicated. And crime is contextual. You can take the exact same person and put him in different circumstances, and in one circumstance he'll thrive as a CEO and in another circumstance he'll get arrested for 30 years for being a drug dealer. And it's the same person; it's just a matter of what neighborhood they found themselves in, and what circumstances.

So, we're never going to be able to predict crime entirely. Nonetheless, it is the case that brains are not the same as one another, and some people are very dangerous. Some people are really bad seeds, that prove themselves to be so over and over, and are really violent and aggressive, and don't have empathy for other people. At the other end of the spectrum you have people who have ended up on the wrong side of the law, for whatever reason, but they're not actually terribly dangerous for the future.

Of course, this is a spectrum. You have everybody in between. The really important part is to figure out how can we get good at having good prediction about this stuff. As I said, it will never be 100% prediction—that's not even the goal; it's not even possible—but the goal is to have a customized system.

Dr. Campbell: But we also need to have better rehabilitation strategies. For example, I don't know whether that 30% you mentioned there includes people whose mental illness is drug addiction, or whether the number would go up if you included drug addicts.

Dr. Eagleman: The number goes up.

Dr. Campbell: Yes, that's what I thought. I work in an emergency room in a rural area of Alabama, where probably every day I see somebody who's been in

jail, and it's almost always been for that. That's a big problem in the community where I work. I remember vaguely from when I was young that they used to try to do rehab in the prison system. And that's been pretty much abandoned. And the current drug rehab programs don't seem to work.

Dr. Eagleman: Yes, that's exactly right. The problem is this: the war on drugs attacks the drug supply. And, of course, it's completely unwinnable, because the drug supply is like a water balloon; if you press it in one place, it will come up somewhere else. The right thing to do, if you want to take care of drug problems, is address drug demand—meaning the brain of the addict.

And so, at this stage we know a lot about circuitry and pharmacology of drug addiction, and that it would make the most sense for us to treat drug addicts. And, of course, some jurisdictions are moving in this direction. They're making drug courts—which is so sensible and humane. Instead of throwing people in prison, you try to figure out how you can help them break their drug addiction. That's the right direction.

As it turns out, the only jurisdictions that are doing this are those that are sort of running out of money, and find themselves flat broke—for whatever reasons of state budgets. And so, they're doing it because they realize it's much more cost-effective, rather than throwing all the drug addicts in jail; which doesn't, of course, do anything.

Dr. Campbell: So, we don't have very much more time, but there was one more question I wanted to ask you about this. What do you see as being the biggest obstacles to turning our justice system into a forward-looking system—money?

Dr. Eagleman: Yes. It always comes down to that. In the last few decades we have quadrupled our prison population, and now we lead the world in terms of

the percentage of our population behind bars. And one of the things this has come with is a giant private prison organization.

I'm generally in favor of privatization of certain things, and I would have thought that that's probably a good idea. But, as it turns out, it's gone too far. And now there's, of course, a multibillion dollar private prison lobby in Washington, DC. So, when it comes to strategies such as rehabilitation and how can we help people, we stand in the way of major businesses like that.

And at the other end of the political spectrum, what I've found very surprising is we also encounter resistance from unions, in the form of the California prison guards union. There are a lot of people who are very invested in the prison system, and putting as many people in prison as possible. And it was something that I hadn't actually realized—how many people would be opposed to that.

So, there it is. I think that's where we're going to run into problems. It's just going to be an uphill battle.

Dr. Campbell: Before we close, let's talk about the average person. What do you think is the biggest implication for what you've learned—I'm talking about in your book—with regards to the average person, who's not likely to end up in prison?

Dr. Eagleman: Well, there are many lessons in this book, but the main one is getting to know one's self by actually—instead of just using introspection and intuition about it—actually seeing what we know about it.

And one of the really amazing lessons is this bit about being a neural parliament, and not being made up of just one thing. I think this gives us a much better view of why we can argue with ourselves, and curse at ourselves, and contract with ourselves, and why we can do things where we look back and we think, *Wow, how did I do that? I'm not the kind of person who would do that.*

But, in fact, you are many people. As Walt Whitman said, "I am large, I contain multitudes."[2] So, I think this gives us a better view of ourselves, and it also tells us ways to set up our own behavior to become the kind of people we want to be, by thinking about how to structure things in our life so that the short-term parties that are interested in instant impulse gratification—so that they don't always win the battle.

Dr. Campbell: Is there anything that we've left out that you want to say something about before we do close?

Dr. Eagleman: Thank you. Nope; I think that covers it.

Dr. Campbell: Do you have any advice for students that are interested in neuroscience?

Dr. Eagleman: Read everything you can get your hands on, and see which aspects of neuroscience resonate with you, because it's a huge field, it's only getting bigger, and it's really hard to work in a lab 24/7, as we all do, unless you love it—unless you love the stuff you're working on. There are just as many completely thrilling neuroscience projects out there as there are really boring ones. And so, my advice for students would be read broadly and figure out what works for you—what's the best thing that resonates with you.

Dr. Campbell: And what questions excite you—because they're not the same for everyone.

Dr. Eagleman: Exactly.

---

[2] "Song of Myself" in Leaves of Grass by Walt Whitman (1860) originally published as an unnamed poem in 1st ed in 1855.

Dr. Campbell: Well, David, I appreciate you taking the time to talk with me; and I hope you will let me know when you do get your next book out, so we can talk about it.

Dr. Eagleman: OK. I'll look forward to that.

[music]

I want to thank Dr. David Eagleman for taking the time to talk with us. I highly recommend his book, *Incognito: The Secret Lives of the Brain*, to everyone. It is available in various formats, including as an audio download from Audible.com. It is definitely the kind of book you can give someone as a gift, because these ideas have practical implications for everyone.

With that in mind, I want to share a couple of my favorite quotes from the book, that we didn't have time to talk about because Dr. Eagleman was rather pressed for time. These relate to the essential question of what does all this mean for the average person.

On Page 203 of the book, Dr. Eagleman said, "The condition of your brain is central to who you are." A couple pages later he said, "Who you are depends on the sum total of your neurobiology. This means neurotransmitters, hormones, brain circuits, etc."

On Page 208 he noted, "The critical take-home message is that invisibly small changes inside the brain can cause massive changes to our behavior." However, a little bit later on, on Page 216, he makes the point, "Science is not on the verge of understanding how to build minds from pieces and parts."

He suggests on Page 219 that we should, "…think about the brain as the densest concentration of 'you-ness.'" And finally, on Page 219 he said, "The brain is not so much the seat of the mind as the hub of the mind."

So, I hope this will give you a taste of the fact that there's a lot more to this book than we were able to get into in our brief conversation today.

Now, I recently posted a short episode that sort of puts all my usual announcements in one place. You can get that out of the feed; I'm not going to repeat all those announcements today. But I do want to encourage you to visit the website at brainsciencepodcast.com, and make use of the show notes and the episode transcripts. One thing I will repeat is the fact that if you're interested in more references and details, the episode transcripts are the place to go.

One of the things that will be in the show notes for this particular episode is going to be a link to a page on Goodreads. Dr. Eagleman is going to be answering questions between July 11th and 15th on his Goodreads page, and I will be putting a link to that in the show notes. If you're on Goodreads, I want you to join the Brain Science Podcast Group on Goodreads; and there are links to that in the show notes.

Please be sure to send me your feedback at docartemis@gmail.com. And don't forget that this show does depend on your donations.

Thanks again for listening. I look forward to talking to you again next month.

[music]

Transcribed by Lori Wolfson
All errors or omissions responsibility of the transcriber