>> From WXXI News, it's 1370 Connection.

[Background Music] I'm Bob Smith, and have you ever wondered, what makes you, uniquely you? Some of it might be programmed in your DNA, which of course is a different package for every one of us, except identical twins. But even more of it, is our experience on how we process, what happens to us, what happens around us, and also what we make happen. That's a complicated process but my guest of the hour spends his working hours for your head. Sebastian Seung is a neuroscientist with MIT and with the Howard Hughes Medical Institute. He is the author of books including his forthcoming connections, how the brain's wiring makes us who we are. He's going to be speaking this evening at 8, at RIT's Webb Auditorium as part of the Caroline Werner Gannett Visionaries in Motion Series on the topic "Searching for the Self in the Brain's Connections," and he's here with us right now. Great to have you with us, thanks for joining us today.

>> Thanks Bob.

>> Now, I got to ask you first of all. How does this wiring get formed, does it all evolve according to a genetically-determined blueprint or does it keep connecting and reconnecting and wiring and rewiring itself in various ways as we're going through life or is it a combination of all the above?

>> Well, Bob as you can imagine, it is a very complicated process. Well, the first thing just to appreciate the complexity, have you ever thought about how much wiring there is inside your brain?

>> I think, it's probably a number so big, I can't fathom it.

>> Okay, your brain might be more than the average person.

>> I don't know about that.

>> What about the average person? What about the--

>> I am more complicated than you could imagine, believe me. Anybody that you spent anytime getting to know, you find out that you don't know. And that's--what are the reason why probably.

>> Well, just to backup even more. So, the wires of the brain are--is at a figure of speech, but they're really the branches of neurons. You've seen pictures of neurons before, right?

>> Yeah.

>> They look like trees and they have these long branches that come out of them, and these branches transmit signals, and so we call them wires in analogy to electronic devices. But I don't know if you're a numbers guy, Bob, but I was asking, just guess. How ma--how long if we took all those wires from your brain, to laid them out end to end, how far would that stretch?

>> I hesitate to think, but I imagine it probably is further than we've traveled from this planet so far. I can imagine it reaching to the moon and then not quite there.

>> Bob, you're good, it is further than the moon, it's further than the moon. I'm impressed. So, in fact.

>> That's a wild guess, by the way.

>> That's an amazingly good guess, and in fact, so the distance to the moon is about a quarter million miles, and the total length of wires in your head is estimated to be millions of miles, maybe a million miles. So, that's an extremely long way and of course yours is maybe 2 million or 3 million for you.

>> No, I don't know about that. [Laughter] It's a typical brain, standard size, but I have to say this though. We are all such complex beings, that it's impossible to fathom just how we make all these connections and process them in ways that are, so intricate, occur so fast. How do we even begin to understand what's inside us? And is it true that maybe, we're so complicated in there, that we might not even have the capacity to understand our own mental processes completely?

>> Okay, so that's a great point. So, the complexity is indeed daunting, and you're asking this, I think, very deep question which is whether the human brain can actually understand itself. Maybe there's no way of understanding our own brains, because our own brains just aren't powerful enough to comprehend all that.

>> Does that discourage you, since I've just described in a way what you're trying to do everyday of your working life?

>> Well, Bob, are you trying to get me depressed?

>> No. I--

>> I only just met you. I only just met you. [Laughter]

>> No I'm not. What I'm trying to do is just understand the complexity what you deal with every single day, and most of us, just maybe spend an hour or a minute, every once in a while, thinking about and maybe getting some insights about and perhaps reading sampling about, and getting a little bit more appreciation of who we are, and how complicated we are, and then stepping back and saying, "Wow, are they ever going to figure that out?"

>> Yes I think--so, I think you're asking me about the emotions. What it's like inside the mind of a scientist, right? We don't really talk about out emotions, we're not supposed to. We're supposed to talk about the facts, but of course, when we go about our lives, we have feelings, and there a lot of feelings we get when we think about how the universe works. What it's like inside the brain and so on, and of course one of them is awe, but you're right that it could also be a little depressing that there's--in the face of all that complexity, maybe we'll never be able to figure it out and, so some people get depressed. I know that some of my friends say, "Oh, I don't care, I'm a humble scientist. As long as I feel like we got one step further, in my lifetime, I don't mind that there's still a million miles left to go." But certainly there's a tradition of scientists who get depressed or philosophers like Pascal who contemplated the universe and how large it was, and he felt dread.

>> How small it was at the same time, remember that passage--

>> So small, you can't avoid those people you don't like.

[Laughter]

[Foreign Language]

>> I remember that essay, and believe or not, I ran across Blaise Pascal in French class and French Lit class.

>> French Lit class.

>> Exactly. That's where you first meet him, but you know, it's got to be reassuring in a sense, because the complexity of the mind is something that is taking so many people so long, and will require so much longer, you're never going to lack for anything to do. There's always going to be a need for what you're doing, to go that next step and keep on going on and hand it on the next generation of scientists. You guys are never going to be out of work.

>> You're right. So, we'll never be unemployed and we'll never be bored. I think that's--so some people sometimes, say well, you know, professor, if you're so smart, why aren't you rich? And I say, well, I more afraid to be bored than being poor, I guess that's the answer.

>> It's a good living anyway, I'm sure, I mean I would hope it is. I mean, I hope we're not being parsimonious in dealing with and compensating people who are doing important work like that.

>> I'm not complaining at all.

>> That's good, at least I'm reassured about that, but nonetheless, when you think about it, this is something that starts with a blue print, but it's a skeleton, and now it's a skeletal framework.

>> Yeah, let's get back to the question you asked in the beginning which is how do all--how does all that wire reform, and you can take an organic metaphor. So, when the brain first develops, the neurons are just little round selves. They don't have branches. They have to migrate to the bright locations and then they have to grow like trees. They have to grow their trunks, they have to grow their branches out, and they somehow, those branches have to get the right--to the right destination on the brain and then make connections with each other. So there's a process of creation of neurons, migration, extension of branches, and then creation of the connections between those branches. So, those are called synapses. That's the locations were 2 neurons communicate with each other.

>> Bottom line, it starts in gestation and mom had a better take good care of herself to make sure that you, when you come into the world, are ready to start forming all these connections on your own.

>> That's right, the connection are actually even forming before you're actually born. So, it's starting very early.

>> And it's important that y--which I guess, highlights the importance of prenatal care and also of stimulation and care of the young child, is that child

is growing up, one thing that I take away from this is how important the environment in which a child grows up to be and if we want that child to thrive, we better make it as rich as possible, should we?

>> That's certainly true. So, the--but actually there's a very interesting point which is that neuroscience has--we're in a very primitive state. So, it's actually difficult to demonstrate those claims which we believe in. What we do know is that depriving children of natural environment is very harmful. If you deprive a child of a relationship with a caregiver, if you deprive them of light so they can't actually see it, let's say they're born with cataracts, then there's going to be long term consequences. Now does that mean that if you enhance your child's environment with Beethoven or violin lesson or something like that--

>> Or just good conversation.

>> Or just good conversation, how much that's going to affect their lives in a permanent way is harder to determine. So, what we really know best about is severe deprivation. And this is actually a huge subject in a huge--subject of huge interest in neuroscience which is, even the results of deprivation, to what extent are they truly irreversible? Are there things that happen to you in your life, especially early in life, that you can never recover from, and some people say, you can't recover because your brain wiring can't change after you're an adult, and there's some evidence like that, but there's also a supply of the evidence that sometimes brain wiring can change and so the people in the movement called neuroplasticity like to emphasize the positive aspects of that. But in reality, we just don't know a lot and we need to study more to figure out this question, what are the limits of change? And are there ways in which we can enhance human potential for change?

>> Which gets to another question of course, and that is, what are the crucial ages in the maturation of human being, as far as their ability to learn certain things. Do you find that it's easier to learn some things early, the way I've heard it said, I don't whether if it's true or not, but I've heard it said that it's easier to pick up other languages or even pick up your own language when you are little child than it is to learn it later. Could it be that perhaps the brain is plastic, but it's a lot more flexible and malleable in the way it works in your younger years before you achieve physical maturity and maybe there are certain times when you got to [inaudible] to give that child the maximum chance.

>> Yes, so that's the notion of the critical period. So, for certain abilities like learning a first language, it appears that if you don't learn the first language by certain age, you'll never be able to learn a language later on. So, there's cases of children who were found--have you heard--you know the case of Victor the Wild Child of Avaron? So, he was a French boy found in the wilderness during the time--near the time of the French Revolution and he'd never--apparently never learned to talk when he was young, and a French doctor tried to civilize him and teach him language but he never really acquired more than a handful of words and could never produce sentences after he got older. So, it appears that language learning has a true critical period, but a second language doesn't have a critical period in the same way, right. It gets harder as you get older, but nobody--it doesn't get impossible. It doesn't get impossible. And so, these are precisely the kinds of question that our people are trying to investigate at the neural level. Why is it that learning seems to get harder? What is it about the brain's wiring or the changes that occur in the wiring that

could explain this subjective experience that everybody has, that learning often gets harder as you get older?

>> Which I think everybody could probably relate to in the sense that, "Gee, I picked up my first language as a baby, I cant remember what--I didn't know it, but starting in French as a kid was tough, starting in German as high school kid was even tougher, and I wouldn't even want to try something else afterwards. They relate to that in, by the same talk, it is, as you said it isn't impossible, maybe some things that are somewhat related to each other like learning grammars and vocabularies, maybe there's some route in common that we can built up.

>> Yes, there's--I should bring up one other issue. So you're talking about learning, another great example is recovering from brain injuries. So it's well known that young kids can recover from injury to the brain better that grown adults. Another example of plasticity, for example, one of the most radical neurosurgical procedures is called hemispherectomy. So, that means the removal of an entire hemisphere or half of the brain. This is done in the case of severe epilepsy, so some kids just have this terrible epilepsy, it doesn't--it cant be treated by drugs and they're debilitated by it because they have seizures all the time, and if it's really occurring only on one--starting on one side of the brain, then the surgeon simply removes that half of the brain.

>> The whole thing?

>> The whole thing.

>> Don't even leave anything left.

>> Its crazy, it's crazy, and yet these kids, they are, they recover quite well from that surgery. If you did the same thing to an adult, that would be a much--much more debilitating kind of surgery.

>> Which would you wouldn't want to even contemplate. You're losing half of your mind,

>> That's right, well me, I don't know how to quantify, if half of your brain is half your mind, but it's certainly a much tougher thing for an adult to recover from. So, what--one big question for neuroscience is, can we somehow take an adult brain and intervene in some way, with drugs or other kind of treatments, that would make it as plastic as a child's brain and better able to recover or better able to learn. This is maybe science fiction at the present time, but certainly that's kind of goal that neuroscientists have of achieving in the future.

>> I'm thinking other thoughts, maybe extrapolating incorrectly, but I'm thinking other thoughts about how we might use some of that knowledge, and I'll get to those later, but first, I like to get to the phones of 263WXXI, 2639994, as we continue are conversation with Sebastian Seung, neuroscientist at MIT and the Howard Hughes Medical Institute speaking this evening, searching for the self in the brain's connection. He's the author books including the forthcoming Connections, how the brain wiring makes us who we are. He's here with us at 1370 Connection. I'm Bob Smith. Let's go to the phones right now. We've got Jane on the line from the city. Hi Jane, you're on the air. Welcome.

>> Hi Bob. I have this books that I love so much. I've read it many times. It's entitled High Risk Children without a Conscience by Dr. [] and McKenzie [phonetic] and what it talks about is those first 3 years, and on the first 2 years he says that you have learned 75 percent of everything you will ever learn in the first 2 years, and a lot of people market that, but when you think about the motor learning, of walk, you know, walking, talking language like you said, emotional learning, but what it--what really intrigues me is this idea of bonding, and then if children do not get what they call a constant object internalizing them, the apparent care figure, they don't have anything to bond with, therefore they can't develop trust, and I just wanted some comments on that, because I think it really is relevant to as expectations of children and how ready they are to learn when they get to school. It's so much is needed to be done by the age of, say 3. Then if it's not done, then what about that poor child that's lacking, but I like you talk about that if you would please. Thank you.

>> Okay, that's an intriguing question of in itself. How fast do we learn? How much do we learn at various ages and is there something that we could do with that knowledge.

>> Well said Jane. You've brought up this phrase the first 3 years. I believe that phrase dates back to a big publicity campaign, maybe 15 years ago, and people would say things like the first 3 years last forever, and it's a--it was a very important campaign to make sure the kids the proper kind of care and environment when they're really young. But I find that a little but--I find that statement a little bit alarming, because it kind of suggests that we can change after we're 3, that as we grow older, it sort of the denies the human capacity for change later on and so maybe, it's a little bit too pessimistic. I wouldn't want to go and say that--people ask me that kind of thing all the time actually. So, I remember one day, I gave a lecture and woman came up to me after wards and she said "Professor, I found your lecture very interesting, but what I want really want to know is can people change?" And she said, "Well, you know, your personality, some people says it just fix after age 6. There's no way you can ever change it." And then I look next to her and there was a sheepish-looking man standing there and I thought to myself. "Well, lady, what you really want to know is, can my husband change?" [Laughter]

>> Or maybe the real subtext is, can your husband into the person she wants him to be. Whatever he wants maybe not be necessarily be the issue with her, but that's whole other story, that's probably best dealt with by a Merrill psychologist or relationship therapist, call in Dr. Drew Pinsky.

>> Well, so I think that she was looking to me for--she wanted a scientist to tell her that "Yes, your husband change or no, your husband can't change. Just get used to it and be happy with that." But those answers, I would say that those answers, science can't really give those answers yet. We--I mean, they're too simplistic and so what I would like stress is that of course, I believe that a child's early environment is important and of course, I believe that even adults can change, you know the inspirational ways as they get older, but we also need to have basic research on the brain to truly have a deep understanding of the processes that underlie change, we can't rely on simple statements like the first 3 years last forever. We have to actually look at the brain and look at the neurons and see how they wire up. And that's what my book is about. My book is actually--so, I want to correct Bob. The book is called Connectome, and I understand why he misread it, because connectome is a new word. The connectome

is the complete map of the connections between the brains and neurons. It was coined only in 2005, so Bob can be pardoned for misreading it, and it's a word that was coined in analogy with the word genome. So genome is of course the sequence of letters in your DNA. And what I'd like to argue is that the connectome is the thing that we want to investigate if we want to understand how a person is shaped by both their experiences and their genes. And that's because the wiring of your brain is controlled by the genes, the genes that have a lot of influence about which connections are made, but also your life experiences have an influence on your connections, and so the science of connectome, which is emerging and it's a new field of science, it's really the fundamental science that's going to finally answer, I hope over the coming years, these kinds of fun--these kinds of really important questions about change that everybody has in their minds.

>> I can remember my Psych 101 teacher, making a declaration, he's a behavioral psychologist and he's especially interested enough in studying sleep disorders and their effect on people's mindset and on people's behavior, but he is something of generalist as well, and he made a categorical statement in the lecture hall one day, that he believed that we were perhaps 25 percent heredity and 75 percent the result of our experiences. I don't know how he got that ratio. It seemed intuitively to make sense, but can we quantify it that way?

>> Well, yes there're--there are people--geneticists have tried to quantify the relative contributions of genes and environment and you could read an author like Steve Pinker, he's not a geneticist, but he certainly talks about the influence of the genes on the mind and let's say, the way that you do it is you take identical twins who are raised apart, right? So, if identical twins who happened to be adopted into separate families, their environments are not going to be really anymore similar than 2 environments chosen at random, but their genes are identical. So, the similarity between those 2 kids or those 2 adults when they're grown up is going to reflect presumedly genetic, a genetic kind of cause for the similarity, and based on that people have inclu--have concluded for example that IQ has a very high genetic component. But I want to make a cautionary note, which is that these numbers really are very dependent on conditions. So let's say somebody says that IQ is 75 percent a product of genes. Well, that's in normal American environments, but if you somehow expand the environments to include really extreme ones, or other countries or different levels of wealth, nutrition and so on and so forth, then the effective environment might change very much So, those numbers are not set in stone, these numbers depend on the conditions.

>> It's interesting that you note that they've tracked families and seen what happens to succeeding generations as far as their IQ performance and they found out, that as families become economically upwardly mobile, the next generation IQ jumps in a way that you can't explain, any other way than by an environmental component, and it just keeps jumping and that's one way that the--for example, the differences among races and ethnicities, everything keeps narrowing, generation after generation, as long as we continue to be upwardly mobile society. Now unfortunately, that also means if we don't maintain that upward mobility or that possibility of moving forward, we can have some problems and people could backslide of all groups, but nonetheless, I mean, you can't explain any other way, than something other than genetic heritage, can you?

>> Yes. So, I think in the modern scientific discourse. The question of how much is genes and how much of it is environment, that's no longer an interesting

question. Everybody agrees, genes are important, environment is important. The question is exactly how, and how can we structure our experiences? How can we actually structure experience to create the best outcomes? And that requires a more sophisticated understanding of how genes in the environment influence the brain, not some kind of simplistic formula 50:50 or 75:25.

>> And we'll talk a little bit further about that, what that implies as far as what we ought to be doing for our children, what we ought to be doing in the classroom, what we ought to be doing in society and really, how we can use all the knowledge we're getting, as we continue our conversation with Sebatian Seung of MIT and the Howard Hughes Medical Institute, speaking tonight at RIT's Visionaries in Motion Series. I'm Bob Smith. It's 1370 Connection, we're back in a minute on WXXI.

[Music] 1370 Connection continue again, WXXI, I'm Bob Smith. Sebastian Seung is a neuroscientist at MIT and the Howard Hughes Medical Institute. He's an author of books, the forthcoming "Connectome: How the Brain's Wiring Makes Us Who We Are," will be in your store shelves perhaps this month. Meanwhile, he's here tonight at 8 o'clock at RIT's Webb Auditorium as part of the Caroline Werner Gannett Visionaries in Motion Series, talking on searching for the self and the brain's connection and he is with us right now at 1370 Connection talking to you on WXXI. And right now, talking to Keith on the line. Hi Keith, you're on the air.

>> Yes sir. I have several questions. I want to push a bit, this millions of miles of wiring in the brain and I want to say to the guest, right off, I understand the limitations that researchers such as you are working with and so far as what can be a accomplished but is--does the rub come and so far is even when your lecturing, when your trying to, as Mr. Smith was saying, asking at the beginning, how you spend your various work days when someone as learned as you are in your labs, in your lab work, when you go out in the public and try to inform people, does the disconnect come from--what I'm calling the physical hard wiring and then how you are able to get across to audiences exactly what you're all about? And then how that--

>> Let's stop right there? Are you implying that maybe some of us aren't wired thickly enough or well enough to even grasp what people like our guest are able to do and able to find out that, "Maybe we're just not smart enough to comprehend?"

>> Well that was going to be my second part, but he is dealing with--just like surgeons when they go in to an operating room, they're dealing with blood and flesh and we all hope that, whomever the patient is, they will survive that surgery. But again, they used the term as the rub, a surgeon wants to operate and successfully have a patient come back to life. But there are many in betweens that, whether a mishap with the scalpel or just anything in creation sometimes the patient, many times hopefully the patient gets off the table, other times they don't. You're working with physical limitations that the guest understands. So we talk about, "Oh a million miles of wiring in the brain", for where we are right now in evolutionary times, so far as right this point in history, those are the limitations and I do want to ask further about the limitations that all of us deal with.

>> Well, so your name Keith?

>> Keith.

>> Keith. Keith, okay. So I think one of the things you're asking about is what do I really do everyday in the laboratory and to study that the millions of miles of wire, is that one of the questions?

>> Yes. You're dealing--you're a researcher.

>> That's right.

>> And I did want to--well--let me go to the second part here. Mr. Smith may not want me to jump ahead. Let's do it this way. What about the whole concept of cosmic consciousness. I wanted to ask in your research about bringing true consciousness to the forefront of the conscious state. That right there, you're going to say as you were saying in response to Jane, well I'm--I'll just call you--refer to you as a medical researcher, whether it's Jane's question or mine, you as a researcher may not be able to engage this more esoteric questions, because like the surgeon, you're dealing in flesh and blood dealings within the brain. Again for the last time, it's good to talk about a million miles of wiring, but where does--how do we get an expansive state, let's say that--

>> Okay so let's--so that...

>> I have a feeling we're heading into the--into the frontier between the physical and the metaphysical at this point, aren't we?

>> Okay. So, I think there are several questions here. So one, is I think I want to--I should tell you a little bit more about the wires and how we study them. And then we need to address the question of what is consciousness and how could consciousness possibly be explained by a bunch of flesh and blood. You know, basically the physical structure of these wires, and then the third most expansive question is that of cosmic consciousness which is a consciousness not tied to any particular person. Is that it?

>> Well, why did Jesus and the Buddha by example, why were they able to have such an expansionary vision, what I call interior landscape, the true ability to look with inside themselves, going way beyond the limitations of one, two or three million miles wiring. Why were certain people in--down throughout history, noticeably expansive where as Mr. Smith eluded to--sadly the majority, the vast majority people go through their entire lives not using even close to all of their faculties and just that the waste of the loss of all of this potential, and just trying bridge between what you do in your research and then when you lectured before the public trying to simply express to people, articulate to--

>> Okay.

>> --to them. What you do and what the potential might be?

>> Okay, so.

>> We could gather together a philosopher, a historian, a thinker of religious thought, a scientist and everybody's going to come up with a different answer for that one, 'cause that may be one of the ultimate eternal questions, Keith, and thanks very much for asking it. Wow. We're getting to the essence of the human experience at this point, I think.

>> Well, I think one the things I would say is that--so I think that Keith was asking first of all--so he was really in the end asking the question of what makes a spiritual, a great spiritual figure like Jesus or the Buddha, different from the rest of us. But that's sort of related to the question of, which many people ask, what makes an Einstein or a Beethoven different from all of us or what makes us, any of us, different from each other and we might even extend that and say, "What makes us different from a worm, or a fly or a pig or a dog, and so on and so forth?" And the radical kind of answer that I want to give is that--is that mental differences really are fundamentally differences in connectomes? Right? That what makes you and me different is not our different DNA sequences, our genes, 'cause after all, you might have an identical twin who has the same DNA sequence, but doesn't have the same mind as yours. But maybe genius, madness, spiritual insight, maybe these really are differences that are somehow bra--somehow based on differences in the intricate pattern of connections between the brain's neurons. And that's a radical thought for some people, but actually it's not a very radical thought once you start to learn more about neuroscience.

>> And everybody coming from a different perspective is going to have a different answer. The scientist will say one thing about how the networks connect, uniquely for each individual person. The existential philosopher is going to say something else about, "Well, it's what that individual experienced, saw and what he or she did with it and how he or she worked to that experience and worked on him or herself." And the religious philosopher, the spiritual philosopher is going to say something different too. So what we've got here, is some of the eternal questions about what differentiates each from the other and what differentiates the human species from everything else and--

>> Well but in the end, wouldn't you have to agree that it's the brain?

>> It is certainly.

>> So what differentiates me from a pig or a dog is not my body as much. It is my body to some extent, right? So I may not be as cute and cuddly as a puppy, because I don't look the right way, but it's also our brains and that's a kind of essentialism that some people rebel against. They want to say that really my body is a part of myself. But imagine the thought experiment, right? Suppose I took your brain and I transplanted it into someone else's body, right? So, we still say that that was Bob.

>> You know, well--you know it depends on a lot of different things. Like who is it?

>> Yeah. I guess the most would be if Bob's brain were transplanted into the body of a beautiful blond actress. So then, would that still be Bob?

>> It would be somebody who is a beautiful blonde actress who would think more like a 59-year-old radio announcer.

>> [Laughs] So that's--those are the kind of difficult philosophical questions but some people--yeah [laughter]. Some people would say, "That's still basic--that's still Bob." Bob is thinking the same way, the memories--that person's memories are going to be Bob's memories, right?

>> I guess so, which would probably make the existentialist a little bit happy, I'm sure. But anyway, the mind boggles even thinking about that possibility. I can't think about living as anybody but me in every sense of the word at that.

>> I'm sure your fans are really intrigued by that possibility.

>> I think they're probably conjuring visual images that boggle the mind. 263 WXXI, let's find out what Jim thinks about that or anything else. Hi Jim, you're on the air.

>> Thank you Bob, we're interested. My question goes back to the founders of the profession. Sigmund Freud and Carl Jung, and I would like for you to talk about the impact that they had on the profession, based on it, created a new branch of medicine, specifically Carl Jung and his research on the impact of signs and symbols.

>> Wow that's into another realm, really related, no question about it but into another realm.

>> Well for--interestingly, Freud started out studying brains. He started out by trying to be a neuroscientist, but I think he realized that it was--neuroscience was too primitive to answer the questions that people had about psychiatry in that day. And so he moved away from studying brains and into developing his theory of psychoanalysis and so on. There's a lot of reasons why--although Freud was certainly a genius, there's a lot of reasons why scientists have moved away from Freud. So one attack comes from the evolutionary psychologists like Steve Pinker, so they argued that Freud's ideas about how--well they've reinterpreted Freud's ideas about the Oedipus complex and so on. But I think the one case in which Freud--you know, Freud's wisdom kind of makes sense, in the--his statements about the unconscious. I think everyone agrees that most of mental activity is unconscious, that we're only aware of a small portion of what our brains are actually doing and the importance of repression that we are indeed--you know, it's very important for our brains to repress a lot of our urges and that's something that we all have to struggle with. So those are insights that still stand for today. But they don't really have a lot to do with neuroscience because that--he was really working in a pre-scientific world--pre-scientific approach, where you couldn't study the brain the way that you do today.

>> He didn't have a CAT scan or an MRI available.

>> That's right.

>> Bottom line. Hey Jim, thanks a lot for checking in. Do appreciate it. We have Don on the line next. Hi Don, you're on the air.

>> Hi, I'll--going back to the discussion about how much of it's inherited. Well I think so much is because I think, as an example, we had on the farm a toy dog who was wonderful for herding cattle and he had never been taught. He had been taken away from his mother when he was approximately six weeks old and he was incredible. But you couldn't teach him to chase rabbits. And when we had a Beagle, who was a fantastic rabbit dog but had no idea what do around the cows, run away from them. You know, so much is inherited and then along that comment where we said that people's intelligence increased with upper mobility. Well, with upper mobility, you're more apt to marry someone who has more intelligence. So it's pretty hard to prove such a thing.

>> You're saying that richer people tend to marry more intelligent people and therefore have more intelligent offspring? Is that the query?

>> I feel that.

>> I found that richer tend to marry more beautiful people and have more beautiful offspring.

>> Well that's true, but they're also moving into the society.

>> Yes and no. Because, I mean, let's put it this way.

>> I was just kidding, I was kidding.

>> Yes, 'cause some of the misbehavior and the bizarre decisions being made by some of the wealthier financial individuals--

>> Well, yeah, but there are always exceptions.

>> You know society makes you question the intelligence level, but that's another story entirely.

>> You know, I feel there are always exceptions. But on the other side as I--my parents earn more money. They sent me on to college. Then and therefore I met people were also going on to college. If they didn't have the money, I probably would've married someone who was less--may be--less apt to be intelligent.

>> But what you do is basically meet another product of upward mobility and then may be [simultaneous talking] a little bit further.

>> Well, you're using a circular logic there.

>> Well say, you're--it could be a circular logic around any center.

>> There's no argument. Genes have a strong influence on our minds. There's just no argument about it. But what--and what scientist--science--scientists have accepted that and what they're trying to do is go further and ask exactly how is it that genes have influence on our minds. Right? Does that--I hope that's--

>> Well I could see that. What I--what I would--I was just using an example, and the animals--

>> So which--so for example, which genes are the ones that predispose people to get autism?

>> Yeah.

>> Or be more--

>> And those things I think are very important.

>> Or get dyslexia? And then, even if you find those genes that are associated with these kind of maladies, then the question is how exactly is there--is this causal link between genes and some mental property established?

>> Uh hmm.

>> And one way is through controlling the process by which the brain wires up. And if you understand that link--

>> Uh hmm

>> --then maybe you could find ways of changing--of helping people change. And so the emphasis now is really--if we understand how genes help brains wire up. That is going to give us new ways of enabling people, of empowering people to change themselves. That's kind of--that--I would say that's the--in the end the ultimate mission of neuroscience.

>> Yeah.

>> Hey dude, thank you very much for calling in Don, and then we'll be getting to another call in just a second. Well, I'll remind you of course first all, we are talking with neuroscientist Sebastian Seung who is with MIT and the Howard Hughes Medical Institute and we'll be speaking to see if they get RIT of the topic of searching for the self and the brain's connections at the Webb Auditorium, part of the Caroline Werner Gannett Visionaries in Motion Series. One thing I want to build at about what you just said is what we're learning about the wiring so to speak of the brain--of the mind--I guess we'll use those as functionally interchangeable terms for the moment, even though I know they're not precisely the same thing. Is what we're learning now going to enable us to do things by whatever means, either through education and training or through some kind of medical implication or other to enhance and unleash some of our own innate capacities, maybe find ways and techniques to make us still smarter and enhance and accelerate our capacity to learn at any age, not just to the very young age when that plasticity that you talked about earlier is at its height.

>> Oh Bob, you're bringing up a great question and I think that is a dream of neuroscience that many kinds of education books you'll see these days make claims that they have a new educational method and it's based on discoveries about the brain. But really, I would say that science has not progressed to the point that we have really rigorous evidence at the level of neurons and brains about what educational strategy is better. And often what you'll hear in the end, you'll hear some--if some scientists--some neuroscientists ventures and makes a claim about education, they may something--say something very complicated, but in the end, they end up saying something that just sounds like common sense, doesn't really sound like anything that you wouldn't have thought of in the first place. So I would say that's still a dream for neuroscience and the first thing that neuroscientists are tackling is not learning for normal people but really for treatment of brain disorders. Right? So how can we find better ways of treating Alzheimer's, better ways of treating schizophrenia and so on, that's really the first battleground. And then--but in the future--and that in itself is hard enough. But in the future if there is going to be a challenge of how do we get better than well? Right? How do we have better learning from normal healthy adults and from kids? And I do believe that's going to come, but it's going to take a lot of basic research, it's a long haul.

>> So bottom line, the first goal is going to be therapeutic. The second goal down the line will be mind enhancement of the normal creative functioning mind. But first, therapeutics is job one.

>> That's more urgent, of course. Right? We've got to help people with brain disorders. That's much more urgent than helping--you know, those of us who want to learn better, that's important too. But we'll live okay even if somebody doesn't help us in that way.

>> By the same token of course, we all know instinctively from our own experience that we do learn all through our lives simply within the fact that most of us are not likely to repeat the same mistake twice. We learn from every mistake we make. We also learn from every success that we have, hopefully learn how to repeat it in an appropriate way. And we get better at what we do as time go on. At least we hope we do. And we like to think we do and maybe we actually do. Maybe we're not just kidding ourselves in that regard--and maybe there is some improvement in people's lives and their functioning and their perception and their understanding of things. So it can be done. There's hope there.

>> Certainly I--that's the great thing about the connectome, that we're endowed with natural mechanisms of changing our brain wiring. So the title of my--my subtitle of my book--so my book is called Connectome, the subtitle is how the brain's wiring makes us who we are, but that subtitle is a little bit misleading because we also make our brain wiring. It's not just the brain wiring makes us who we are, that sounds too deterministic. But there's a lot evidence that what we do and what we experience when we learn that the wiring of our brain changes and that's the magic, that the brain is this material structure. Some people think of it as a computer hardware that never changes, but actually the material structure of the brain is changing whenever you learn something new. And the challenge for neuroscientists is to figure out exactly what kind of change is happening.

>> New connections can grow. That's the wonderful thing about being an organic being, isn't it?

>> Yes and indeed. So one of the kinds of theories that people often say is that learning is the growth of new connections and this goes back to an old theory, which is that, maybe learning is the growth of area of the brain in size. Maybe when you learn how to do something, that part of the brain gets bigger, just as if when you go to the gym a lot, your muscles get bigger. It could be that working out your brain makes your brain bigger. But it turns out that learning is much more complicated than that, that when you learn, there's some evidence that you're also eliminating connections. You're also eliminating them. That addition of connections is not the whole thing and the comparison I like to make is to the process of writing. So it's true that writing is all about, in the beginning at least, adding words, the number of words in my paper goes up and up and up and up. But actually, in the later stages of writing, there's a lot of elimination. There's a lot of destruction of words. And in fact, the total length of what I write may get smaller as I make the writing better and better. So you could think about the brain--the connectome, especially the early connectome of a child as being a rough draft and a lot of connections have to be eliminated before that brain actually works properly.

>> In other words, our early minds that kind of verbose, [laughter] sort of like Dickens, and then as we mature, we learn to cut down to the essentials and we become [inaudible] Hemingways, just to use a literary metaphor and probably overstretch it to the nth degree.

>> Well I would like to be either one [laughs].

>> Right. That's true. 263 WXXI. I wish we had more time, but unfortunately we time only to say thank you to our guest of the hour, Sebastian Seung of MIT in the Howard Hughes Medical Institute, he will be speaking this evening at Webb Auditorium at RIT at 8 o'clock as part of the Caroline Werner Gannett Visionaries in Motion Series, the topic "Searching for the Self and the Brain's Connections." Thanks very much for sharing this hour with us and a lot of knowledge with us, this hour at 1370 Connection, thank you all for being with us here in WXXI AM and FM HD to Rochester. I'm Bob Smith, stay with us there is more to come after the news and we'll see you then.

[Music]