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Is Perception Reality? | William Newsome & David Eagleman

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The Veritas Forum

The advances of neuroscience have given us unparalleled knowledge of the human brain, but as any neuroscientist will tell you, we're just scratching the surface of the brain's potential. At a Veritas Forum hosted by Stanford students, William Newsome (Stanford) and David Eagleman (Stanford) explore the depths of neuroscience and what it means for our understanding of human identity.

Transcript

Do we live in a holy universe that has moments of holiness shot throughout if we only have the sensitivity to see it and call it what it is? Or do we live in fundamentally a pointless universe? You can come to either of those conclusions, but I think that kind of questions the start of the religious quest. The advances of neuroscience have given us unparalleled knowledge of the human brain, but as any neuroscientist will tell you, we're just scratching the surface of the brain's potential. At a Veritas Forum hosted by Stanford students, Stanford neuroscientist William Newsome and David Eagleman explore the depths of their field and what it means for our understanding of human identity.

I hope we're coming out. I just continue to be impressed and inspired by how interested people are in neuroscience and in these questions. Thank you all for your time and coming out.

So we've got an exciting discussion. So the first thing I want to do is ask both of these gentlemen what it is that they, what their research is. So can each of you give a brief overview of your work and research interests relating to neuroscience and perception? Sure.

Can you guys hear me in the back? Is this thing on? Okay, good. So I am actually quite appropriate for this. I've spent my career studying visual perception.

I do a lot of work with animals where we can actually train them to tell us what they see

on television screens and basically press bars and work for their favorite rewards so we can actually study perception and the question that's actually been four minutes to nine-nine for a lot of years is how do these sort of hundreds of millions of neurons in the back of our heads, the visual parts of our brain, just electrical and chemical activity back there create the visual world that we're all experiencing right now. And that seems to me like, you know, almost miraculous that that actually happens, that what we're seeing emerges out of action potentials and neurochemicals. So I've spent maybe half my career looking at that, having the good fortune with some great students here at Stanford to learn a bit about how that actually works, particularly the domain of motion vision, seeing motion, calculating motion.

And I've been working for the last 25 years or so using that knowledge of the platform to ask questions about visually based cognition, things like visual attention, visual decision making, visual memory and so forth and so on. So it's been a great ride and that's the basic thrust of what kind of search is about. Excellent.

David, how about you? I've been very interested in something that's a close cousin to what Bill does, which is the issue is how does the brain construct perception in its entirety, not only vision but all the other senses given that it's locked in silence and darkness and all it ever sees are electrochemical spikes and yet somehow it produces this entire reality that we enjoy. So even though you're seeing us up in front, the vision of it is all taking place inside of your head and you know, there are air compression waves and different frequencies of light and so on and you understand those as sounds and colors and so on. So this is I think for both of us the heart of what is so fascinating about neuroscience.

So my career has really been about understanding how the brain constructs reality from the level of the neurons and neural networks to different ways that we can experience reality. For example, I studied a lot about time perception and what can happen when you're in fear for your life and stuff like that and things like synesthesia, which is something that about 3% of the population has, where their experience of consciousness is just a little bit different. It's not a disease or disorder, it's just an alternative way to experience consciousness all the way to the social impact of that.

For example, we're a neuroscience intersects with the legal system and what we do about the fact that reality is quite different inside everybody's head. Great. Now, how would each of you describe, that's from a scientific perspective, how about from a philosophical or religious perspective? Could you each describe your worldview and how that if it does affect motivates, inspire research questions you have or how you would approach your work? Yeah, so I come from a very Christian tradition.

My father and grandfather were both Baptist ministers. I grew up down in North Florida. The council my evangelical speaking style, which many people would have been working

on.

I'm currently a member at St. Mark's Episcopal Church here in Palo Alto, so it's been kind of wanting way. I don't really care that much about denominations. I care a lot about the character of the local congregation.

And I was very interested in science from the time I was a kid. My parents never put any kind of block in front of that. They've always encouraged me.

And I think, you know, I was a physics major, actually, as an undergraduate, but I decided I wanted to study the brain in part because it seemed like this is where it all came together up here between our ears. You know, and somehow there's one world we live in, one reality we live in, and understanding the brain could sort of satisfy some of my curiosity about all the things that we do as humans from science and the laboratory bench, from, you know, worship in a church pew. So I kind of hold up, I guess, the Christian worldview of this dialogue, a little bit of a question, although it's ought to be to use the Christian worldview because there's so many variations within Christianity, and maybe we'll explore a little bit of those tonight.

I'm not conscious of my religious faith, other than being a motivation for getting into neuroscience in the first place, being actually influenced by questions. Questions I ask in the laboratory are just like any good scientist. I hope good scientists would do, which are curiosity driven, understanding how the system works.

I think probably my faith commitments affect maybe sometimes the way I talk about what we discover in the laboratory. I'm not a sort of a reductionist in methodology. I'm not a reductionist, it is an ideology, and I think there's an interesting difference there to be explored.

And I think I hope that my faith and faith commitments and background influence the way I treat people every day at work, even though it doesn't influence the actual experiment. My view on this has been, there's so much in science that we know, but there's an even greater amount that we don't know, and we are always trying to build a peer out into the ocean of all the unknown to try to figure stuff out. But the fact is that there's still plenty of ocean in front of us as far as the eye can see, actually.

So my view in this question is, it's difficult to say I'm going to commit to being a strict atheist because it's difficult to pretend like we've got the whole thing figured out, especially we're surrounded with mysteries. My personal view is that we know too much to subscribe to any particular religion, because at least in the literal interpretation of them, we already have so much knowledge that we can effectively rule out most of those claims. One obvious example is the age of the earth, being 6,000 years old, according to biblical tradition, we now, through various means, have evidence that's at least 4.5 billion years old, this sort of thing makes me feel like we probably don't know

enough to commit strict atheists, and we know too much to commit to any particular religious position.

And this is a statement that you may have heard before, is that you already know what it's like to be an atheist, because all I need to do is look at someone else's religion, and you think it's ridiculous that they would ever believe that particular set of beliefs. So given that there are 2,000 religions on this little planet, I feel like we can probably go beyond that. So for me personally, that puts me in a middle ground.

Some people think of that as agnosticism. I don't find that word particularly compelling, because what it typically means is I don't know if the thing that I have inherited is true or not true. The guy with the beard on the cloud, maybe he exists, maybe he doesn't, that kind of thing.

So I call myself a possibility in, and the idea with possibility in is an active exploration of the possibility space. So that takes everything that we know in science, and uses that to carve this space. So there's still tons of unknowns, and we can rule out parts of that space, and we can open up new folds in that space.

And one of the things that's so lovely about science is being able to hold multiple hypotheses at a given time. That's what scientists are really good at, is saying, well, we don't really know, it could be this could be this. Okay, we'll try to gather evidence to weigh in favor of one or another, and until that time we'll hold all of these on the table.

Science's table is wide. So that's what I think is a useful position to be in, as far as that is, is a possibility in this. And this, by the way, does not mean that anything goes.

Possibility of, you know, I've given talks on possibilities in the past, that people come up to me and said, I think that's great to eat with that. So you get where I'm coming from with this ESP and crystals and so on. So that's not what the possibility is.

It is that anything goes at first, and then we use the tools of science to address those things. And as cool as it would be if ESP existed or something, it doesn't, to the best of our, you know, scientific studies on this kind of stuff and lots of other things. We can actually rule pieces and parts of that out.

Great. Well, this is a great point to get started. I think that moving into the meat of the specific questions, I want to get into your perspective on how big is the brain ocean.

So David, you described sort of this peer that we're building out into the unknown. How much of the brain do you think we presently understand? Again, to get our percentage, just like point estimate, where we have like halfway there. Of course, it's impossible to give a percentage so I know what 100% is.

So, but, you know, very little. I mean, we don't know the basic things. I actually wrote an

article in Discover Magazine in 2004 called 10 Unsolved Questions and Neuroscience.

And they're still unsolved just as unsolved as they were then. And I would never imagine that when I wrote it that in 2018, we'd still be struggling on these things. But like, you know, one of the big ones is consciousness.

How do you put together 100 billion neurons or just specialized cell types and 100 billion glia and smush all these together? And you experience the taste of feta cheese or the smell of cinnamon or the redness of red or the pain of pain or something. You know, if I give you 100 billion tinker toys and ask you to start putting them together, at what point do you say, ah, now I'm going to put this last tinker on, ah, now it's experiencing the beauty of the sunset or something. The question, we actually don't know how to answer this question in neuroscience about where consciousness even comes from.

So, you know, there's a deep question, of course, about can we build robots or computer programs that will become conscious like Westworld, this sort of thing. But we don't, you know, that could happen accidentally, but we don't even have a theory. The weird part is, not only do we not have a good theory of consciousness, we don't exactly know what such a theory would look like because we change our traditional tools of say, oh, carry the two and do a triple integral here and up there it is.

There's the taste of feta cheese because it's sort of a different life. So anyway, that's, I think the answer is very little, but I don't know how little. Very little.

And we'll get back to consciousness. But what's your thought on this question? I agree with David on this one. I get asked this question sometimes by audiences like this, my typical answer is well under 1%.

Yeah. And probably under 0.01%. I mean, we know some really important things about the nervous system. And David knows a bunch of interesting things he could tell you I do too.

But it's, we're just scratching the surface. In 2018, we're literally just scratching the surface. By the way, the popular book in our field is called Principles of Neural Science.

But it's that thick. And if you really wanted a book called Principles of Neural Science, you wanted to be the size of a pamphlet or a haiku or something. Like we'll eventually get there in a thousand years.

But anyway, I just think it's mistitled. It's a lot of principles. It's true.

It should be probably in cycle of PD and neuroscience. Well, maybe we, we could jump into the, uh, a deep end first and okay, so you said, David brought up the question of consciousness. So, you know, the taste of fenachese or something like that.

Well, what, what is consciousness? Yeah. Let me tell you, okay. I just, we, uh, that we don't know.

I mean, what we know is that we experience it from the inside. We know it is like something to be alive. Um, and it is like something when you are in pain.

But you know, if we look in principles of neuroscience or something, you know, pain got it pretty well worked out. There are receptors in your skin and they send trains of signals up to particular parts of the brain and these well-earned other parts of the brain. Well, it's not clear anywhere in there's, why does it hurt? And, um, and so yeah, consciousness is the internal experience that we have.

And it's just, um, I mean, as I said, it's just not clear how to make a computer program that starts saying, hey, I'm, I'm having an internal experience. So, um, consciousness is a word that gets used that one word for multiple meanings, right? And David's articulated one of them quite nicely. I would say, you know, a lot of confusion starts when we mix up these meanings.

One of them is you're conscious versus unconscious, like when you get hit on the head with a hammer, you're unconscious and then you're conscious. Second is a natural phenomenon. You're conscious when you're awake, you're unconscious when you're asleep.

The third is what I would call the phenomenal consciousness that David is talking about here, the sense of awareness of the direct sort of apprehension of the experience of, of redness or a particular taste or something, which, um, you know, the philosophers call it qualia, if any of you are familiar with that. The fourth is really, I would call it self-reflexive consciousness. It's a, it's a, it's a reasoning about our own consciousness and about our own experience and building a higher level of consciousness.

But the, I think the most people think of this, this phenomenal consciousness that the consciousness that they articulated, I agree that I have no answer for that, how that happens. I don't think science has an answer for that, how that happens. To my mind, scientifically speaking, it's one of two great miracles in the universe.

The first is that, you know, there is something here rather than nothing. We, we didn't have to have a universe here, I don't think. Uh, and the second is that bits of matter can become conscious.

I mean, you could easily imagine, I think, uh, building a robot that imitates many of our cognitive, uh, and behavioral, uh, possibilities and actions, but isn't conscious in the sense that, that we are conscious. And so, I, I agree that that's a deep mystery. So I, it's, it's a, it's, it's something we simply don't know the answer to yet.

I'll tell you one thing I do believe about consciousness, and this is important. In a lot of

neuroscience circles, you'll hear speculation that consciousness is epiphenol. That means that it's like a froth on top of wave at the ocean.

All the action is really in the ocean, and there's just this froth that gets kicked up by the wave. And so a lot of people will, what neuroscientists will say, you know, all the action of causal gears and behavior at the level of synapses and neurons and hormones and neuromodulators. In consciousness, and just this froth that kind of rolls on top, and it's not causal, you know, the narratives we tell each other about our lives and our stories are not, you know, they're just kind of decoration put on after the fact.

And I don't believe that. Okay. So, you know, one of the most striking examples for me personally of consciousness being causal can, can, can, concerns bias that we all grow up with.

Cultural bias, familiar bias, regional bias, racial, gender bias is all sorts. And as a professor, I may go on for 10 or 15 years systematically grading students papers differently, depending on characteristics that they have that I'm not even aware that I'm doing it, right? I'm not even conscious of it. But if somebody shows me the data and shows me that I'm systematically giving one group better grades than another group, and I become conscious of it, then there's a chance to do something about it.

And until I do become conscious of it, there's no chance of doing anything about it. So I think that's a very clear example where consciousness is quite causal and important to all of us. Yeah.

What are your thoughts on the causality of consciousness or the reality of it? I think the quote I was going to give that talks about this is from Francis Crick. You, your joys, your sorrows, your memories and your ambitions, your sense of personal identity and free will are no more than the behavior of a vast assembly of neurons. You're nothing but a pack of neurons.

So Crick was actually one of my mentors when I was a postdoc and I, and I, and I loved him, I loved him, but, but what that quotation at least, what that misses, at least by itself, is that there are emergent properties. So you can build things out of things. So I could say, look, I'm just 30 trillion trillion atoms, but I'm more than that, right? I have love and hunger and desires and fears and so on.

So, you know, if I were to take, you guys know this property of this, this notion of emergent properties, like if I take a bar of metal, that doesn't have the property of lion tightness. But if I put several of them around in a cage, then that has the property of lion tightness. They can keep a lion in there.

So that's the notion of emergent properties. We get lots of things together. So clearly we are made up of this stuff.

The reason we know that, of course, is because when you get brain damage, even do a very tiny part of your brain, that changes who you are. That can change your ability to speak or see colors or name furry animals or a hundred other things that are seen in the clinics every day. As opposed to other parts of your body, if you were to lose your fingertip in a car accident, you'd be sad about that, but you wouldn't be any different as a person.

So we know that, somehow, this is the densest representation of who you are. So this pack of neurons really matters. It's just that it's of a level of complexity that bankrupts our language.

There are, you know, a hundred billion neurons almost, and there are each one of these has about 10,000 connections with its neighbors. And every single neuron has the entire human genome in it. It's trafficking, you know, millions of proteins run and very complicated about chemical cascades.

So we're talking about a system that we can't even start to graph. We're trying to invent new strains of mathematics and computation to try to even get it part of this, trying to grab the tail of it. So while it's true that we are a pack of neurons, also true that this pack of neurons is running algorithms that make us who we are.

But does it work in both directions? So clearly, you know, there's the lion tightness. I could say that the atoms piled on top of each other have lion tightness and lion tightness isn't really anything special. You can't have lion tightness that acts down back in the other direction on the cage.

Do you think that consciousness or awareness or visual perceptions, these things that we have that are emergent properties, say, do those things, can those things act back down in the other direction? Or are they just the one direction? Oh, I do think that consciousness is efficacious. I totally agree with that. In my view, consciousness is sort of the highest level of the operating system, which takes into account the things that matter at this scale of space and time, as opposed to neurons and atoms and things that are working in a completely different world down there.

And so you've got this huge creature where like the Death Star or something, you know, these giant thing that's lumbering around in comparison to these very small pieces and parts. But it does appear that consciousness is efficacious. Now, I think it's true for both of us that we don't have an explanation.

We don't have a full story about why that is, but it certainly seems that if we were making votes, I think we'd cast our vote in the same way there. And isn't neuroscience committed to bottom-up causes? In a large part, but neuroscience is very comfortable with top-down language. So we talk about attention, for example, there's no other attention.

And we talk about bottom-up attention. We talk about top-down attention. It happens all time in classrooms and research laboratories around here.

It's about a much attentioner, things that come into your sensory systems that grab your attention. There's emotion over here, or a line appears over there, and boom, I'm attending to it. That's bottom-up.

My attention was captured. But top-down is an example, which I'm looking for a friend in this audience, and I know they're going to have a red baseball cap on. I scan for red, and boom, there I find it.

That's top-down attention. There's something that's a prior inside you that suits your behavior of goals is capturing attention. To such an extent, we are, you know, we hear it all the time.

I mean, if you go into psychology department, you'll hear it talk about the frontal executive, the executive in the frontal lobe. I always have a mental image of someone in a suit and tie in a briefcase, walking off the work, talking about frontal executive. I've always found it odd.

It captures a certain reality of high-level control behavior, impulse suppression, planning for distant goals that I think is really quite important. These are high-level organizational states of the nervous system, I would say, and those high-level organization states influence and orchestrate the activity of lower level of neurons that actually reach out and touch your muscles. So in that sense, I'm very comfortable with top-down, but a lot of neuroscientists don't like that.

They think that sounds spooky, but I don't think it's so spooky. It's like the example you asked David about the nothing-but-pack-of-neurons. I mean, that's true to what I said, but it begs the question.

I mean, an airplane is nothing but a pack of star-²²phone titanium and wire and copper and all this kind of stuff, but that kind of begs the point, right? It's true as far as the airplane goes, but it says nothing about the purpose that that thing exists for, how it's used, what it can accomplish under certain conditions of propulsion. It just misses so much, and there's nothing buttery. You hear this a lot, and it's called nothing buttery.

So to give Francis credit here, I think what Francis was really doing was rhetorically arguing against dualism, basically, because there's a sense in our tradition, and even in the Western scientific tradition, I started by Descartes, that you can't explain the mind ultimately in mental activity and the mental spaces that we occupy from these kinds of bottom-up, machine-like explanations. Descartes was convinced that there was a soul, a material soul that operated out in some space that had nothing to do with the brain and the body. It was independent of the brain and the body.

Of course, then he had the problem of saying, well, how does it interact with the brain and the body? When the mind out here makes up its mind to do something, how does it communicate that to the brain? And he postulated it, came through the tiny old gland. John Eccles, John Eccles who won a Nobel Prize in the late 20th century for neurophysiology was a dualist, and he thought that the brain, the mind interacts with the brain and these fascicles, the axons that go up to the surface of the cortex. And to a neuroscientist, I think that kind of reasoning just is not satisfactory.

It's like postulated magic for something to control the brain, and we're operating on the conviction that all of the wonderful things about our mental lives comes from within the brain. I think that's, I call that central dogma, neuroscience, actually. Neuroscience says the dogma.

It's a dogma in sense. Not that I'm going to cut the head off of anyone who goes against my dogma, but just that's a background assumption we bring to work every day when we come to experience. Do you mind if I ask you, Billman, how do you think of your Christianity in relation to that? Yeah, that's a good question.

So I think in much the same way that I think of my belief in friendships and my experience of friendship, sort of the way that I come to believe injustice or things of that nature. It is not an extra brain thing. It's all mediated through my brain and it's mediated through my experience.

Of course, a lot of this I inherited from my family and my culture of origin. But you know, if you want to hear it, it gets to a certain age and you start thinking what I've said, you know, a lot of hokum or something, and you start measuring things against your existence, against your experience. And I think that you come fundamentally and deeply to an interpretation of the world and what kind of universe do we live in? And do we live in a holy universe that has, you know, moments of holiness shot throughout if we only have a sensitivity to see it and call it what it is? Or do we live in fundamentally a pointless universe? And you know, you can come to either of those conclusions, but I think that kind of questions, the start of the religious quest, I don't think involves anything magical from outside the brain.

I think it comes from our questioning, our curiosity, our motivations, what we find to be true, measuring doctrine against experience. So I don't see this profound mysterious in that sense. Does that mean that it all comes from the brain? Or is there is the holy something that is external? Well, I think, you know, for I think for theist, the source of holiness at least and the source of all life and the source of the universe is external.

It's not I'm not a pantheist. I don't think that God is simply some of the universe. But I think that there are many clues in our creation.

And I do believe that we were created through evolution. I had no problem with that at

all. We can talk about that if anyone wants to raise that and talk about it.

But I think that in that creative process, we're created with the ability to ask these questions and to yearn after a fulfillment and a wholeness and a holiness to our existence and that it's a part of creation from a creator that was actually external to the universe. God, when it comes to a soul though, are you a dualist or a most? Soul is interesting. I'm personally and this is my own personal interpretation.

I'm a materialist, but I'm a sort of non-reductive materialist. I made a comment earlier that I'm not a reductionist, ideologically speaking. So I think that the religious concept of soul refers to what you were talking about earlier.

Quelvian Crickett, you were sort of in a sense. And the sum of sort of values, beliefs, aspirations, memories, this sum total higher level functions that makes me who I am, that's what religious writers or some religious writers refer to as the soul. And in some epochs of Christianity, it has been regarded as something external.

The soul in hand is the mind and the soul leaves. But that's not actually the Hebrew tradition from which Christianity comes. So Nancy Murphy, who's a professor of Christian philosophy of former summaries written an excellent blue book on this.

I think it's called what's it called? Brain and spirit or embodied minds. I can't remember. Something like that is Nancy Murphy, who's a married sheep, she obviously knows this much better than I do.

But the her argument is that the existence of this external soul is something that came relatively late in Christianity. I'm very comfortable defining that as how little states of the nervous system. And something about those states, if there is a soul that survives after disembodied rats, it's something about those external states that has to be captured in another reality.

And by the way, I don't think that's a crazy thing to think. We have people all around us in Silicon Valley now talking about downloading our consciousness and chips, right, and taking all of the synaptic connections that putting ourselves into a non-perishable kind of existence. So this isn't just a religious idea that this is possibly scientifically, this is actually commonly talked about here.

So I think that it's not a crazy thing to think about at all. How do you experience or how do you explain people's response or experience of God or the divine or holiness? How would you explain those observations? I mean, there's a lot of variability in human brains. We know that.

And so some people, some people say that they have an experience of God. And the question is, is testimony evidence? And unfortunately, it's not because we also have every other flavor of human who, you know, 1% of our population has schizophrenia and

they have all kinds of experiences. 15% have psychopathy.

They have a different view on the world. 3% of synesthesia. They have a different view on the world.

So it's tough to know what to make of this. A lot of thinkers, of course, have talked about the genealogy of this sort of thing. Freud suggested that when you're a child, when you're an infant, anytime you're hungry, you get food, anytime you're in pain, you get care for and so on, and you grow up into this world a while later and all of that goes away and you have a need to fill that with something else.

And so you might look to something that's like a maternal or paternal figure to replace that. There are lots of different views on this sort of thing, but not everyone certainly not everyone has this sense of the holy. And so one thing that's clear is just that it's very different to be inside different heads.

Yeah. So anyway, that's something that I always struggle with is about, if somebody tells me, look, I genuinely feel like I had this religious experience and I am a, a Zoroastrianer, I am a Hindu, I'm a Muslim, I'm a Christian, or whatever it is that they have, given the number of religions on the earth, if they say, I know for sure that my thing is right because I have had this experience, how do I interpret that? Given that 2000 other people would have a different experience. So can I comment on that? So I find this move that David made here, or the looting, the skits of brilliant experiences is a common one.

I'm some neuroscientist, one of my colleagues here at Stanford will talk to classes about epilepsy and people having hyper-religious experience with a temporal lobe of epilepsy. And the, the implication there is that somehow religious experience is abnormal. And I don't believe that at all.

That's not my implication, man. Well, okay. So that's great.

And it's, it's, it's really good to, to make that clear. Religion and religious experiences can get sick, absolutely, but so can feelings of what can get sick and feelings of nationalism can get sick and feelings of care for the environment can get sick when it permits you to do terrorist actions to protect your favorite, you know, piece of the environment. Many pieces of neuro, many aspects of human existence can get sick.

And that does not mean that the healthy experience is not the real thing. Okay. And I would just go back to experience a lot.

I mean, David says, what'd you say? You said that the experience is not evidence. Well, you know, testimony is not it. Testimony is not evidence.

Okay. So, I mean, testimony is some verbal reflection of my experience, I think, however, imprecise that might be. But, you know, if you have the experience of love, is that not

evidence about something that's real inside your head and something that you should take very seriously? And I would say it is.

And there are many varieties of religious experience. There was a guy named James, I think, at Harvard who wrote a book like that. But there are many varieties of romantic experience as well, right? And brains are different and their experiences are different.

But that doesn't speak here or there to the validity of the experience itself or the reality or the preciousness of it in the human experience. So, I just want to make that clear. I totally agree with that.

If somebody describes to me their love for their spouse, I get that into something happening inside their head. The questions I took it was, does it mean something about reality? If someone says, "Look, I, as a, you know, such and such religion, what have you done?" I had this experience where my deity came down and spoke with me, told me XYZ. The question is, do I completely understand that that means that it's happening inside their person's head and I believe them.

But does it mean something about the truth value of the existence of that deity? That's what I said. We have a psychiatrist here. Fortunately, I'm here.

I'm here to save this. This is a psychiatrist here to save the day. So, but I think this gets to the question that's sort of, we've been approaching from a number of of angles.

But let's ask it explicitly here to both of you about, well, how do we, well, is there an objective reality out there? David, you said that, quote, "The world around you is an illusion, a show put on for you by the brain." So, I mean, we could say that, okay, well, 90 plus percent of people around the world have had some sort of experience of the divine, of the holy, or something like that. You're saying, well, yeah, it's happening in their head, but is it real? We can't be so sure. But then, what about the color red? I mean, is that something that's, is that just true in general, that we can't be sure of any reality, or is it just God that we can't have a real experience of? Oh, I mean, in terms of objective reality, the one thing that we do know is that we are sampling just a little portion of the world.

So, take something like the electromagnetic spectrum. We have what we call visible light, which is all the colors of the rainbow. That's less than a 10 trillionth of the light that's out there, the different frequencies of electromagnetic radiation.

We have specialized receptors in the back bar eyes that allow us to pick up on this little thing. We say, "Oh, there's the world in front of me." But in fact, everything, radio waves, microwaves, cameras, x-rays, it's all passing through your body, completely invisible to you. You have thousands of Stanford cell phone conversations passing through your body right now, and you're not aware of it because you don't have to specialize by a lot

of receptors to pick up on this.

So, we know that what we're picking up is a very tiny slice of reality that signals for hearing, and so on. And when you look across the animal kingdom, you find all kinds of interesting peripheral devices that animals have to sample different portions of reality. So, snakes have heat bits to pick up on the infrared and honeybees to detect the ultraviolet range.

And, of course, we build machines to sample the radio range or the x-ray range. So, what we've been doing, I think, is science is scratching at the surface of figuring out all the parts that we don't even have any experience of. So, as far as objective reality goes, we know for sure that we're not seeing most of it.

And if nobody knows how string theory is going to come out, whether that will win the day or not. But string theory typically, what's postulated, is 13 spatial dimensions, of which we occupy three of them. And this is our world.

And so, in a piece of fiction I wrote, I said, you know, what if there are whole civilizations living between dimensions four and seven, and they're having their great wars and empires, and whatever. We don't know that they're out there. So, anyway, this is, yeah, we definitely are not seeing most of what's happening.

So, I would agree that we're not seeing most of what's happening for the very reasons that David has articulated. But, I would say that our sensory perception has to be in touch with aspects, important aspects of reality, or else we wouldn't be here. I would be crushed by a car going outside if my visual system didn't thankfully represent the things that are out there.

So, I just think there is an objective reality out there. I think, you know, here's an interesting thought experiment that I heard from done by a bunch of philosophers. One time, if spaceships, suddenly, this is a legitimate talk in philosophy, if spaceships came under, you know, suddenly appeared in our atmosphere and, and beings came down, it was apparent they were, you know, from another galaxy, not a soldier, or a soldier, or other planets, but that they managed to transport themselves here in order to do that.

Would they have had to come to the same mathematics and same physics that we have come to? Or could they invent a completely different physics and manage to do spaceships? And, you know, my gut feeling is that there's probably one physics that governs the universe and that they would have to have gotten to something similar to the same physics in order to have done this, probably more advanced form, but same. And, you know, if a philosopher looks at me, suddenly you're a Platonist, and I said, okay, well, I mean, that's whatever happens when you're supposed to. Tonic ideals or whatever.

I think there's, there is an objective reality, I think that we can grab ahold of parts of it, but I really completely would say that there are vast flaws of it that we aren't even touching. I mean, one of the things that's always fascinating to me are illusions and hallucinations and so on. Just as an example, as people lose their vision because of problems, let's say with their eyes or with their visual cortex, they'll often have hallucinations that are extremely clear to them that somebody walked in or things are happening.

Often they won't tell their clinician this because they're, they start, you know, they, by checking with other people, they realize that so-and-so has been dead and isn't, you know, isn't around and so on or there are birds inside the room or so on. And so they're worried about seeming crazy. We think anyway that we have a good understanding this from the point of view of, you know, as the eyes are passing less data back, the visual cortex is saying, you know, I'm supposed to be seeing something out there and so you generate these other things.

Just like when you dream your eyes are closed, you have full rich visual experience. But, you know, the point is we have so many cases like this where we can look at things and see how people can have completely believable experiences on the inside, even though that's not corroborated by others. And I'm not talking about matters, I'm not correlating religion matters.

I'm just saying when it comes to how we experience reality, you know, it's a very weird world. Let me take this beautiful crimson sign in here. I mean, you guys know, colors don't exist in the outside world, just different frequencies of electromagnetic radiation.

And yet you have this sense of that, you know, and there's this old question which we've all talked about about it is, is what I'm seeing is crimson the same as what you're seeing is crimson. We don't know that it is. And it doesn't need to be as long as we can transact and negotiate in the outside world.

If I say, hey, you know, pass me that crimson sign and your mother taught you to call that crimson, my mother taught me to call it. So you pass it over here. And it may be weird than that.

It may mean that, not only what I see as crimson, but I see as reality. When you see as reality can be very different. As long as we can transact and negotiate okay in the outside world, then we can get along that way.

I suppose that's kind of the question, the question hand here is, I mean, you say that we all know that that color doesn't exist, but I'm pretty sure color does exist. I mean, I have an experience of redness. And I've heard theories about electromagnetic radiation and they're pretty good and like reflection and retinose and lenses and all of those things.

But why do you say, and you say more about your idea, but why do you say that's an illusion? Why is the scientific theory the real thing and the primary experience I'm having the illusion? Well, if redness doesn't exist, if it's, if what we know is that it's different wavelengths, then your internal experience of it is, is something that your brain is using to tag that outside thing. And if you have theories about this philosophy to find the right fruit against the green of the tree leaves and so on more rapidly, if you just have a direct perceptual experience of these things, instead of, for example, tagging, okay, that's that way, that's that way, that's on. But yeah, we know from example, for example, from the world of visual illusions that I can set up something very easily.

And I say, hey, do you think these two colors are the same or different? He says they're totally different. And I say, no, in fact, there's, if you take a photometer, they're exactly the same color coming off. And there's a whole panoply of illusions like this, where we can show how, you know, we can work out the ways in which your brain is doing particular manipulations such that you see things.

And typically, these are things that, like Bill said, they're things that are useful. They do the right things in the world so that you survive. But what it tells us when you look at these visual illusions, I think by the way, you're only interesting to like six graders and then to neuroscience when they grow up.

What it displays for us is that this is a construction of the brain. What we take to be reality- naive. All right, well, let's switch, let's focus on the question around the ethics of senses.

So, David, you do sensory enhancement, you're working on trying to add senses. Maybe say a little bit about that, but then what does that mean? Does that have any ethical implications? So what I'm doing is building devices like this wristband, which is picking up on sound and converting it to patterns of vibration on the wrist. This is for deaf people.

And it converts sound from high to low frequencies. And it's essentially exactly what your inner ear is doing. It's transferred onto the skin and deaf people can come to understand the auditory world that way.

And so this is an example of something that's generally called sensory substitution, where you take data that's normally getting to the brain through whatever peripheral devices you have, and you just stick it into the brain through a different device. Of course, this is connected, goes up to spinal cord, goes into the brain. And my view on this, which is shared by a number of neuroscientists is that the brain is essentially like a general purpose compute device.

And whatever data you feed in, it all gets in there in the form of spikes coming along data cables. And it just figures out what it's going to do that it figures out how to

correlate with other senses and figures out how to correlate it with your motor outputs and what happens next. And so yeah, what we've been able to do has been really heartening for me because there are 212 genetic reasons why people can go deaf.

And people are trying all sorts of ways to fix this, but we're just circumventing the whole problem. And we're getting this all around the world, we're just going to give this to a deaf school in Thailand and so on. So anyway, I forgot what the original question was, but that's the, anyway, that's what we're doing with senses, we're feeding senses and the brain figures out what to do with it.

As far as ethical implications, you know, everything we do in science ends up having ethical implications somewhere. I haven't seen yet what this is. I mean, obviously one of the things we had to do is make sure that you can't hack this and feed in something strange.

But I haven't really seen the ethical implications of this yet, but I'm keeping my eye on it for it because the thing we always have to keep in mind is making sure that our science isn't moving ahead of our moral compass. And Bill for you, what are the implications of, what are the implications of your work with regard to visual perception with regard to making choices? Does that change how we should see ourselves or how we should move forward as a society? So I think the work that I've, you know, has been done on that probably has the most relevant implications for these kinds of discussions is the work on decision making. And we've been involved in mapping out some simple, some circuits, neural circuits, underlying simple forms of decision making.

And we've shown the activity and some of these circuits can predict the choice that an animal is going to make, you know, like seeing motion right or seeing motion left or seeing mostly red or seeing mostly green. And these neural activity can predict the choice the animals can make at the end of the trial. And of course, the question that tends to come up if this thing is so mechanistic that you can predict choices from neural activity, what does that say about free will or, you know, these kinds of questions is our sort of freedom to choose an illusion.

And that we really are, you know, as I said a while ago, the causal gears are really down at much lower levels than the ones that we're aware of. So I think, you know, these are serious questions. They're interesting questions.

They're questions that people struggle with you. They need neuroscience to struggle with these questions. You know, Augustine of Hippo, St. Augustine, famous Christian Bishop of North Africa back in the late 400s.

You have a strong sense of predestination, you know, that sort of the fate there and ultimately existential fate was set at birth. And this, of course, came back in Calvin and the pre-deterministic there. But there's equal strains in Christianity, the exercise

freedom, and freedom to choose the responsibility for engaging in normative behavior.

So these kinds of strains are present even in Christianity. I believe that there are mechanisms, if we define free will as meaning that our behavior has no cause, okay? I think that's a back pocket definition a lot of people run around with. And it's hard to resist that if we define that way, that the behavior has no cause, then I don't believe you pretty well, honestly.

I believe our behavior does have causes. But what I think when I think we're most free is when the causes of our behavior are consistent with our basic beliefs, our basic values, our basic aspirations, our goals, our memories, our history, when our behavior and our choices are shaped by those things, then I think we're free. When our choices are coerced, either by the threat of not-nots or simply by the political system that we live in, and what I'm forced to pay taxes for or not pay taxes for, then I'm not free.

There are sort of typical developing nervous systems that have ranges of freedom, I mean possibilities for, sorry, not this, possibilities for choice that some nervous systems that are atypically developing do not have. And so there are elements of freedom there. And I tend to think about freedom not as a lack of cause, but as choices that are based on the very things that we want our choices to be based on.

To me that's freedom. So this is, it's difficult to resist the temptation to say, well, if somebody can record it by brain and predict the decision I'm going to make, that is not a free decision. But I don't believe that.

The question is, what is the cause and what counts as the cause? And there are places where those choices are free and where I'm just going to, it's not free. And I'm saying that's the big, you know, that's the thing I get asked about the most. It's not really about the vision work per se, and I'm done.

It's really about the decision I can work. Aren't all of our choices always being the cause to some degree or another white multiple factors? Well, go ahead with that question, but we, please text our questions to the, and I've got them streamed to me here. This is an important question.

And I think the question was, aren't all of our choices always being shaped by multiple factors, many of which did you say those are not, many of which we're not even aware of? Yes. Yeah. And the answer is yes.

Absolutely. And that sort of goes back to my remarks about consciousness earlier that there are many things choices that we're making and social scientists, right? Sociologists, social psychologists love doing this to us, right? They love doing experiments that reveal that our reasons for making choices that we provide in one of their experiments are not true. And that really it comes from some priming factor that

they have provided unawares to us.

And they love doing this and some of it's really amazing. But you know, and we all have these biases that act on us all the time. Some of those biases are really good, right? But one biases, if your parents teach you to be polite when you're a child and it becomes a habit, I mean, that's a bias you have coming into any social interaction.

And it's a good thing. So these heuristics and biases, many of them are well suited to getting along in the world. But until you become conscious and aware of these biases and these heuristics acting on your behavior that you're using every day, you're not really free.

You're not free to choose something different. And I think this is an odd thing, right? This is that freedom, the part of freedom is becoming aware of the ways in which you're not free, bringing them to conscious inspection and then being able to choose a different way. And so we are subject to these biases that we show scientifically but maturity, becoming maturity as a human being across a lifetime, because this involves bringing so many of those things to light and then making reasoned decisions about how you want to give the future based on ethical and value commitments that you've made for a whole lot of schools.

So we're about time to shift from my questions to your questions. So I want to give David a chance to respond and say a little more about free will. The free will discussion is a long one, but the part that I just want to get straight is if you're influenced by various things including long-term desires and so on, the difficulty and understanding free will is it still could be mechanistic, as in if you think of the brain as a parliament and all these different neural networks that want different things at any given moment, they're fighting it out and something wins.

One time something wins, another time and so on depending on your hunger, depending on what's going on around you and so on, it still could be that it's totally mechanistic and it incorporates all of your teachings and your long-term goals and so on. This is a difficulty. I happen to not want to believe that we are Tom and Tom and I that if you rewind history 10,000 times we do the same thing every time.

And part of it is just wondering if our science is too young to even know exactly what we're talking about with this. But for better or worse, the reason that so many of our colleagues believe in the absence of free will is because it does appear to be a system where everything drives everything else and it's not clear where this extra bit gets pushed into the system. Yeah, and so I'm going to say again what I said, I don't have a problem with mechanisms.

I believe in mechanisms. I want the mechanisms to be there. When I cross out command, I want the visual system to give me the right answer 100% of the time.

And I don't want some quantum mechanical fluctuation to the carbon industry. I'm good with mechanisms. Now, I think that there are mechanisms that mediate decisions that are based on all these positive attributes of our systems and our development that we want to have cause our behavior.

And I'm good with those mechanisms and to me that doesn't reduce freedom. Now, freedom, we're not automatons. Okay, there are many sources of noise inside the nervous system, mostly thermal noise, little eye and chills, popping open closed all the time in very unpredictable ways.

Now, in theory, if you ran everything back to the same position in space and time to the atomic level of ran forward, would it come out the same? I don't know. But practically speaking, it comes out differently. You sit on the knife edge of a decision and you decide this way, one time, you just saw it this way, another time, and that is fundamentally not predictable.

And it's important that we not have perfectly predictable behavior. If David orders pizza for lunch every day, either David orders pizza for lunch every day, and I know that they're going to be there on outside their door at 10 till 12 every day. I can get that pizza and they won't fit their pizza.

You need to have a little unpredictability in your life in order to survive. The animal comes down to the watery hall by exactly the same approach, exactly the same time. Life chances are that animals are going to wind up dead.

So, randomness in the nervous system is really important because in sort of physics modeling terms, it allows you to explore more parts of the space. You don't want to get locked in to certain rewards at certain times because there might be richer things out there. So, the variability is important.

And there is quantum mechanical variability that matters. It's probably not about ion channels and neurons fine, but the classical quantum mechanical effect is absorption of photons by matter. And it's exactly absorption of high energy photons by skin that can lead to melanoma.

And if you get melanoma and die, it has real effects in the macro world. It has effects on you, it has effects on your family, it has effects on your friends or colleagues here at Stanford where you are, and boy, those ripple through. And that was a quantum mechanical, a series, probably a quantum mechanical that's just physics, not predictable.

So, we don't live in a deterministic automaton like world. Biology has been really spectacular at getting as faithful mechanisms as possible in place to guess through a very chaotic world. But it's not, you know, it's not in the end.

It's, I think that's a long metaphor for us to use. Let me just say what Flustard pointed out though is that noise or quantum mechanical randomness, that doesn't equal free will. If it's simply that I've got ion channels shattering, I might make a different decision that's not free will as we would want.

I agree with you David. Randomness is not free will. Randomness is no more, it doesn't feel any more free to me than complete determinism.

So, I completely agree with you. Patricia Churchman put this really nicely in a book of hers. She said, you know, if my behavior were subject to frequent random events, I would think that someone was messing with my mind.

You know, it's not free. It's freaky and abnormal. All right.

So, we're going to move on to audience questions. So, again, you guys are the most questioning group. This is incredible.

All right, so, if you keep working on those cards, you haven't already finished. But we'll get to audience questions. So, some of these have the question or has some information about them.

So, this is from somebody who studies visual and augmented reality. David, do you describe possibility has anything goes at first, then science rules things out. Why is it only science that can rule things out? Have you ruled out other methodologies for ruling things out other than science? That's a great question.

You know, the fact is science appears to be the best tool that we have for making progress. So, the reason we got to the moon and have the internet and have cured smallpox and have increased our lifespan and so on is really due to the scientific method. Other cultures have used other ways of knowing things for a long time.

But I would suggest that it's the exponential take off in humankind's progress. The fact that we live in this kind of world, whereas all of our closest cousins in the animal kingdom are still living in the same forest they've lived in, the same oceans they've lived in, there's one species that's doing this really special thing and it's really due to the take off of scientific thinking, which means, you know, as I mentioned, it means saying, okay, it could be this could be this could be this good. How can we put it to the test? And by the way, I didn't say that.

And then science rules it out. I said then what science tries to do is come and bring evidence to support one story versus another, to bring the weight of evidence to bear on one story versus another. There may be other ways of knowing, but I don't think they're a practical.

So what are your thoughts on that question? Yeah, I should turn my battery back on,

that's why I think about that question. I think that most of our most important decisions that we make and why have absolutely nothing to do with science. I am a scientist, I love doing scientist science.

If I had to go back and do my career over again, I'd do the same thing over again. But most of our decisions don't involve science. So an example of an important question that science can't answer is is it better to live or to die? And for anyone in a group this large, you know, people or maybe you yourself have experience of that real question.

And there's no experiment. You can do it in a laboratory to go in and get an answer to that question. I'm not a one that many people, you know, maybe consider in this horrendous shot of marriage in this person.

And it has nothing to do with science. You know, if you wait for science to rule out the possibilities, you know, it's been a long time. So this is, these are questions that we have to answer by non-scientific sources of wisdom and perception and reasoning about the world.

And what those are is up to each of us to choose. Now these things don't, it doesn't mean that you check your brain at the door, right? You look for evidence, you try to get to know if you consider whether it marries someone, you try to get to know their family, you try to get to know something about, you know, history of being in a relationship with them for a long period of time. You consult wise people who've been down this road before.

You thank you, you've got evidence that in the end it takes a leap of faith to make a commitment like that. You know, that leap of faith may take you in a great direction that's the most wonderful thing in your life. And it may take you in a bad direction.

And that's just the risk that we take. That's the human condition. And I think that's exactly where we are in the religious post.

I think that you make a leap of faith and then you come to know through trial and error. So I love science and I'm glad I live in 2018 and not in 1918 before we discover your antibiotics. But in the end science doesn't answer our biggest question.

So we'd agree, sorry, we'd agree that there are different types of questions that science can answer or not. But I just want to point out that even with the personal sorts of decisions, people make long decisions all the time. They commit suicide and they shouldn't have, they don't, they shouldn't have, they marry the wrong person to get divorced.

So it's that, I just want to clarify that making decisions from this other position is not necessarily something that continually improves whereas where science is a structure that continually gets better. I agree, it gets better at describing and understanding the

economic and physical world. I agree.

So the next question and we've got a ton of questions. Let's try to keep, I mean these are big questions. So but to try to keep it short and we'll go through as many as possible and we'll do one or one.

I apologize, I'll do high-coos. Yeah, please answer the following in the form of high-coos. So as short as possible, I know that's impossible but here we go.

What is some piece of evidence, neuroscientific or otherwise, that might radically change your worldview or narrow down the possibilities? I have been wondering if even though we study the brain in our three dimensions, you know I mentioned before that there might be several other spatial dimensions, whether there's some part of the brain that has an interaction with these other spatial dimensions. This is where neuroscience and physics would smash together. There's no evidence that this is true but that would be a radical changer for me.

Let's have the spaceship come in. And talk to the aliens and see that they have nothing resembling $F = ma$. That would call for a radical reassessment of my universe. All right.

What would a form, what form would an answer to the question, what is consciousness take? Would it be a mathematical formula? Would it be an understanding of why combinations of neurons give rise to the same metacognition? That is from a psychology student. The difficulty here is that we don't know with each other if we're conscious. I don't know that you're conscious but you say hey I feel cold, if you're hungry, I'm happy, whatever.

So I believe that you're probably in the same experience I am. But this is why it's difficult even if we have a good demonstration of a conscious computer programmer in Westworld and Android to know whether it's ever really been demonstrated in a way that we would believe. So I don't have an answer for demonstration.

I do believe when the Soviet Union fell in the early 1990s, I went on record. We had all this defense money, and we had no big enemy in the world anymore. And I went on record to say if I were king of the United States, I would take one of our national laboratories that's devoted to nuclear weapons research.

And I would fill up with neuroscience and tell the physicists and mathematicians and the engineers to work together to give us a tool that can record from the brain and stimulate the brain at fine spatial and temporal resolution, noninvasively with no health danger to the human being. And then we could start on science and consciousness because the only thing I know to do is to activate certain parts and circuits in the brain and see whether they're currently conscious experiments and humans. I can't do that now.

I can still do that in a circuit so I can show that there are behavior changes, but I can't ask them what did that feel like. I can only ask a human what did that feel like. And so we need those tools and then we can start with science and consciousness.

So this is a question from a mechanical engineering student for Bill. How is the leap of faith followed by trial and error different from the scientific method? So I would say I mean it's a great question and there are similarities between science and religion as you know I mean commitments are made in science and religion. But I think the leap of faith, the key difference is that scientific experience and the results of them when science is done right and beautifully that knowledge can be transferred anywhere in the world and anyone else with the right equipment and right conceptual understanding can reproduce those results and extend them and build them in the way that David described very eloquently a few minutes ago.

And my personal experience whether it's in a relationship, whether it's in a result of moving my family from one side of the country to the other, that just can't be transferred. It's not third person objective in the sense that science is so that's the thing. You know science you do take leap to faith.

You know Copernicus took a big one and he suffered a lot but he was right. And so I just take leap to faith every day but it's you know the outcome, the end to outcome is transferable and more objective. David then how would you respond to that? I mean do you think that scientists take use of faith every day as scientists? Yeah what we do every day is we we make a leap to some island that we say hey maybe that's true and then we look back and see if we can build bridges there but that's how science runs all the time is you're making these wacky ideas and then most of them are wrong and occasionally you get a bridge that works.

Next question is I think it's safe to say that there's a bias against religion and a lot of the hard sciences. How do you think this bias impacts the types of individuals who choose to engage in research and how does this ultimately shape the science that we do? I suppose I'll frame that as do you think that there's a bias against religion and if so how might that shape things? I think that there's a bias it's peculiar seems to be applied unevenly across religions so you know now Ilana is a rock star here at Stanford you know he's been here many times right and draws huge crowds and well but I think I think that there is a tendency to be a bit disdangle especially biological sciences toward Christianity and some of that is good it is with good reason because you know some of the central advances in biology were resisted and still are resisted by a lot of the Christian church and biologists just don't like that very much and so there there is some really I mean I've heard scientists I mean these are real scientists here at Stanford they'll talk about you know some they will come to light that I went to church last weekend or something and say yeah now I'll try to engage in conversation do you have any you know religious experience sir do you have any religious connections yourself and say no

no I'm a scientist I don't go in bed you know is that being a scientist or being a religious or opposite thing so I do think there's some majority of stuff associated with and probably some students here can tell much more telling stories I don't know what they would think I agree there is the advice somehow when one is first entering science it's sort of like this this group that you're entering and there are certain rules to the way the game is played and so religion has no part in that and I mean look I've actually gotten that bias as a possibility in which is crazy that but but you know my atheist scientist friends really beat me up about that sort of thing so I feel like that bias definitely exists whether it affects what happens in the laboratory I don't know because in fact we go in every day is whatever we are we do the science that we're doing so we know that it affects us day to day I mean there aren't counter examples I was a outside member of a PhD thesis committee of a student in engineering who is a member of the university christian fellowship on you in that way he ended up as thesis you know as most of us did of giving a bunch of acknowledgments to people who had been meaningful to him and then he stood there said you know and I want to give thanks to Jesus Christ who has been my you know inspiration and co-pilot and all this kind of stuff and I'm like the old what's going to happen the law is going to cave in and you know we went through the exam afterwards to him with the committee and I was this random nurse I was in these engineers this university rules the chair has to come from outside and you know we were finished and we were walking out to find the candidate and tell him he had successfully formed his PhD and one of the one of the faculty said to the other faculty so you know I thought you were his primary advisor you know and the other faculty member just kind of shorted and grand and said well I'm playing second for the little that guy so you know you can see striking counter examples even right here at Stanford on the other hand I did have a faculty member or colleague in my department tell me that Memorial Church should be removed from campus what he said was mission bomb the thing and this was this was before 9-1-1 so but you know he said mission bomb the thing I said why it's a monument to irrationality has no place on the university campus and I said good by far the most irrational thing I've ever done in my life is get married and have kids and if you want to start bombing monument to your rationale on campus you better start with my condo over Peter Coon this is from a symbolic systems major when Mary the color scientist learned something when she first steps out of her room and experiences color and does one of you want either of you want to take the challenge of describing the Mary's room question this is the color scientist right here yeah I mean so Mary is a theorist who knows everything there is no color theory and accounts for behavior normally sighted humans even though she's never seen color herself and then magically she seems colored for the first time and the question is the point of question is does she learn anything new from seeing the colors and experiencing that she did not know from the complete scientific mastery of color vision right that's a question yeah and and this what I think this exposes is the is the difference between all the work we do here and the experience that we have I mean if I gave you a textbook about all the exactly why you love chocolate ice cream the question is would that actually change anything about your

experience or would you love chocolate ice cream the same way whether or not you've read the book does it have to do anything with that or these really sort of um this isn't how Steve J. Gould meant it but he used this term non overlapping magisteria but you know this idea of there's this whole world here we describe stuff there's this whole world here we experience stuff and you know are these overlapping or or not yeah this was a this was a philosopher named Jackson who posed this kind of room and you know I think the answer is yes Mary would learn something new I think that experiential thing that qualia is essential and that's what David Chalmers calls the hard part hard problem consciousness right but there there are people who disagree I think I heard that Jackson himself is disavowed that argument he became convinced that that was the correct answer though I don't know the details I'm sure that in this world there's somebody who knows that tell us you know good for him I don't know what this is right and wrong answer but good for him for becoming famous for this idea and then reverse him so for Dr. Doosum as a neuroscientist how would you explain the holy spirit in terms of neurons and activity of the brain you know I suppose this gets a broader question of is it possible maybe for David for there to be a hyperdimensional being or God can God directly communicate with us I mean like is it possible for there to be interactions outside of the you know the work of day ones of vision and such yeah so I mean first of all the tradition that I grew up in it wasn't the Holy Spirit was the Holy Ghost it wasn't even the Holy Ghost it was the Holy Ghost and some of you might know what I'm talking about here but I you know I can't explain this of course I tend to think of the the Trinity you know from a Christian perspective of just three different ways of experiencing God you know God the Father is eternal God the Son is a particularly unique revelation that was made flesh you know appeared in our midst in the life of Christ and the Holy Spirit sits in a way a conviction that we continue to be in dialogue you know with transcendence on an everyday basis so I don't envision this three little statues sitting out there I just think of it as three different ways of experiencing the same reality you know I tend to operate I'm a neuroscientist I'm in that culture I tend to operate on the assumption that all of this is mediated through our daily experience according to well well we don't know that yeah as David not was said but according to mechanisms of interacting with world that is interfering but can I rule out the possibility that some people have you know an unusual a non physical kind of experience but I simply have an eye no I can't rule that out I'm not I'm not going to rule that out David and I've talked about this a little bit as a psychiatrist he sees you know quite quite a bit of this he's on top of data than I'm on top of it's on the large surprisingly large percentage of people who claim to have these kinds of experiences right yeah something about one or two percent of people having experienced an hallucination in the past you know 30 days or something but it's it's surprising but but I suppose this raises the question I guess as a possibility and is that is it possible that God or a higher being is actually communicating sending information to our brain um sure and one of the things that's difficult about I mean one thing I mean there's about the science of the community is that we're always fighting a battle on two fronts which on the one hand we're trying to get rid of stupid ideas and really fight

against those and show one of those and on the other hand we're trying to be let me just say possibilities in that sense of saying why what about this what about that and and these are often contradictory and so it's just it's difficult to know where to play that in science but we haven't ruled out that you know extra dimensional influences on the brain or anything this is not equivalent to saying that is what's happening or even I'm just likely that that's what happening but because it's not something that's ruled out I think it's a little point that the possibility space that we have to keep until we can't anymore all right well that that brings us to 830 so we I just let's thank both of our presenters [applause] find more content like this on veritas.org and be sure to follow the veritas form on Facebook, Twitter and Instagram

[music]