

Bingecast: Michael Egnor on the Human Brain

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Austin:

Greetings, I'm Austin Egbert, director of Mind Matters News. You're listening to another Bingecast where multiple episodes are combined into a single program. This week, we talk with Dr. Michael Egnor about a variety of topics involving the human brain, including various theories of the mind, freewill, evidence for mind-body dualism, and research into the brain activity of coma patients. Enjoy.

Announcer:

Welcome to Mind Matters News, where artificial and natural intelligence meet head-on. Here's your host, Robert J. Marks.

Robert J. Marks:

Greetings. The mind-body problem, better titled the mind-brain problem, is about differentiation of the mind and the brain. Is the mind an emergent property of the brain, or is there something else going on there? Our guest is Dr. Michael Egnor. He's a professor of neurosurgery and pediatrics at State University of New York, Stony Brook. He's the director of pediatric neurosurgery. He's an award-winning brain surgeon. He was in fact named one of New York's best doctors by the New York Magazine in 2005. Dr. Egnor has lectured extensively throughout the United States and Europe, including at the opening ceremonies and the launching of the Walter Bradley Center for Natural and Artificial Intelligence in Seattle in 2018. He is a senior fellow of Discovery Institute's Bradley Center, and a frequent contributor to Mind Matters News, that's at mindmatters.ai and Michael, your writings and posts to Mind Matters News always get a lot of hits disproportionately high. So thank you for joining us here.

Michael Egnor:

Thank you, Bob.

Robert J. Marks:

Emo Phillips, he said one day he was walking around and he recognized that his brain was the most wonderful organ in his body. Then he said he realized who was telling him this. It's kind of amazing, Emo Phillips quip aside, it's kind of amazing, we can use our minds to even partially understand our minds. So, Dr. Egnor, before we talk about minds, what constitutes a good theory of the mind and the way the mind relates to the body and the brain?

Michael Egnor:

Well, it's a great question. And a very important question. Actually it was a question that Aristotle asked. And when he, in his work De Anima - On the Soul - he asked, what would a good explanation for the soul consist of? He felt, and I completely agree that the first thing is-

Robert J. Marks:

Now, if I can interrupt you, you mentioned the idea of a soul. Is this kind of the idea of the mind according to Aristotle?

Michael Egnor:

Yes. The classical philosophers really thought in terms of the soul more than in terms of what we would call the mind. And what we call the mind is kind of a subset of what the classical philosophers thought of as the soul. They saw the soul as that which makes a living body alive, so that they saw the soul as what we would call the mind, but also the physiological functions - the heartbeat, all the physiology that goes along with it. And actually, I think that's a more sensible and comprehensive view of the human being. So what we think of as the mind is just several powers of the soul.

Robert J. Marks:

I see. So you were relating to the way that Aristotle thought about it.

Michael Egnor:

Yes, yes, yes. He didn't separate out what we would call mental processes so sharply from ordinary physiology - breathing and heartbeat, muscle movement. He felt it was all kind of an integrated whole. It's actually one of the beauties of the Aristotelian way of looking at things. There's no artificial separation there. He sees it all as part of a whole.

Robert J. Marks:

I see. So could you be more specific what constitutes a good theory of the mind and the way the mind relates to the body?

Michael Egnor:

Well, the very first thing that we need, is we need a theory that makes sense. And by that, I mean, a theory that at least is not internally self-refuting. A good example I think, of a self-refuting theory of the mind is eliminated materialism, which is a bizarre theory held by many materialists today.

Robert J. Marks:

Could you repeat that phrase? Eliminated materialism.

Michael Egnor:

Eliminative materialism.

Robert J. Marks:

Eliminative, okay.

Michael Egnor:

Yes. And it is the viewpoint that the only thing that exists is the brain and that, as far as the mind goes, and that there is no mind. That is, what we have come to think of as our mind is just the physical processes going on inside our brain. That is different from another theory of mind called identity theory, that was held in the 20th century, that has been pretty much discarded. And identity theory was that the mind is the same thing as the brain. And that has been discarded, because it's logical nonsense that is that every attribute of the mind, the reason and emotion and perception, all of those things are completely different from matter. That is that one describes matter in terms of extension in space or mass or various qualities like that.

Michael Egnor:

One describes perceptions and reason and emotions in completely different ways. There is no overlap between them. So the mental states can't be the same thing as physical states, because they actually don't share any properties in common. They're clearly related to one another in important ways, but they're not the same thing. Eliminative materialists go one step further. They actually say that there are no mental states, that the only thing is the brain, which is kind of an odd thing to say, because what eliminative materialists therefore are saying is that their ideas are mindless. I mean, how can you have a proposition that the mind doesn't exist? Because that means propositions don't exist and that means that you don't have a proposition.

Robert J. Marks:

So that's the self-refuting you were talking about.

Michael Egnor:

Yeah, it's crazy. And then Aristotle made that point. Now the very first thing, if you're going to explain the soul or the mind, is that what you say has to make sense. There's a neuroscientist named Bennett and a philosopher named Hacker who've written extensively on this topic of neurophilosophy and written some very good things. And their motto is, "That the precondition of truth is sense." That is, that you can't pretend to have a scientific truth or a philosophical truth or any kind of truth. If the statement you're making about it doesn't even make sense and eliminative materialism is self-refuting it, if it's true, then it's false. So the first thing is that your theory has to, in some way make sense, and there are various theories that do kind of make sense, so to varying, varying degrees. The second criteria is that the theory needs to offer a reasonably good explanation for the mind and for the body. It has to fit the evidence. You can't have a theory that makes sense, but it doesn't fit the evidence very well.

Michael Egnor:

And you very much want it to be consistent with the results of neuroscience. Obviously, I mean, neuroscience is a beautiful and powerful field and any theory of the mind and the brain has to correspond to a significant degree with the findings in neuroscience. Neuroscience I think has been philosophically misguided in substantial ways, but we have to take the experimental evidence, the data, quite seriously, and try to understand it in a way that makes sense.

Robert J. Marks:

Certainly, a lot has gone on with neuroscience since Aristotle. So with these three criteria, what are some of the theories of mind that are on tap, that makes sense, according to the criteria you've outlined?

Michael Egnor:

Sure. Well, making sense of course, is to some extent, relative, meaning some theories make more sense than other theories. By far the most common perspective today - I think both in the philosophical community and certainly in the neuroscience community - is materialism. And materialism, or what one might call physicalism or naturalism, they're all rather similar perspectives and basically, the perspectives there are that the only thing that exists are material things, things that have extension in space and mass and things like that in the natural world that can be described by the basic sciences like physics and chemistry. The materialists believe that there is no supernatural world. And materialists also believe that there are no agents or properties or entities in nature that don't have material origins, that there are no souls, there are no spirits, nothing like that. And so, the materialist perspective is certainly

the dominant perspective in neuroscience today. I think it's a deeply misguided perspective and it's, I believe held by neuroscientists mainly because they haven't thought about it very deeply.

Michael Egnor:

It's kind of the default option, but when you think about it deeply, it doesn't provide a particularly satisfactory perspective on the mind and the brain.

Robert J. Marks:

Wouldn't the materialism ideology require that the mind to be an emergent property of the brain?

Michael Egnor:

Well, it might even limit us with the idea of emergence. That is that materialism would only be completely consistent with an emergent perspective if the emergent thing was material. That is that if one felt that some kind of immaterial soul emerged from brain activity, then that wouldn't even be a materialist view. And I think the emergence is a very problematic concept. I actually don't think it's a particularly useful concept in philosophy of mind.

Robert J. Marks:

I can also attest in the area of artificial life and such, that emergence digitally from digital organisms and digital evolution has really fallen short of doing anything that's truly meaningful.

Michael Egnor:

Yeah, it basically doesn't do any lifting. It is essentially an invocation of magic. And there are two very serious problems with the concept of emergence in philosophy of mind. The usual emergent assertion is that the mind in some way is an emergent property of the brain. And the problem with that assertion number one, is that there are things that are considered to be emergent properties that are kind of accepted. A classic example is the wetness of water. And it's emergent in the sense that if one studies water rigorously from the standpoint of physics, there's nothing about it that's particularly wet. That is, you can study the quantum mechanical attributes of oxygen and hydrogen and all the chemistry and physics of water, and not come out of that with anything that suggests that it's wet. But when you put real water in front of you and dip your finger in it, it's kind of wet. So people say that wetness is an emergent property of water.

Robert J. Marks:

That's curious.

Michael Egnor:

The thing is with the philosophy of mind is that if a mind is an emergent property of the brain, what you're dealing with with philosophy of mind is something that is ontologically completely different. That is that there are no properties of mind that have any overlap with properties of brain. Thought and matter are not similar in any way. Matter has extension in space in mass. Thoughts have no extension in space and no mass. Thoughts have emotional states. Matter doesn't have emotional states, it's just matter. So it's not clear that you can get an emergent property when there's no connection whatsoever between that property and the thing it supposedly emerges from. The other problem with emergence, I

think is even more fundamental. And that is that when you think about, for example, the wetness of water as an emergent property of water, what you're really talking about is a psychological state.

Michael Egnor:

That is, you're saying that psychologically, you didn't expect water to feel wet, but by golly, it does. So that's emergent, but you can't explain the psychological state itself as emergent.

Robert J. Marks:

Would the word qualia apply here?

Michael Egnor:

Yes. Qualia is the subjective experience of things, the way things feel. And one might say that it's first-person experience as opposed to third-person experience, which is objective. And it has been a notoriously difficult problem that has been addressed in many ways of the 20th century, to try to explain how it is that the matter of the brain, which is entirely third-person, meaning it's got mass, it's got extension space. It's things that you can study under a microscope. How is something that's third-person objective capable of giving us first-person subjective experience? And David Chalmers, who's a very well-known philosopher of mind, has called that problem the hard problem of consciousness. And Chalmers has described two problems that we face in explaining consciousness. One is the easy problem of consciousness. And what he means by that really is neuroscience.

Robert J. Marks:

By the way, just to set the stage, Chalmers, would you classify him as a materialist and coming from this materialist viewpoint?

Michael Egnor:

No.

Robert J. Marks:

He is not, okay.

Michael Egnor:

No, he's not. He has a quality of panpsychism, that is he kind of thinks that consciousness is a fundamental quality of everything, which sounds initially like it's kind of crazy, but I actually don't think it's nearly as crazy as it seems. I'm not a panpsychist. I don't think everything is conscious. But there is in my view no question that all of created reality manifests mental things. That is that there's clearly a mind in some way manifested in reality. I don't think reality has a mind, but I don't think you can separate mind from reality. So I can see where panpsychists are coming from. I think they're wrong, but they're not completely wrong.

Robert J. Marks:

Now you're going through some of the different theories of the mind that are untapped and we've gone through materialism. And I'm sorry, I derailed you when you're talking about Chalmer's theory.

Michael Egnor:

That's okay.

Robert J. Marks:

But what are some of the other models of the mind other than materialism?

Michael Egnor:

Sure. Well, one would be panpsychism, which is, or some people also would have something called neutral monism, and those are views that consciousness is sort of just a fundamental property of everything.

Robert J. Marks:

Wouldn't that also be materialist?

Michael Egnor:

Not really, because it would describe mental activities as not inherently material. That is that mental activities are real and they exist in association with matter, but they aren't the same thing as matter. It's sort of the idea that the real substance that forms the universe is inherently conscious and we are just particularly dramatic examples of it.

Robert J. Marks:

I remember a post that you wrote for Mind Matters News, which was, "Electrons are not conscious," which is on this. I believe though that a panpsychist can also be an atheist. Usually I equate materialism with atheism, but you said that there's broader things than materialism such as panpsychism which can also be embraced by an atheistic perspective.

Michael Egnor:

Yeah, sure. Panpsychism doesn't, at least as it's normally endorsed, doesn't necessarily have any theistic implication. I think you could easily be an atheist and be a panpsychist. I don't think you can be an atheist and be rational, meaning that when you look with rigor at the question of the existence of God, I don't think you can be a rational atheist, but there are tons of, there are lots of irrational atheists and some of them are panpsychists.

Robert J. Marks:

I see, okay. So we have materialism, panpsychism, what other theories of the mind are on tap?

Michael Egnor:

Well, there are a number of dualist theories of the mind. And dualism just generally considered, is the viewpoint that mental states are not the same thing as material states, as brain states. That there is when you consider the material aspects of, for example, a human being that there is a remainder that is mental, that is not material. But there are a variety of ways of looking at dualism. Kind of the classical dualist way of looking at things, at least in modern philosophy is Cartesian dualism, which was proposed by Descartes back in the 17th century. And he proposed that human beings are composites of matter extended in space and of spirit, which he thought of as a thinking substance. So he thought that there were two separate substances that were joined to form a human being and basically the material body joined to the immaterial spirit.

Michael Egnor:

And there certainly are good things to say about the Cartesian understanding of the mind and body, but I think it's fundamentally misguided from a philosophical and logical standpoint, and that it actually has done quite a bit of harm philosophically, because it was described in the 20th century by a philosopher named Gilbert Ryle as, "The ghost in the machine." And that is that Descartes understood human beings basically to be biological machines that were inhabited by a ghost, which is the spirit or the mind. And materialists have simply said, "Well, there's no ghost. So we'll just understand human beings as biological machines."

Robert J. Marks:

I see.

Michael Egnor:

And that's a profound error, but Descartes opened the door to that. But the perspective that Descartes cast aside was that of hylomorphism, which is-

Robert J. Marks:

Okay, slow down. What was it called again?

Michael Egnor:

Oh, sure. Hylomorphism. H-Y-L-O-M-O-R-P-H-I-S-M. Some people spell it, H-Y-L-E-M-O-R-P-H-I-S-M. And that's that all of nature consists of a composite of form and matter. Morphism means matter and hyle is the Greek word for form. And oh, sorry, is the Greek word for matter. So hylomorphism means that everything in nature is a composite of form, which is Aristotle would call it principle of intelligibility in matter, which is a principle of individuation.

Robert J. Marks:

I see.

Michael Egnor:

So it's a rather profound metaphysical perspective. And in that perspective, the soul or the mind is the form of the body, but it's a different perspective than Descartes' perspective. And it doesn't see mind and body as being separate substances. It sees a human being as being a unitary thing with different principles involved, but not different substances.

Robert J. Marks:

One of the criteria that you've mentioned for establishing a good model of the mind-brain problem is consistency with results of neuroscience. How do these three different theories stack up, materialism, panpsychism and dualism?

Michael Egnor:

Sure. Well, panpsychism, while I do think I could see how a person might make that inference - some very intelligent people like Dr. Chalmers have made that inference - I don't think panpsychism is a particularly scientific viewpoint. Realistically speaking, there's no particular reason to think that electrons or grains of sand have minds.

Robert J. Marks:

Well, I'm sitting here thinking, "How the heck would you ever test something like that?"

Michael Egnor:

Right. Well, you could ask an electron and people have tried, and the electrons don't answer. So yeah. I mean, right. It's a difficult thing to test. Materialists have of course, made the claim that neuroscience completely supports materialism. I had an internet debate with Dr. Steven Novella, who is a neurologist at Yale, a number of years ago, and he's a materialist. And Dr. Novella said that every single bit of evidence in the history of neuroscience supports materialism, which I think is not the case.

Michael Egnor:

But materialists would claim that neuroscience supports materialism. The problem with that is that neuroscientists generally work from a materialist perspective and they ask questions of the mind and the brain from a materialist perspective. And goodness gracious, it's no surprise that if that's the way you ask the questions, then materialism always seems like it's the answer. When I was in college, I had a professor of biology, Dr. Pollack, who I really loved. He was a great professor, a great philosopher, as well as a great scientist. His adage was that in science, the question you ask is more important than the answer you obtain. That is, that the way you approach the problem and the kind of question you ask determines how meaningful your answer is. And if you get the question wrong upfront, then your answer won't be meaningful no matter what kind of work you do.

Robert J. Marks:

Oh, absolutely.

Michael Egnor:

So you have to ask the right questions. So if you're a materialist and all your questions are predicated on materialism, you're never going to get it right. So, I think dualism is a much, much better explanation for many aspects of neuroscience.

Robert J. Marks:

That was my next question. Do you, speaking as an experienced neurosurgeon who has played around with the brains of many, many people, what do you believe? Do you believe that the mind is distinct from the brain as a dualist does?

Michael Egnor:

I think, first of all, that if one is going to understand the mind and the brain, you need to start with a solid metaphysical foundation. And I think hylomorphism is a solid metaphysical foundation. I don't think Cartesian dualism is a good metaphysical foundation, and I certainly don't think materialism is a good metaphysical foundation. I think the best explanation for the relationship of the mind to the brain is Aristotelian hylomorphism, which is the viewpoint that the soul is the form of the body and certain powers of the soul, particularly the intellect and will, are not generated by matter, but are immaterial things, what Thomas Aquinas would call the spirit, but other properties of the mind like perception and memory and imagination are physical. They are directly related to brain matter and they're generated by brain matter. I think that's the best explanation, philosophically, for what we find in neuroscience.

Robert J. Marks:

Very good. Most of the debates about the mind-brain problem have been argued over the years by philosophers and theologians, I believe. However, we do have the emerging field of neuroscience. Do you have any thoughts what neuroscience is going to tell us about the mind-brain problem in the near future, or in the far future even?

Michael Egnor:

Well, as Dr. Pollack said, it all depends on the questions we ask. My favorite quote about neuroscience was by a philosopher named Roger Scruton who described neuroscience as a vast collection of answers with no memory of the questions.

Robert J. Marks:

You have to unpack that. What does that mean? Everybody has the answers, but is not asking the questions?

Michael Egnor:

And I should point out that Scruton, I believe he's an atheist, so he's not your typical dualist, and I don't even know if he'd consider himself a dualist. But what he points out is that neuroscience is done with such an unreflective and rather primitive materialist predicate that people don't even really think about what their experiments mean, they just spew out the data. They spew out the data, attach a materialistic explanation to it, and just go onto your next experiment without thinking deeply about what are the real questions in these experiments? What are you really trying to find out?

Michael Egnor:

And he's quite right that neuroscience is a vast collection of answers, meaning if you took all the data that has been generated by neuroscientists over the past century, you could fill libraries brimming over. I mean, the amount of research - and a lot of it has really good research, really high quality stuff, it's amazing - the philosophical insight and reflection that is associated with this work is basically at the level of a not-terribly-bright elementary school child. Meaning that it's amazing how bad the philosophy is.

Michael Egnor:

I once asked a neuroscientist here where I work, we were having a discussion one time about the mind and the brain. And I asked him, "How is it that neurons in the cortex are associated with mental states?" And he just said, "They just generate them. That's all."

Robert J. Marks:

Oh boy.

Michael Egnor:

And I think, well, that didn't really say anything. That's not a level of explanation. And he didn't think there was a problem with that. He just said, "Ah, they generate it. So what?"

Robert J. Marks:

Boy, you're talking about blind faith.

Michael Egnor:

Well, yes. And as Scruton said, no memory of the questions. Doesn't even understand the question. And that's what struck me most about materialists in neuroscience is that they don't even know what they don't know. They don't even realize how little they can really explain.

Robert J. Marks:

Some scientists subscribe to an ideology dubbed "the non-overlapping magisteria" or called NOMA. It's basically the idea that your science is separated from anything religious and vice versa. I reject the premise and maintain there is a relationship of NOMA to the old Jim Crow South, where races were separate but equal. You have the same thing in NOMA. You have faith and science, separate but equal. The premise of separate but equal always seems to diminish one side in favor of the other.

Robert J. Marks:

So putting NOMA aside, let's start by asking Dr. Egnor, can neuroscience shed any light on faith? Dr. Egnor, is there a soul? What does neuroscience say?

Michael Egnor:

Well, I think there certainly is a soul and I too reject NOMA. I think it's a nonsensical idea. The reality is that truth is unitary and that claiming that there basically are two separate truths that have no overlap is just nonsense, and I only have faith in things that I think are true. I think neuroscience strongly supports the inference that we have a soul.

Robert J. Marks:

Is there a difference between the soul and the spirit? Do we have a spirit? What does neuroscience say there? Or are they equivalent in some sense? I'm not informed enough to have a nuance between the two.

Michael Egnor:

Ah, that's okay. Of course, all of these, the reality of a soul or a spirit, depends to some extent on how you define them. The classical Thomistic way, from St. Thomas Aquinas, of understanding soul and spirit, I think is the way that makes the most sense. And soul, by St. Thomas, was understood in much the same way that Aristotle understood the soul, as being the principle of life in a living thing. That is, it's kind of everything that makes you alive rather than dead, rather than a dead body.

Michael Egnor:

So if you look at a living body and compare it to a dead body, the difference is the soul. It's a principle of organization, a principle of function. And the spirit in the Thomistic viewpoint is particularly the aspects of the soul that are not material. And that would be particularly the intellect and the will.

Michael Egnor:

So a Thomist, at least loosely speaking, would say that the soul is the principle of life in a body, and the spirit refers more specifically to the immaterial aspects of the soul, which are the ability to reason and the ability to make decisions based on reasons.

Robert J. Marks:

Wonderful. What did the research of one of your fellow neurosurgeons in history, Wilder Penfield, tell us about the soul and the spirit?

Michael Egnor:

Well, Wilder Penfield was one of actually many neuroscientists who was a dualist. In fact, many of the greatest neuroscientists in history have been dualists -

Robert J. Marks:

Could you just briefly in a sentence, explain what a dualist is, again?

Michael Egnor:

Sure. A dualist is someone who believes that some aspect of the mind is not material. That is, that there is something above and beyond just brain matter that constitutes the human mind. And Sherrington, who was really the original pioneer in neuroscience, worked back around the beginning of the 20th century, was a dualist, as was Dr. Penfield, who we'll talk about momentarily. And there's a guy named Eccles in the 1960s, who was a Nobel laureate, who was a passionate dualist. Other neuroscientists like Roger Sperry and Benjamin Libet, all of them are... Sperry was a Nobel laureate also. These are all neuroscientists of the top rank who were all dualists.

Robert J. Marks:

And it's interesting that they maintained this position because of their neurosurgery experience.

Michael Egnor:

Well, actually, yes. And Wilder Penfield was a neurosurgeon at the University of Montreal in Canada, who was really the pioneer in surgery for epilepsy. He worked back in the mid-20th century for several decades. And he did surgery on probably upwards of 1,000 patients who had intractable epilepsy. They would have seizures that couldn't be controlled. He did brain surgery to remove the area of the brain that was causing the seizure and to cure their seizures.

Michael Egnor:

He did a lot of that surgery on patients who were awake during the surgery, because the brain itself feels no pain, and if you can anesthetize using local anesthesia, like lidocaine, on the scalp and the skull, you can do the surgery without the person feeling any pain, and they're wide awake as you're working on their brain. So he had an opportunity to study the human brain in conscious people.

Robert J. Marks:

Let me ask you, let me interrupt you. What's the necessity of having an open brain operation? I think if I had the option of an open-brain operation or being knocked out, I'd prefer to be knocked out.

Michael Egnor:

Yeah, both-

Robert J. Marks:

But clearly there's a reason that you have this open brain surgery.

Michael Egnor:

Most folks, if it didn't matter one way or the other, would rather sleep through it, but the reason for being awake is that it allows, and we still do this surgery, it allows the neurosurgeon to map the surface of the brain to make sure that the surgery to treat the epilepsy doesn't cause brain damage, that would cause a deficit like a stroke. So it allows us to find out exactly what different regions of the brain are doing so that we can be careful and preserve the regions that are important.

Robert J. Marks:

So does the surgeon touch a part of the brain and ask the patient, "Does that make you tingle somewhere?"

Michael Egnor:

Yes, basically. We use electrodes that produce a small electrical current that either stimulates or interferes with the functioning of a particular spot on the brain. And you can generate a map of the brain just the same way as you can map a city. Penfield was the first person to do this on a systematic basis. He started his career as a materialist. He thought the whole mind came from brain and he was just going to study it.

Michael Egnor:

At the end of his career, 30 years later, he was a passionate dualist. He said that there is a part of the mind that is not from the brain. He had several lines of reasoning that convinced him of that. One line of reasoning was that in mapping people's brains - and again, he mapped upwards of a thousand people this way - in mapping people's brains, he would do hundreds of individual stimulations of the surface of the brain to see what happened. And people would have all kinds of things happen. They would have their arm move or they'd feel a tingling, or they'd see a flash of light, or sometimes they'd have a memory or they'd have an impediment, like they couldn't speak for a minute or two after a certain spot was touched.

Michael Egnor:

But Penfield noted that in probably hundreds of thousands of different individual stimulations, he never once stimulated the power of reason. He never stimulated the intellect. He never stimulated a person to do calculus or to think of an abstract concept like justice or mercy. All the stimulations were concrete things: move your arm, or feel a tingling, or even a concrete memory, like you remember your grandmother's face or something. But there was never any abstract thought stimulated. And Penfield said, "Hey, if the brain is the source of abstract thought, once in a while, when I'm putting an electrical current on some part of the cortex, I ought to get an abstract thought," and he never, ever did. So he said, "Well, the obvious explanation for that is that abstract thought doesn't come from the brain."

Robert J. Marks:

I see.

Michael Egnor:

The other line of reasoning that he had, which is kind of related to this, is that since he was a pioneer in the treatment of epilepsy, not only did he study the surgical manifestations of epilepsy, but he also studied just the presentation of seizures that people would have in their everyday life. So he studied

hundreds of thousands of seizures that people had, and he never found any seizure that had intellectual content. Seizures never involved abstract reasoning. When people have seizures, sometimes they have a generalized seizure where they just fall on the ground and go unconscious. Or sometimes they'll have what's called a focal seizure. They'll have a twitching of a finger or twitching of a limb, or they'll have a tingling feeling, the same kind of thing that he got when he stimulated the surface of the brain, but nobody ever had a calculus seizure. Nobody ever had a seizure where they couldn't stop doing arithmetic or where they couldn't stop doing logic.

Michael Egnor:

And he said, "Why is that? If arithmetic and logic and calculus and all that abstract thought comes from the brain, every once in a while you ought to get a seizure that makes it happen." Never happens. So he asked rhetorically, he said, "Why are there no intellectual seizures?" His answer was because the intellect doesn't come from the brain.

Michael Egnor:

His third line of reasoning was the following. He would ask people to move their arm during the surgery. So he'd be playing around with their brain. And he'd say, "Whenever you want to move, move your right arm." So the person would move their arm. And once in a while, he'd stimulate the part of the brain that made the arm move and they moved their arm also when he did that. And then he would ask them, he said, "I want you to tell me when I'm making your arm move and when you're moving your arm without me making you do it, tell me if you can tell the difference." And they could always tell the difference. The patients always knew that when he stimulated their arm, it was him doing it, not them. And when they stimulated their arm, they were doing it, not him. So Penfield said that he couldn't stimulate the will. He could never trick the patient into thinking that it was them doing it. He said the patients always retained a correct sense of agency. They always knew if they did it or if he did it. So he said the will was not something he could stimulate, meaning it was not material.

Michael Egnor:

He had three lines of evidence: his inability to stimulate intellectual thought, the inability of seizures to cause intellectual thought and his inability to stimulate the will. He said "That means that the intellect and the will..." And I'm using these terms... The terms he used were slightly different. He called the intellect and the will "the mind" was the term he used, but that's what he meant. The intellect and the will, in his view, were not from the brain, which is actually precisely what Aristotle said.

Robert J. Marks:

Wow. So Penfield ruled out intellectual thought originating from the brain. Did he extend this, do you know, to try to identify the source of this intellectual activity?

Michael Egnor:

Well, I would speak for him. He wasn't an Aristotelian in his philosophical perspective, he didn't really get deeply into the philosophical theories, but his view was that it was an immaterial power. That the will and the mind were not material, and I believe he would've just considered them spiritual.

Robert J. Marks:

So it sounds like he was at least graduated to the area of a deist, would you say that?

Michael Egnor:

Yeah, I don't actually know his religious beliefs. It would surprise me if he were an atheist. I think, frankly, after a scientific career like this, I think atheism would be a pretty hard thing to hold to. If you think really deeply about these issues, atheism is not where you tend to come out. I don't actually know his religious beliefs, but he clearly believed that aspects of the human mind were spiritual rather than physical.

Robert J. Marks:

That's amazing. Do you find this true across most neurosurgeons or not?

Michael Egnor:

Anecdotally, I think most neurosurgeons are theists, for sure. I mean, most of the neurosurgeons I know believe in God, but of course that's true of most people. I think that the reality is most neurosurgeons probably don't think terribly deeply about the metaphysical questions that they encounter, but I think it is widely recognized among neurosurgeons that there are aspects of the relationship between the mind and the brain that are not simple physical relationships. We deal with that every day.

Michael Egnor:

In fact, frankly, from my perspective, that's one of the things that led me to be a dualist. I was a materialist years ago and I was an atheist. In my view, you can't thoughtfully do this work and remain a materialist because I see things all the time that don't make any sense from a materialist perspective.

Robert J. Marks:

My father, when I was a lad, offered the following anecdote about free will versus predestination, and this was the way that I understood it for a long while. If you dig a post hole or you're creating a post hole of your own free will, was the post hole already there and you're taking out the dirt? If you're creating the hole, you're exercising free will. If already there, the hole was predestined.

Robert J. Marks:

So for many years, I actually thought that the idea at least between free will and predestination, was something that couldn't be determined experimentally, but my mind has been changed and we're going to be talking about that today with Dr. Egnor. Neuroscience sheds clarity on the problem.

Robert J. Marks:

Dr. Egnor, you have educated me on the research of Ben Libet and how that informed us about human's ability to have free will. Could you elaborate on that a little bit?

Michael Egnor:

Sure. Ben Libet was a neuroscientist in California, I think at the University of San Francisco, for many years in the mid 20th century, and he didn't win the Nobel Prize, but I think he should have. He certainly is one of the most consequential neuroscientists of the 20th century.

Michael Egnor:

Libet's fascination was with the relationship between thoughts and time. That is, he wanted to know what was happening inside the brain, timed as precisely as possible with activity of the brain. So at the

moment you think something, what is the brain doing? And in fact, he wrote a book for the lay press called "Mind Time", was the name of the book.

Robert J. Marks:

"Mind Time." Do you know if that's still in press at all?

Michael Egnor:

Yeah, sure, sure. You can get it on Amazon. It's actually a very nice book and a very nice synopsis of his research and it's fairly technical. He goes into quite a bit of detail, but it's quite readable.

Michael Egnor:

Libet, his most famous experiment - he did many different kinds of experiments looking at brainwaves and thoughts - his most famous experiment was on the question of free will. He asked a whole bunch of normal volunteers to sit at a desk and he had a button in front of them that they could push, and he had a clock in front of them that they could look at the clock and to within a few milliseconds, they could time a thought that came into their head. The clock had a sweep second hand. Actually, I think it was on an oscilloscope and it had a sweep hand. They could say that, "I had this thought at exactly this time," again, within a few milliseconds.

Michael Egnor:

He also attached electrodes to their scalp so he could record the electrical activity in their brain. And he asked them, he said, "Just sit there at the desk and whenever you decide to push the button at the desk, look at the moment you decide to push the button on the clock and then push the button. He would record their brainwaves synchronized in time with the clock and with the button pushing, so we could kind of tell what's going on in the brain corresponding to their thought and to the pushing of the button. What he found was that about half a second before they decided to push the button, there was a spike in the brainwave activity corresponding to that thought. Again, he found that it happened before the thought, before the decision. He initially thought that that argued against free will. It almost seemed like the brain was generating the thought and the person didn't really have any control over it. It was just the physiology of the brain that made the thought happen.

Michael Egnor:

He said, well, it looks like that free will might not be real. It might just be driven by brain chemistry. But then being a really good scientist, he decided to look at it in a little more depth. He asked the people, when you make a decision to push the button, immediately veto the decision. Sit there at the desk, say hey, I'm going to push this button and then say, no, maybe I won't push the button. Then don't push it. He looked at the vetoes and what he found was that when you made a decision to push the button, you still had the brainwave that preceded the decision by half a second, but when you decided to veto pushing the button, there was no new brainwave at all. It was silent in terms of brainwaves.

Robert J. Marks:

Interesting.

Michael Egnor:

But you did make the decision to veto, so he said that it wasn't so much that you have free will, but you have free won't. That is, you have the ability to decide whether or not you're going to comply with what your brain is urging you to do. That compliance is not material. It's not a brainwave. It's immaterial. He said, that's the soul. That's free will. He thought that he really had demonstrated scientifically that we have an immaterial power to override our material, you might say, temptations. He said that this actually corresponds rather remarkably to the traditional religious understanding of temptation and original sin. He said that we have a constant bombardment from our material brain of impulses that are sort of encouraging us to do things. He said that we have the free will to override that and the free will is not from the brain. It's a spiritual thing. It's remarkable research. It's very good research. I think it's pretty convincing evidence that free will is real.

Robert J. Marks:

This is fascinating. The first time I heard this from you I thought, boy, does that make sense. Because the original sin aside, people get addicted to things. I used to be addicted to cigarettes. I know I had an impulse in my brain that wanted to make me reach for a cigarette. In order to quit cigarettes, I had to veto it. I had to exercise what you call free won't. I think anybody that overcomes an addiction, be it to alcohol, to porn, to tobacco, whatever, has to exercise this free won't. It certainly makes a lot of sense in terms of everyday application.

Robert J. Marks:

When we were together last, I pointed to a verse in Second Corinthians where we're told to take every thought captive. I thought what a great description of this idea of free won't, that we have these impulses that come to us that we're to take action from them and exercise our free won't and go against what those thoughts are telling us to do. I think there is a neuroplasticity effect from this free won't. Is there? Does the brain rewire itself in a sense? Could you elaborate on that? Because I think that's fascinating, the brain rewiring itself.

Michael Egnor:

Sure. There's been a fair amount of work done on that. Jeffrey Schwartz, who's a psychiatrist in California has written and spoken about that quite a bit. There does seem to be the capacity by exercising the immaterial will to ultimately change brain activity. One could envision, and I think Dr. Schwartz has spoken of this with quite a bit of insight, one could envision a situation in which the preconscious impulses from the brain over time are altered by the immaterial will so that you're not entirely a victim of your brain. You can override it and you can change it. The nice thing is that this is the traditional sort of religious understanding of human motivation, and there's a lot of scientific evidence that supports it.

Robert J. Marks:

I know as somebody involved in artificial intelligence is something called Hebb's Law, which summarize that neurons that fire together are wired together. If you think a thought a lot about A and B, then the neurons between A and B build up a stronger and stronger connection. That seems to be what happens with addiction, but Hebb's Law, I think discovered in the mid 20th century or something, is something that people in artificial intelligence use and I know is a fundamental aspect of neuroscience, but that seems to supply a fury at least to what happens to this rewiring of the brain during the neuroplasticity phase, and is really, really fascinating. You mentioned that sometimes Libet's experiment of free won't is actually misrepresented by materialists. Could you elaborate on that a little bit?

Michael Egnor:

Yes. The misrepresentation is very common, and it's almost routine to read or to hear Libet's work being described as scientific evidence for the absence of free will, which is bizarre because Libet himself explicitly endorsed the reality of free will, emphatically endorsed the reality of free will. Libet pointed out that his research unequivocally supports the reality of libertarian free will, but the experiment very often, or his experiments very often are described both in the scientific literature and in the popular press as supportive of materialism, which is something that they don't support and something that Libet himself made very clear that that was not his conclusion.

Robert J. Marks:

It seems that in order to do that they would have to exclude the part of the free won't in the experiment.

Michael Egnor:

Yes. Undoubtedly, in some situations would be the result of ignorance on the part of the person making the claim. The person just may not know much about Libet's work, or may have no insight into the original research and they've just heard about it and heard about it wrongly. Other times I have to say that maybe the misrepresentation is deliberate because it doesn't support a materialist perspective.

Robert J. Marks:

You think the ideology is actually trumping objectivity there?

Michael Egnor:

Oh yeah. Yeah. It goes on a lot.

Robert J. Marks:

Has Libet's experiment been reproduced and confirmed by different researchers?

Michael Egnor:

Yes. Certainly the existence of the brainwave that occurs before a decision is made has been shown many times. In fact, Libet wasn't the first one to show that. It was called the Readiness Potential, and it was shown a couple of decades earlier by some German researchers. Libet was the first person to look at it in the kind of detail that he looked at it in, but it was known that there was a potential in the brain that happened before decisions were made by about half a second. Recently, functional MRI imaging has been used, which has shown perhaps even a longer interval between the brain activity and the decision. Even a matter of several seconds before the decision is made one can see activity in the brain. I don't believe anyone though has looked at the veto part of it. That is that Libet's free won't aspect, I don't believe has been looked at again, because by and large it's been denied or ignored.

Robert J. Marks:

That's interesting because according to Libet, there was no brain activity during the free won't portion of the decision. Is that right?

Michael Egnor:

Precisely. Libet interpreted the results of his experiment as strongly endorsing the reality of free will, and his experiments have largely been used to deny the reality of free will. It's a radical misrepresentation of what Libet actually found.

Robert J. Marks:

My goodness. That would be so interesting because I think that no brain activity detected during the free won't would really be strong evidence about the immateriality of the mind. That would be really nice.

Michael Egnor:

Right. One can say, if one is really doing objective science, one could say, well, perhaps there was brain activity associated with the free won't, except that the way Libet was recording it, didn't find it. That's possible. Although, he found that the brain activity associated with the original thought, one would imagine that the veto would also show up, but none of those issues have been really looked at again carefully, which doesn't speak well for, honestly, for the integrity of neuroscience, because they should've looked at it again.

Robert J. Marks:

You think that that would be such a big deal. Something that people would be really interested in it, but maybe they're not interested in going down a path which leads them far from their ideology. That's probably the problem.

Robert J. Marks:

Here's a question I was asked in college, which I thought was kind of interesting. It's a philosophical question. If you lose all four of your limbs, are you still you? Most would say yes. There in fact was a cheesy 1962 sci-fi movie called *The Brain That Wouldn't Die*. In it a woman's head was kept alive without a body. The head, though, could still see, think and talk. If this happened to you, would you still be you? I think most would say yes. If only your living and functioning brain were able to survive, maybe connected to sensors and some robot arms, would you still be you? Most would say yes, but what if your brain were cut into pieces? Would you still be you? Believe it or not, we have an answer and Dr. Egnor is going to answer it. Dr. Egnor, tell us about the research of Roger Sperry. Is it Speary or Sperry?

Michael Egnor:

Sperry.

Robert J. Marks:

Sperry. Okay. His research as a neurosurgeon and what it tells us about what makes you you in terms of the brain?

Michael Egnor:

Sure. Roger Sperry, he was a neuroscientist and worked largely in California during the mid 20th century. He won the Nobel Prize in medicine and physiology for his research. He was very interested in the neurological consequences of an operation called corpus callosotomy, and a corpus callosotomy an operation in which the neurosurgeon basically splits the brain in two. In that surgery, which I've performed and then my colleagues perform, the corpus callosum, which is a large bundle of nerve fibers

that connects the two hemispheres of the brain is cut so that the two hemispheres of the brain are functionally disconnected. There's no longer a material connection between them.

Robert J. Marks:

Let me ask you a question. I watched a movie called *One Flew Over the Cuckoo's Nest*, and there they did a frontal lobotomy. In fact, there was a country music song that came out at the time, terrible country music song said, I'd rather have a bottle in front of me than have a frontal lobotomy. But Nicholson's character, I think, had a frontal lobotomy. This corpus callosotomy that you're talking about is totally different than a frontal lobotomy. Is that true?

Michael Egnor:

Yes. Frontal lobotomy was an operation or several different operations that were part of what was called psychosurgery, which is surgery to sort of change your emotional or cognitive state, and fell into disrepute. Largely for good reasons. It was used, for the most part, rather inappropriately.

Michael Egnor:

Corpus callosotomy is seizure surgery, and it was surgery that is designed to help treat people who have intractable seizures. It's really a different kind of surgery and it doesn't share anything really in common with lobotomies. The reasoning behind the surgery is that there are some people who have small seizures in one hemisphere of the brain, who have those seizures travel across the corpus callosum into the other hemisphere. When the seizure does that, it becomes a major seizure instead of a small seizure. That can be very disabling. There are people who have 20 or 30 of those major seizures a day and medication doesn't always work. The point of the corpus callosotomy is to prevent the major seizures from happening and it's reasonably effective. There are many ways of doing it. Sometimes the entire corpus callosum isn't cut. Sometimes only part of it, but sometimes the entire corpus callosum is cut. Sperry felt that these patients were very interesting from the standpoint of neuroscience, because they ask the question -

Robert J. Marks:

When you say they were cut, the left and right hemisphere were totally separated from each other?

Michael Egnor:

For the most part, yes. There are small regions in the lower part of the brain called the anterior commissure and the posterior commissure, where there still was some potential for connection, but 99% of the connections between the two hemispheres were cut by cutting the corpus callosum.

Robert J. Marks:

99%. Okay. Wow.

Michael Egnor:

Sperry asked a question. He says, so what happens to these people? It was clear that by cutting the corpus callosum their seizures were made better, but were they still one person? What did cutting the brain basically in half do to a person? He studied these patients in great detail. I've had patients with this as well. What he found is what I found and what all neurosurgeons who've dealt with these patients

have found is that they're basically okay. That is, you cut the brain basically in half, and except for the fact that their seizures usually get better, they're no different. They're perfectly all right.

Robert J. Marks:

Isn't that incredible?

Michael Egnor:

Right. If you were to meet these people, if they sat down in front of you and you had a conversation with them, you couldn't tell the difference. They're perfectly normal people and they can't tell the difference. They don't feel any different. What Sperry did though was that he studied them very, very carefully. He found that there were subtle differences. For example, it's well-known that if you look straight ahead, everything to the left of the midline of where you're looking is seen via the right hemisphere of your brain and everything to the right of where you're looking is seen by the left hemisphere of your brain. The visual fields kind of cross in the brain.

Michael Egnor:

Sperry showed that the left hemisphere is mainly the hemisphere that mediates speech and the right hemisphere tends to mediate sort of geometrical and spatial understanding. If the corpus callosum is cut, the two hemispheres have perceptual abnormalities. That is that if you show the right hemisphere an apple, then the right hemisphere can mediate knowledge that it's an apple, but it's not capable of mediating speech and saying it's an apple. Only the left hemisphere can do that. He was able to understand the functioning of the hemispheres in a little more detail, but all of the functional abnormalities that he found, number one, they were undetectable in everyday life. In fact, that's why he won the Nobel Prize. You don't win the Nobel Prize for finding obvious things. In everyday life, these people were perfectly normal.

Michael Egnor:

In very careful, subtle testing, you could find these perceptual abnormalities, but the other thing that he found was that all of these abnormalities were perceptual. None of them were intellectual. That is there was no abstract thought. It wasn't like you disconnected addition from subtraction or justice from mercy or integral calculus from differential calculus. There were no intellectual changes. These were all just perceptual. What I believe this research shows and what I believe is the most interesting thing about Sperry's research was not what's usually cited. Most people say that what's interesting about Sperry was the abnormalities that he showed. What I think is most interesting is the lack of abnormality that he found. That is that these were basically normal people with brains cut in half. That is what ought to make us say, wow.

Robert J. Marks:

You're talking about abnormalities and there were no abnormalities in terms of abstract reasoning and such?

Michael Egnor:

Correct. It would be the same thing as if you were sitting at your computer and one of your mischievous kids took a chainsaw and cut your computer in half and you're typing away and nothing changes. It works just fine. You'd think hey, there's something about this computer that I didn't understand before, because it's still working. The surgeons cut these people's brains in half, Nobel Laureate neuroscientists

studied these patients, and found very little that was wrong. Specifically, they found that the only differences were perceptual things, not intellectual things. In my view, what Sperry showed was that the intellectual aspect of the human mind is what philosophers call metaphysically simple. By that, I mean that it can't be split, like matter can be.

Michael Egnor:

Any material thing, if you think about it can be split. That is, your cell phone or a piece of paper or a brain, you can cut it. You can cut it in half. In fact, if you think about it, what defines a material thing is that it has extension in space. It's got parts to it. Cut it down the middle, you get a right part and a left part. Does the mind have parts? While one might make a case that the perceptual powers can be sort of divided into parts, the intellectual powers cannot be. You can't cut the intellect in half. If you did, you'd have two people and you don't get two people. What the split brain research showed, I think, is that intellect and will, which follows on intellect, are what's called metaphysically simple. That is, they're not composed of parts. That is typical of a spiritual thing. Spiritual things aren't splittable. You can't split a spirit. It doesn't make any sense to talk about splitting spirits. I think that Sperry's research strongly confirms the viewpoint that the intellect and will are immaterial powers of the mind.

Robert J. Marks:

I'm sitting here thinking about ways that the two hemispheres can still communicate. Things that come up, I don't know if these have been considered, but one would be a quantum connection where you have entangled states on both sides that some way connect to each other, maybe some electromagnetic connection or the idea that the brain might act like a hologram. That if you cut away, it's like looking through a window. If you take a window and you take away half a window, you can still look through the window and see what's on the other side. Do you know anybody that has tried to explain away the split brain surgery using an argument of this sort?

Michael Egnor:

Well, I'm not aware of anybody who has brought up the point that the split brain surgery strongly supports the viewpoint that the intellect is metaphysically simple and is an immaterial power of the mind, even though the research obviously supports that view. The notion that there must be some other way for the hemispheres to connect, be it quantum or electromagnetism or something, I think may be sort of a category error, meaning that I think the most logically rigorous way to look at it is that the intellect isn't a material power of the mind, so that talking about connection of the hemispheres related to the intellect doesn't really make any sense. Meaning that if something is immaterial, then it doesn't have material connections, by definition.

Robert J. Marks:

I see.

Michael Egnor:

It's not a relevant point, meaning that you could chop the brain into a thousand pieces and it wouldn't have an effect on immaterial powers of the mind, because the material powers of the mind aren't from the brain.

Robert J. Marks:

Yeah. That is a point. In fact, when I was giving the introduction, I thought, if you cut your brain into, would you still be you? Well, that's not what defines you. Your brain is not what defines you. It's your mind, it's your soul, it's your spirit.

Michael Egnor:

Then you can raise the question as to if the intellect is an immaterial power of the mind and the brain itself mediates material powers, which it certainly seems to. Obviously, there are a lot of material aspects to brain function. People are paralyzed if you get a stroke and things like that. How do these things work together? That's a tough question. It's a question that has bedeviled Cartesian dualists, who believe that the brain and mind are separate substances. It's a little easier for Aristotelian philosophers to explain, because they believe that the soul or the mind is the form of the body, and that the mind or the soul is related to the body in the same way that the form of a chair is related to the chair itself. So it's something just intrinsic to a physical body and it doesn't require any particular special explanation.

Robert J. Marks:

Is there any way that a materialist could relate to the observations you've made about the split brain operation?

Michael Egnor:

They could ignore it, which is what they try.

Robert J. Marks:

Okay.

Michael Egnor:

Because let's face it, if you chop the brain in half and from the standpoint of the intellect, nothing whatsoever happens, that is an extraordinary result. It's like chopping the heart in half and finding that it has no effect on the heart.

Michael Egnor:

It's not what you would anticipate. And the fact that that hasn't been talked about to my knowledge at all, is an indication that the approach materialists have taken to Sperry's results is to ignore the really important parts of his results.

Robert J. Marks:

My goodness.

Robert J. Marks:

If you're in a coma, can you still think? Neuroscience gives us an answer. What does neuroscience say? I have down here in my notes, Adrian Owen. What did he do?

Michael Egnor:

Sure.

Robert J. Marks:

And what did he tell us about comas and people thinking in comas?

Michael Egnor:

Sure. Well, first of all, as a predicate, people usually take coma to mean that a person has no meaningful interaction with their environment. And there's a condition called persistent vegetative state that is thought to be the deepest level of coma. And it's not brain death, because brain death means actual death.

Michael Egnor:

But it's the closest thing there is to brain death. It's a state in which it's been assumed that a person has absolutely no subjective experience. Meaning, there's no first-person experience. You don't dream. You don't feel anything. You don't think anything. You're just not really there.

Robert J. Marks:

But I assume there's still brain activity going on, right?

Michael Egnor:

Yes. Yes. Yes, people in persistent vegetative state can breathe. They can control their heart rate, things like that. But basically, they've been thought of as a vegetable. That is, as a human body, without a mind. And that's been the assumption for persistent vegetative state.

Michael Egnor:

Now, the reality is that families and nurses and doctors who take care of these patients very often have said that they really have the sense in caring for these patients, that they very often are aware of things. But it was hard to quantify. It was hard to put your finger on.

Michael Egnor:

And examples are that you can be in the room of a person who is either in a persistent vegetative state or in other kinds of deep coma, and you can say something verbally in conversation that makes the person's heart rate go up or down.

Robert J. Marks:

Ah.

Michael Egnor:

They seem to have an emotional response to what you're saying. But that's always been sort of anecdotal. So the question that one can ask is, is there any evidence that a person in the deepest level of coma has any awareness of what's going on around them? And that question was addressed rigorously first by a neuroscientist named Adrian Owen at Cambridge, in England, back about 15 years ago.

Michael Egnor:

And Owen took a woman who was in persistent vegetative state, she'd been in a car accident and had severe brain damage, and she had been in this state for several years. And he put her in an MRI machine

and did what's called a functional MRI test. And a functional MRI test is a test that looks at changes in blood flow in the brain that we believe correspond to activation of parts of the brain.

Michael Egnor:

So you can kind of tell what's going on inside the brain during the time they're in the machine. So he put her in the machine and he put headphones on her. And he asked her to think about things. Now, remember, she's a woman who supposedly is in the deepest level of coma, completely just a hair above brain dead. And he said, "Imagine you're walking across the room. Imagine you're playing tennis. Think of things."

Michael Egnor:

And he found activation in her brain. Even though she had massive brain damage, there were patterns of activation. So he then took 15 normal volunteers, put them in the machine and asked them the same questions. And her patterns of activation were identical to theirs. Looked the same. So he said, "Well, to a first approximation, it looks like she can think just like they can think."

Michael Egnor:

But then he said, maybe the activation we're seeing in the brain isn't because she understands. Maybe it's just the brain's reaction to sound. Maybe it doesn't necessarily mean that you understand. Maybe just the noise from the headphones is causing this activation. So he scrambled the words. So instead of saying, "Imagine you're walking across a room," he would say, "Across walking imagine room your." So it made no sense.

Michael Egnor:

And the activation went away in her brain and in the volunteers. So he showed that the only time she had activation in her brain was when what was asked of her made sense. And her activation was indistinguishable from the activation of completely conscious people. So he concluded that she was able to understand and think about what he was asking her to understand. And think about it, even though she was in the deepest level of coma.

Michael Egnor:

So his research has been repeated by a number of other laboratories, for many, many patients in persistent vegetative state, and about 40% of people in persistent vegetative state show high levels of intellectual functioning, even in deep coma. And there are ways of conversing with people in deep coma where you can, for example, look at the activation state representing yes, and the activation state representing no, and you can ask them questions.

Michael Egnor:

Are you lonely? Do you wish your mother were here? Would you like something to eat? Stuff like that. And they can answer you with these brain states. In addition, some people can do mathematics in coma. Or you can ask them, is the square root of 25 six? And they do a no. Or is it five? And they do a yes. So there can be very high levels, not in all patients that we've found, but in many patients.

Michael Egnor:

Again, probably 40% at least of mental function in profoundly damaged brains, to the point where actually the medical profession has added a category of patient to this list of ways you can be in a coma. And this is called minimally conscious state. So patients who have evidence of intellectual functioning in deep coma are called minimally conscious. Although frankly, they're not really minimally conscious. They're quite conscious.

Michael Egnor:

What this research shows us, besides just the remarkable fact that people who we had previously thought were in deep coma are quite aware of what's going on around them, this obviously would have relevance, for example, to the Terri Schiavo issue that happened also about 15 years ago, where this woman in Florida, who was in persistent vegetative state from a lack of oxygen to her brain, was starved to death by her husband.

Michael Egnor:

Supposedly, according to what her wishes would be, because it was assumed that she had no consciousness at all. And this would suggest that there was at least a chance that she was very much aware of what was happening to her, which is what her family said, what her parents said. So it suggests to us that we should treat people in coma with a lot of respect and a lot of consideration, and what I think ought to be the presumption that they are aware. And we should treat them that way.

Michael Egnor:

But anyway, what this research suggests is that there is a disconnect between mental states and brain states. That is that you can have massive brain damage and still have surprisingly high levels of mental function, which at least suggests it's an indirect evidence. But it is evidence that some aspects of mental functioning, particularly intellectual functioning don't necessarily have a basis in the brain, that maybe that functioning transcends the brain.

Robert J. Marks:

Let me ask you a question, because we've talked previously about the difference between perceptual thought and abstract thought. In my mind, doing square roots is like memorizing multiplication tables and such. It's just something you go to in your memory, and it's not true math.

Robert J. Marks:

If you give them a math problem they've never seen before, that would be true math. Is it possible to detect abstract thought in these coma patients, or is everything perceptual? Or am I hearing you wrong?

Michael Egnor:

Well, it's tricky. First of all, one has to ask, what is the difference between abstract thought and perceptual thought? How would you define them? I think the point of cleavage is between abstract thought and concrete thought. The classic Platonic Aristotelian distinction between abstract thought and concrete thought is that abstract thought refers to concepts that are completely divorced from any concrete object, physical object, whereas concrete thought is about a physical object.

Michael Egnor:

A very good example would be the difference between thinking about the hamburger that's sitting in front of you and thinking about nutrition. You can think about the hamburger and it's a quarter pounder, and it's got cheese, and it looks pretty good. And you can think about nutrition. You can think about the fact that it's got 1,000 calories and maybe that would blow your diet. And those are two different ways of thinking.

Michael Egnor:

The problem for neuroscience is of course, that we tend to think of them together. That is that by and large, when a rational human being thinks about food, there'll be some abstract quality to it. Like, maybe I shouldn't have that banana split right now. On the other hand, when you think about abstract things like nutrition, you're likely at the same time, thinking about concrete foods.

Michael Egnor:

Maybe if I'm thinking about nutrition, I'm thinking about those fries I had last night, where they weren't the best thing for me. So it's difficult to separate out neuroscientifically, thought about concrete things and thought about abstract things.

Robert J. Marks:

And that would be very difficult in the state of a coma, for a neuroscientist to differentiate between.

Michael Egnor:

Right. Right. Although one could say that, for example, I think asking a question about, for example, square roots, there's a lot of abstract concepts there.

Robert J. Marks:

Well, unless the patient is a nerd.

Michael Egnor:

Well, if they've memorized the pictures, if they had memorized what it looks like on a printed page, yes.

Robert J. Marks:

Yes. And again, I would refer back to the idea of memorizing multiplication tables and addition tables.

Michael Egnor:

Right. Right.

Robert J. Marks:

And I think that a lot of people that do mathematics for a living, like me, have that really at the tip of our fingers, not because of an abstract thought, but because that's what we do for a living. And we've been there a number of times.

Michael Egnor:

Yes. And one thing that is helpful in at least seeing that there are two different kinds of thoughts involved, is if you think of your ability, for example, I know that you personally have written extensively

on Fourier transforms, and a person in Russia who speaks no English whatsoever can know everything you know about Fourier transforms. And a person in China can know everything you know about Fourier transforms, even though nothing about your languages overlaps.

Michael Egnor:

And you could imagine somebody, although I would imagine the written mathematics is simpler, you could imagine somebody who uses different symbols in their mathematics, would also know exactly what you know about Fourier transforms, even though they're using a completely different set of symbols. And so the knowledge that you would share in common with somebody who does not share your language or symbols, would be the abstract thought.

Robert J. Marks:

I see. Do you think that there might be a clever experiment of the type that Owen generated, that would actually allow differentiation between abstract and perceptual or concrete thought? Does anything come to mind?

Michael Egnor:

Yes, that's a tough one. And there are people who've looked at issues like that and all sorts of ways of approaching it. What I think is at least a doorway into solving that problem of separating abstract and concrete thoughts so it can be studied rigorously with neuroscience, is to use Owen's rather ingenious approach of scrambling the words in the sentences, so as to remove the semantic content from the sentence. And one could do that.

Michael Egnor:

For example, one could record the brain waves of a person looking at a word on a card, and let's say the word was the word mercy. And when you see the word mercy, it evokes thoughts about the abstract concept of mercy. You could take exactly the same letters and scramble them so they didn't mean anything, and show the person the same card. So that for all intents and purposes, the person is still looking at a card that contains five letters in black ink on a white card.

Michael Egnor:

And the difference between the brainwaves of the card that says mercy and the card that shows the scrambled letters, would be the brainwaves that are correlated with the abstract thought. And if abstract thought is immaterial, then there shouldn't be a difference.

Robert J. Marks:

Well, you've kind of answered my next question. I think that most of Owen's stuff was done in, what did you say? An MRI machine?

Michael Egnor:

A functional MRI.

Robert J. Marks:

Functional? F?

Michael Egnor:

Yes.

Robert J. Marks:

Okay. Functional MRI. Do you think that that's always required? I think the functional MRI is going to be pretty expensive, isn't it?

Michael Egnor:

Yes. The other way one could do it is with electroencephalogram, a brainwave study where you put electrodes on the scalp. Or you could even do it during brain surgery, with awake patients, if the surgery is for some other reason and the patient consents to being a part of a research project on mind states.

Robert J. Marks:

While they're comatose in other words?

Michael Egnor:

No. No, but you could look at this question of the neurological correlates of abstract thought in patients who are just awake. Looking at people who are comatose is one way of getting at the issue, but you could also look at it in people who are awake.

Michael Egnor:

The implication of this finding, I think in comatose patients, is that there is a disconnect between a mind state and a brain state that suggests that the mind state is not completely explainable by the brain state. But you could also look at that in awake patients.

Robert J. Marks:

Okay. Do we conclude then that humanitarian treatment of those in a deep coma should be to keep them alive, keep them nourished and keep them going, even though they have very little capability or possibility of being recovered?

Michael Egnor:

Yes. Yes, it supports the basic notion that all human beings, regardless of their physical condition, warrant respect, warrant compassion and have a basic right to certain fundamental things like food, like water, like hygiene, like shelter, like clothing. Just the basic ways you would treat any human being. I don't think that people in comas should be considered less than human.

Michael Egnor:

So I wouldn't treat a person in a coma with any less respect than I would treat somebody who was awake and sitting in a chair in front of me. For example, I think that what was done to Terri Schiavo was a brutal, cruel thing. I should point out that when she was deprived of food and water, and it took her more than a week to die, when she was deprived of food and water, they gave her morphine.

Michael Egnor:

Which you would think that if you really thought that she had no awareness, then why would you give her morphine? So I think even the people who were starving her to death on one level, were concerned that she was aware, which is a pretty horrible thing.

Robert J. Marks:

That's an interesting observation, that their conclusion was actually self-contradictory in their treatment. Wow.

Michael Egnor:

She was on a morphine drip during this. They gave her continuous morphine.

Robert J. Marks:

Yeah. It seems to me the treatment of people in deep comas parallel something like the severely handicapped children or such.

Michael Egnor:

I was at a medical conference during the time that she was being deprived of food. And there was a discussion during the medical conference about the ethics of depriving her of food. And most people at the conference felt that it was appropriate to deprive her of food. And I uttered against it.

Robert J. Marks:

They did?

Michael Egnor:

Oh, yeah. Yeah. Yeah, it was widely, widely accepted. Or at least, most people who spoke up. It turns out afterwards, I found that a number of people didn't think it was appropriate, but they didn't really want to speak up. But I pointed out during the conference that it was ironic that we were having this discussion while a profoundly handicapped woman was being starved to death, and the conference was catered.

Michael Egnor:

So we were sitting there eating sandwiches, talking about starving a brain damaged woman to death, and saying it was okay to do that. And everybody, there were a couple of 100 people there, everybody put down their sandwich. Nobody else ate the rest of the session, because we realized what we were doing.

Michael Egnor:

The other thing, the point that was made, and this really goes into medical ethics, but I think it's a very interesting question is, one of the rationales that was used for depriving her of food was that her handicap left her unable to get food herself.

Michael Egnor:

And that some sense, changed her status, that if she had lost that kind of autonomy, then, well, she was different. And that it was acceptable since she couldn't obtain it herself, the food herself, to let her pass away without feeding her.

Michael Egnor:

And so I asked the people at the conference, I said, "Is there anybody here that if you didn't have supermarkets and you didn't have caterers, and you didn't have people to make your food for you, could obtain your own food? Could you grow your own food?" Nobody could. We all depend on other people to feed us.

Michael Egnor:

People like Terri Schiavo depend on other people to feed them in a very, very direct way. The rest of us depend no less on other people to feed us, only we go to the supermarket and we think we're feeding ourselves, but we're not. So I stressed that she was no more dependent on other people to feed her than we are. And it was just as cruel to deprive her of food as it would be to deprive any of us of food.

Robert J. Marks:

Yeah. It seems to me, the philosophy of the sacrificing of coma patients is a slippery slope to Nazi Germany's condemnation of useless eaters.

Michael Egnor:

Precisely, precisely.

Robert J. Marks:

You get to the point where people are condemned because they're not productive to society. Well, thank you, Michael. Our guest today has been Dr. Michael Egnor. He's a professor of Neurosurgery and Pediatrics at State University of New York. And for Mind Matters, until next time, be of good cheer.

Announcer:

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