

Neuropsychology - The New Psychology

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This material no single factoid, but I think all of it together is a hugely complicating issue for notions of free will, for notions of vulnerability, for notions of culpability, all of that built around this question often lurking between the lines, which is, why did that behavior occur? Whose fault is it? As a boring subset of that one is, why did this behavior occur? Who is worthy of praise for it? That one is ultimately equally interesting, but probably less pressing in society. But where are these behaviors coming from? And we've gotten really good at doing some moderately sophisticated things in dealing with the answer to a question like these. And a great example of that is with epilepsy. 500 years ago, if you had an epileptic seizure, where is this behavior coming from was absolutely clear, which was demonic possession of some sort or other, a staggering, heartbreaking literature of the history of treatments of epileptics and the response to epilepsy. If in the process of somebody having a seizure 500 years ago, they flung their arms around and struck somebody else in the process, it would be considered some version of assault and battery, in most of Western European countries, again, explained with a demonic underpinning. And we're in a different position now. If today somebody has a seizure and in the process, they strike and break something, they're not to be held legally responsible for if they strike somebody. That is not assault and battery. It is a ludicrous idea, because somewhere around 1900 or so, most people in this country got trained with a thought, an explanation, a where did this behavior come from that is as defining of everything that is good about our culture world.

Most people got to think the following thing. It's not him, it's his disease. And that is a huge landmark transition from 500 years ago, people being burnt at the stake with some really bad attribution given to us having the capacity to draw an absolute line between the essence of who that person is and the action potential storms that happen every now and then. It's not him, it's his disease. We're spectacular at doing something like that with epilepsy. We are lousy at doing it in all sorts of other domains. One example, schizophrenia. Back to schizophrenia again, and the abnormal behaviors of it, and the occasional violence

associated with it, lower than in non-schizophrenia people, but the occasional violence and, of course, the classic case again, that guy John Hinckley trying to kill Reagan in the 1980s. Paranoid schizophrenic, floridly so, and that very wise jury of, in retrospect, some remarkably unsophisticated people deciding, it's not him, it's his disease, and put him in a psychiatric hospital. And the apoplexy that went through this country in response to with the editorials, the senatorial bloviating crap about, he's getting away with this, he's getting away, he is responsible, showing an utterly limited ability for people in this country, and some extremely powerful ones, to draw a line between the essence of who this John Hinckley is and the dopamine abnormalities in his brain. And we have trouble drawing that line as well, doe example, in the realm of parents and teachers and guidance counselors making sense of the biology of learning disabilities, the biology of dyslexias, and a whole world of people not very good yet at drawing a line between that and the person. And instead, out come concepts like lazy and stupid and things of that sort that have a long, long well-maintained in the history of education in this country. And a lot of people in positions of power, parents et al, still have not gotten very good at drawing the line between the essence of who that person is and the biological constraints that are superimposed on top of it.

What you begin to see after a while is something very interesting, which is going to be one of the main points of this last structure, which is, as more and more information in this world of behavioral social biology, whatever it is we're calling this, as more and more of this has occurred, as we get more and more domains where we have to at least begin to consider there's a line in between the essence of and the abnormalities of at some point, this is going to stop being the biology of them and their disorders and is going to be the biology of us. And when things get really close to home at that point, that's where a lot of people get very, very anxious and very skittish about, essentially, the punchline from a class like this, the transition from them and their existing in a different category with a boundary, with a bucket, versus the rest of. Us as it gets closer and closer to home, the transition from them and disease to us and individual differences and quirks and idiosyncrasies, and a biology that is just as much of a biology as them and their diseases, where the subtleties come in. And where there has to have been that case, sort of that sense challenging, is looking at some of the subtle neuropsychiatric disorders that we have in the class, a few of which I'll go over again here, but a few new ones, where over and over it's the theme of, there's not that much difference between me and them. I imagine exactly what the continuum is. It is not clear whatsoever where the line should be drawn, the new category of normal versus abnormal. Case after case of this. One obvious one most recently emphasized, schizotypalism, schizotypal personality disorder. And when you look at the range of symptoms, this is not a psychiatric disorder. This really is not, and justifies the transition to schizotypal personality, rather than a disorder. It isn't a psychiatric disease to consult astrologers.

It isn't a psychiatric disease to go to Star Trek conventions. It isn't any of these things. It is one extreme in one axis of human behavior, and it is one where, by definition, we're beginning to sense the biology of it lurking around out there. We know it's got something to do with the same genetics that you find in the fuller loaded version in schizophrenia itself.

We could begin to imagine that this is the biology of us and some of our quirky obsessions, versus them and their schizophrenia. More examples. We endlessly heard about the frontal lobe in this class, and we heard about the boring, easy examples, when it is blown out of the water, when you have Phineas Gage, when you have frontally damaged disinhibited murderers. We've heard all about those, and those are the easy ones. Those are not so easy if the vast majority of states in this country cannot deal with the notion at a criminal trial that somebody with no frontal cortex is not a biologically normal human. But nonetheless, that's relatively easy compared to the issue that we really have to think about, which is, the person sitting next to you has a different frontal cortex than you do. And you, by now, can come up yes, it's the person on the left, seeing sort of where the eyes are shifting and coming up with this obvious fact that this makes a difference. This makes a difference not in explaining why one person here might be a serial murderer and the next person not, but just, who's got it together with the studying? Who's going to do an all-nighter Thursday night? Who has what sort of personality? Who is too shy to say something or other? Who's the one who is always the first to say and this world of individual differences. And you have no shortage by now of ways in which that may manifest itself. How many neurons and how many synapses and what sort of receptors and all of that? You could go on all week long as to the possible underpinnings of that, and you could go on all week long as to what events genetic, prenatal, et cetera might have brought that about.

But the whole critical thing there is the transition from them and their brains with no frontal cortex left to making sense of the fact that all of us with perfectly normal frontal cortices nonetheless all have different ones. And at some point, this transition brings the term frontal, frontal disinhibition, out of the realm of pathology. I mean, a great example of this in terms of how commonplace this now is among of biological psychiatry types you'll be at some conference, and some poor, quivering grad student gets up to give a short talk. And this is the first talk the person ever gave, and they're obviously like a total nervous wreck, and they manage to sort of limp through the end, and they're a sopping rag at the end there, but they've done OK. And then some total jerk big shot in the field gets up from the back row and savages the guy, and gets him on stupid statistics, minutiae, and chest thumps and attacks his enemies and yells at him for not citing, and going on and on. And somebody is going to lean over to somebody else in the audience, and referring to the guy back, saying, Jesus, he is getting more frontal every day. And that may not just be a metaphor. That may be a way of hinting at the biology that is absolutely there. Why? Some of us do some things like that, and some of us would die rather than be that forward or that disinhibited, those individual differences. And we surely know they are there, and we're beginning to understand the baby steps of different versions of dopamine receptors in the frontal cortex, that whole world of transitioning from them and the front of their head blown out of the water to us and our individual differences. Another domain of this, another realm of insight, and that's this disease Huntington's Disease. And you will perhaps recall back to the very first class, making reference to what turned out to be Huntington's, what is very often the profile of somebody with Huntington's.

Middle aged guy suddenly starts behaving in some outrageous way, disinhibited, all of that, that whole business of, there's behavioral features to this disease. Huntington's Disease is a

neurological disorder. Huntington's Chorea the term chorea, choreography, body movement, Huntington's uncontrolled writhing that eventually consumes the entire body 24/7. The person eventually, not so long, soon, dies from choking to death on their saliva because their muscles aren't coordinated any more. Totally horrible neurological disease. But what has taken people years is to realize that that's not what Huntington's looks like at the beginning. And instead it's the profile, the scenario that I gave in the very first class, again. Middle aged guy, happy marriage, in the suburbs, jobs, 2.73 kids and dogs, all of that sort of thing. And the one day he suddenly punches somebody at work. Then the wife discovers he's having an affair with whoever. Then he gets arrested for brawling drunkenly in a bar and he never used to drink. And then he embezzles all the funds from work and disappears forever, until a year or two later, when he shows up in a neurology ward at the other end of the country because he's getting tremors. And what people have now figured out is, two or three years before Huntington's is a neurological disorder of movement, it's a psychiatric disorder of disinhibition, and is one where you begin to see a behavioral profile like this. And what you see is, by the time you've got early stage Huntington's patients when they're hospitalized, they are famous for coming on to the staffers or showing up in the day room without their pajama bottoms, or just famous for doing stuff like that, the disinhibited behavior of Huntington's patients. And what's remarkable there is, people have known for a long time what the neuropathology is of Huntington's, Huntington's, the movement disorder. And it's the disintegration of some motor pathways in the brain.

Now that people have genetic markers for the disease, know with some likelihood who's going to get it when, what's become apparent now is, two or three years before you start getting damage in the part of the brain having to do with motor control, you get damage in the frontal cortex. Huntington's is initially a disease of frontal cortical degradation. And what is remarkable about that is, this is a genetic disorder which immediately barrels us into the, this a maladaptive trait. You are dead by the time you're 50 or so. Our usual question, why is it evolving, why is it being maintained in the population, seeing a theme of a hidden benefit of Huntington's, which is that disinhibited behavior a couple of years before the neurological symptoms do you in. During that time window, individuals with Huntington's out-reproduce their unaffected siblings. They become, among other things, sexually promiscuous, and they pass on more copies of their genes. And what you suddenly see at that point is framed from the standpoint of arms that won't stop moving we're talking neurology framed from the standpoint of number of copies of genes. This is an evolutionary advance. This is something which behaviorally increases reproductive success. Onset is typically around age 40, so catching it around that time, which is typically around the point where reproductive activity reproduction goes down in humans. So getting an extra little blip out there from the standpoint of an evolutionary biologist, this isn't a disease. This is a great invention where the bill happens to come a while later, but there is no free lunch. And framed that way, this was a very different way of thinking about this disease. But what was most striking is, when you first hear about it and somebody says, OK, what do you think the causes of this behavior are? What causes this? And the ones that most readily come to mind is, the guy's a jerk. The guy's having a midlife crisis. The guy's what, like, oh, no, it's actually a single gene defect where there's too many glutamines.

That, and it's a disease of a single gene goes wrong, and out comes this. And we need to consider is, there's individual variation in aspects of that system long, far outside the range of what would get a disease label. And it doesn't take too much imagination, again, to translate that into why the person sitting next to you is a little more this way and a little less that way. Just the same challenge for us going from them to what makes us, us. Next example. Disease I've only briefly mentioned, I think, previously. Tourette's disease. Tourette's disease. Everybody knows about Tourette's disease, which is, it's this disease where people curse uncontrollably. Scatology. Tourette's disease, that doesn't begin to scratch the surface of what Tourette's is about. With Tourette's, yes, you get that scatology. You also get inappropriate gesturing, tics, facial tics, gestures of all sorts, aggressive ones, sexually inappropriate ones, all sorts of vocalizations, barking sounds, animal sounds. It is just a torrent of behaviors coming out. Now the critical thing when looking at Tourette's is, this is different from the inappropriate behavior of somebody with frontal damage. Frontal damage is closer to home. Every single day, I would bet all of us have thoughts that are boastful or lustful or petulant or whatever, where we would die if anybody knew we were thinking that. And damage the frontal cortex, and when you think it, you say it. It is not the secret desire of every Tourette's patient to bark like a dog and make quacking sounds once every seven seconds. And finally, thanks to the damage of that disease, they are disinhibited to do so. This is an astonishingly clear example of a line between the essence of who that person is and these weird hiccups of the id that occur in the limbic system with Tourette's. And again, in its milder form, it's not a disease. It's individual variation. Now remarkably with Tourette's, of course, people are beginning to learn something about the biology of it.

There's a genetic component. It's probably not that strong. Beginning to see brain imaging correlates of it. One totally weird possible way to wind up with Tourette's, and this is a brand new class of pediatric diseases called PANDAS, PANDAS diseases, which stands for do not write this down which stands for Pediatric Autoimmune Neuropsychological Disorders Associated with Streptococcus. Here's what happens. You have a three-year-old, four-year-old kid who gets a strep infection and runs a high fever and winds up being the one in 10,000 kids in this situation where something goes wrong, recovers from the fever, everything is fine, and then two weeks later explodes into tics and obsessive patterns and Tourette's-like disinhibitions. And where did this come from? Totally paralyzing. And none of the normal drugs work. And suddenly someone stumbles on what does work. You give the child a drug that suppresses their immune system. Things go back to normal. Then a couple years later, they have some other fever and they spike a high fever, and two weeks later they explode back into these tics, these disinhibited behaviors, these obsessions, all of that. What's going on? What appears to be the case is in the subset of people with a high fever, these kids, the blood brain barrier opens up in a way that allows the immune system to get to places in the brain where the immune system isn't supposed to be. And you form antibodies that attack elements of your own brain, of your own central nervous system. And this is what turns out to be the case. It appears to be, in some cases, an autoimmune disorder, the treatment being, give the person immune suppressants. And when you look at adults with Tourette's disease or adults with obsessive compulsive disorder, they have far

higher than expected at chance levels appearance of antibodies in their bloodstream against constituents of their nervous system.

And they have a higher than expected rate of these childhood fevers. The sort of stuff we've been getting throughout, groping at these strange little pieces of making sense of this stuff. And have something like that, and you wind up with a disease that has this bizarre array of symptoms that you see in Tourette's. And some years ago, I actually had somebody in this class who had Tourette's. And it wasn't bad. He had like a few facial tic sorts of things. And after the first couple of classes, he came to office hours and was kind of describing that he had Tourette's and he was very glad that I was familiar with his disease, and explaining that this was sort of something that occasionally became disruptive in classes. And if it would be possible, it might make sense to have an exam in a sep and he spent the entire time doing this. This was the disease. This was the essence of who he was. And you could not ask for a clearer line. Look at this. 500 years ago you have Tourette's disease. It tends to have an adolescent onset of the symptoms. It's got somewhat of a bias female to male ratio. And certainly you've got a 13-year-old girl who suddenly starts cursing uncontrollably with bizarre sexual references or whatever. And what's the only possible conclusion? You've got someone possessed by the devil who should be treated appropriately. Look at where we've gotten to in 500 years. We've gone from taking people like that and burning them at the stake to letting them take the MCATs in a different room from everyone else so they don't disturb them with the barking. We've gotten real good, with a disease like Tourette's, of drawing the line over the disease and who the person is. That's a realm where we've gotten a lot of progress. More of these subtleties, again, what in some ways was one of the most challenging pieces of the religion lecture, making sense of have a brain that has uncontrolled epileptic firing for a couple of minutes once every six months, and you're much more interested in the philosophy of religion, the temporal personality business.

And again, that challenge of, most of us have gotten to our religious stances through a great deal of hard work and introspection. And, even if only once in the history of the universe, somebody instead has gotten there because their neurons have synchronized firing in their limbic systems once every six months, that is very challenging to the sense of no longer talking about them, and very challenging to the sense of making sense of us as autonomous individuals within our own control. Other realms of this. OCD. Again, we've got some sense, after the last lecture, of what it looks like and just how incredibly, incredibly crippling it is in its extreme forms. These people cannot leave their homes. These people cannot function. They most certainly cannot hold down jobs. It is just as destructive of a disease, in its worst forms, as is schizophrenia. And people are beginning to learn something about the biology of it, that link to childhood high fevers and strep infection. Some evidence of genetic component to it. There is first neuroimaging being done. And you might remember that area of the brain, basal ganglia. Or maybe not. Have I actually mentioned basal ganglia, or have I just wished to? OK. Basal ganglia. Motor area. What people are beginning to see is, in OCD, put someone in a scanner, and there is increased metabolic rate in the basal ganglia, this part of the brain involved in movement, involved in making sense of the compulsions, the need to tap a certain number of times, the need to arrange the utensils so that they are perfectly parallel. The need to it's like there's an itch in the motoric systems there. And

people are beginning to understand that one. Take somebody with OCD and treat them successfully. It's typically with SSRI's, serotonin uptake inhibitors, which also work for aspects of depression. Treat someone effectively, and the metabolic rate in the basal ganglia goes back down to normal.

The pieces begin to fit there. Getting into even stranger realms because these diseases, by now, have mostly even passed the disease of the month TV special, they are becoming to be understood so well. Then there's a whole world out there of the most bizarre possible diseases you can imagine. Here's one of my favorite ones. It's called Jerusalem Syndrome. This one is great. This is such a bizarre disease. Jerusalem Syndrome. Shockingly, you can only get through Jerusalem Syndrome in Jerusalem. Here's what you get. It's gotten to be a rule-out. The person who gets it cannot have problems with depression or anxiety. Rule out all the other psychiatric disorders. It's a standalone diagnosis. Here's the sort of person who gets Jerusalem Syndrome. An American, highly religious Southern Baptist on their first trip ever to the Holy Land. Two other requirements that virtually are in every single case. The person has to be relatively on their own. At the end of the day, they are in a room by themselves, and they have to be having huge problems with the jet lag. In other words, they're up at all sorts of weird times of day, and really in soggy shape because of that. Here's what happens. This is the person who's been waiting their entire life to finally come to the Holy Land, has been saving, has been whatever. They scrape together. They go there. This will be the land where Christ walked. And they get there and they see that Jerusalem is like a normal city. There's traffic jams, there's smog, there's noise, there's pickpockets, there's McDonald's. There's all of that, and they're disappointed. They are shattered by this. And something comes unhinged, and something comes unhinged in the middle of the night there. They're not being able to sleep alone in that room, dealing with this shocking realization that the place they had dreamt of their entire life doesn't exist anymore. And something cracks. Here's the detail that I love. In every single one of these cases, the person rips apart the hotel room bed, shreds the not the mattress, the sheet shreds the sheet, takes their clothes off, and before you know it, they're on a street corner in Jerusalem dressed in a toga preaching to everyone, telling them to go back to simpler ways.

The psychiatry SWAT team from the hospital there shows up, takes the person, puts him in the hospital there for a couple of days or so. Their head clears. Ships them back to Biloxi or wherever, and they never have a problem with this again for the rest of their life. They get 50 cases of this a year in Jerusalem. This is a recognized syndrome. People publish papers about Jerusalem Syndrome. It struck me, though, that there is actually a very easy cure for it, which is, in Jerusalem, in all the hotel rooms, if the sheets always were plaid or something. Something about the white just begs to be pulled into a toga, and that sort of pushes them over the edge. But this is a real disease. More of these. Stendhal's disease. Stendhal disease you can only get in its official form in the city of Florence. And Stendhal, the well-known what was he, a philosopher or writer or hockey player? Writer. Yes, the well-known writer, thank you, Stendhal, who, describing the first time he came to Florence, and this sense of vertigo and nausea and complete loss of control that came from seeing one too many amazing, priceless, unmatched frescoes, where you get into a manic state from it and you can't take it anymore. And you come out running like a wild boar through

the streets of Florence. This occurs with some regularity there, and this is termed Stendhal Syndrome. There are papers written about the subject. More of these. Then there is a disease which, trichotillomania these impossible-to-pronounce ones, people who eat hair, people who eat hair obsessively. Not just the anxious version, sometimes, of somebody who's kind of like chewing their hair when they're sort of anxious. But instead this is where a person is pulling hair off of their brush in order to eat it.

They go over to someone's house and they go to the bathroom and open up and find the brushes and the combs there to pull the hair off. This is an incredibly disturbed disease, where at an extreme, you get somebody who has consumed so much hair that it forms a hairball. It blocks their stomach, and this is life-threatening. It forms a plug of hair with a long strand of it coming up the esophagus. And this is life-threatening. And you have to take it out surgically. And it's this whole clot of hair with this thing that was going up in the esophagus. And what is this disease called? It's called Rapunzel's Syndrome because of the long stretch of hair. How weird is that? What is that about? Just imagine we start with one of our charts here, and we say, steals hair from friends' bathroom brushes, and sort of say, try to do that one of working our way backwards of what happened the second before, to evolution of whatever. How bizarre is that? That's like nothing compared to the next two diseases, that are so hard to pronounce I'm not even going to attempt to. Actually the first disease is pretty run of the mill and pretty straightforward. The first of these is merely the disease of people who can only become sexually aroused by amputees. Whoah. OK. That's a little bit peculiar. That makes like the person with it seem like the kid next door compared to this one. This is the disease of someone who has a body dimorphism image. It's a body integrative disorder. This is someone who, their entire life, has believed they are meant to have a limb missing. Their sense of themselves involve them being an amputee. This is a real disease. This is a real disease where people have websites where they communicate with each other about how to have industrial accidents, accidents that will remove a limb, where it will look like an accident. There are secret physicians who will do this. There was a paper in a neuroethics journal a couple of years ago by a physician arguing that one should be willing to carry out the surgery on a person who wants this done, because they will find a way to do it disastrously otherwise.

As termed by the person who first described it, this is a new way of being mad. And this is terrain like you cannot imagine. Finally, most shocking of all, this was a case report a couple years ago of somebody who had stroke damage to the cortical area towards the frontal cortex, but also a little bit in one other area. And as the case report described, this person, in the aftermath, became obsessed with polka music. Polka music. This was like some gang member Hell's Angel guy who had, like, brain damage after one brawl too many. And out the other end, this is someone who's willing to slash you to bits if you disagree with which is the best polka group coming out of Krakow these days, or some such thing. The person spent a dozen hours a day listening to polka music. What the hell is with that? what? Damage there? We're just seeing these totally bizarre ways in which things can go wrong. Things can go wrong in merely peculiar ways. Things can go wrong in ways that destroy people's lives. So what are we to make of things like this? This whole world of these subtle neuropsychiatric disorders where, with each one of them, it's easier and easier to imagine

how it translates into not them and their disease, but our individual differences. One thing to appreciate is that the majority of these that fall in this category, they didn't even have names 50 years ago. There wasn't a way of describing, or even imagining, that biology could go wrong in this particular way. And there weren't even names for those. Most of these didn't have names 10 years ago. And what's obvious then is, there's no way the science is going to stop. Just more and more of these names are going to appear, more and more of these syndromes and disorders. And at some point, every single one of us is going to have two or three of those labels.

And what happens at that point, because this is describing a very close array of human individual variability. I do not have OCD. But I will count stairs on occasion. I, during periods of anxiety, will do that. Obviously I have only one clothing style for the last 10 weeks. Every day, coming here, I go through the same sort of rehearsal saying, I am not going to start off the lecture today by saying, OK, let's get going. And then I've done it again. And I don't have OCD. I have that weird, weird compulsive behavior, or ritualistic ones. Obsessional. OK. Here's what I've been wasting most of today thinking about. I have a grant due next week, and I'm getting so little done on it that I'm beginning to get anxious. So I've been having this whole repeated pattern of this intrusive force thinking about, Charlie Bit Me. So I think about Charlie Bit Me. Then I think, this can't be for real. They had to have had professional actors. Then I think, that's not possible. There's no way you can get a baby to bite the finger that way. Then I think, if this was actually staged, I am deeply hurt by the YouTube people. Then I think about how his accent sounds when he says Charlie. Then I realize I'm moving my lips. Then I say, OK, you got a grant due. Stop screwing around already. Whoah, Charlie Bit Me. What a cool video. I wonder if they staged it. This has been going on for all of today. This is not OCD, but it's elements of. And just as every one of us has elements of some of these, where all of these individual differences come in. And at some point we will have to deal with the fact that the same exact biology, writ large, that may make somebody a schizophrenic in a milder form, will have them being very interested in metamagical issues, and in the mildest form allows you to have a fantasy while standing on line in the supermarket. It's the same biology on the same continuum. And somewhere in there it stops being them and their diseases and becomes us and who we are.

So one of the challenges with that is, what's going to happen as we get more and more of these names that describes us more and more, and we understand the neurotransmitters and the early experience and the genes and all the last 10 weeks. And as we understand more and more of that, something often happens at that point, which is, people begin to get real uncomfortable, real sense of being threatened. For this tremendous fear that what if those scientists accidentally go and explain everything when we're beginning to see biologies of tastes and religion and who likes risk and who is capable of being faithful and who is not, and who has and this realm with individual differences, and begin to see the machinery underneath. Lots of people get uncomfortable at that point, because it challenges one of the pretenses that we all, virtually all, desperately cherish, which is the notion that we are utterly, utterly unique, that each one of us is this flame of individuality that cannot be captured, that cannot be constrained, that defines us, this individuality that is just bubbling away there. And there go those scientists learning more and more about less

and less. And they may mess that up. They may wipe out that sense of our uniqueness. And that worry was perfectly encapsulated. This famous story, science fiction story, by Arthur C. Clarke called *The Nine Billion Names of God*. Wonderful metaphor for this. This is a bunch of Tibetan monks, and apparently in some branch of Tibetan Buddhism, there is a belief that God has nine billion names, an obvious metaphor for the unknowable, the unattainable. And in this story, these monks team up with a bunch of computer scientists with the greatest computer around that they program to start printing out the names of God. And what happens in the story is, as it's cranking through and it is going to name the nine billion names of God, as it cranks through this, as each new name comes out, one of the stars in the sky goes dark.

And that's a perfect metaphor for this fear that people have, which is, if inadvertently scientists go and learn everything with each new soulless factoid that turns us just into a bunch of equations or biochemical pathways, that with each new factoid, one of the stars in the sky will go dark as we lose some of our individuality, as we lose some of what makes us who we are. There is no reason to worry about this, and this is for two reasons. First off, even if scientists went and inadvertently explained everything, that still would not take away the wonder of it. You can take a gazelle leaping and turn it into a whole bunch of biomechanical equations. You could turn Bach into Kontrapunkt Rules, and that does not in the slightest change, or should not in the slightest change, our capacity to be moved intensely by them. And there's no reason why something should lose its power simply because it turns out to have layers of complexity that were not initially available to us, which we slowly attain. It should not destroy that sense in the slightest. The second reason why this isn't something to worry about is, scientists are never going to inadvertently go and explain everything about everything, because we've seen throughout the class over and over and over again, every time one question gets answered, 10 more get generated, half a dozen of which are much more interesting questions than you started off with. It is a fractal. It is an infinite fractal of knowledge to be attained. They're never going to go and inadvertently explain everything. Wonderful quote from the geneticist Haldane he's the one who came up with two brothers are eight cousins another one of these, where he once said, "Life is not only stranger than we imagine. Life is stranger than we can imagine." Scientists are never going to inadvertently go and explain everything. The purpose of science is not to cure us of a sense of mystery. The purpose of science is to constantly reinvent it.

So that's one realm in which people are threatened by all the sorts of knowledge and where this is going in terms of describing the what makes us who we are. There is another realm, not just the, what happens to our sense of selfness, another realm of, what does society do with this? What does society do as we get more and more of these terms and we understand more and more where the gears are, where the controls are, where the challenges are to the sense of autonomy and agency in people? What's going to happen at that point? What's clear is, if you are poor or poorly connected, you are screwed, because as more and more of these labels are given out, that's just the excuse that's needed to deny you a job or health care or fair housing. That is clearly an enormous danger with knowledge of this. But hopefully what happens instead, on a more optimistic note, is somewhere in all

these continua that this class was about, you see, there but for the grace of God, and a couple of neurotransmitters and three or four more receptors, could go I, as you begin to see a continua as you begin to see all sorts of realms that are tragically done in biology. We have no trouble looking at a schizophrenic and seeing, this is a disease, and this is someone who needs our care and forgiveness and protection. And we are in a world now where people who obsessively count numbers eight hours a day, we will have to be able to view that as just as much a disease that is just as much deserving of care and protection and understanding. With any luck, what all this knowledge is going to do is force us to extend an umbrella of protection, a realm of empathy, into areas we could never have dreamt of before, but never have dreamt of. The same exact extent that if you took the wisest, most compassionate, most introspective person on earth from 500 years ago and told them epilepsy is a disease, it would have made no sense at all. And we are certainly sitting here with a whole world of things where it could make no sense to us at all, where we will come to see that it has biological components as strongly as any of these others.

And we will have this challenge of seeing that this is a realm not of judgement, but of protection. And when we reach that point, we will have discovered that when we describe somebody as being healthy, when we say we are healthy, what we are really saying is, we merely have the same diseases that everybody else does. And with any luck, out of this will come a great deal of compassion. OK. So that's where all of this may play out in terms of the challenge to people's sense of individuality, what society should do with knowledge like this as it emerges. What's probably most important is what all this stuff means in terms of impacting you and your interactions in society, and what you will wind up doing. One of the irritating themes, probably the most irritating concept in this whole course, is the one of modulation, these stupid if-then clauses, because what they say over and over and over again is, just when you think you've figured out what is causing behavior, oh no, it's not actually causing it, it is amplifying the preexisting tendency of this or damping or modulating or imposing a contingent clause. Doesn't anything cause anything? It's like the entire point of this class that nothing ever actually starts a behavior. Everything is modulating, so you could never figure out how stuff is actually working. Why does this have to be so complicated? And one thing that comes out of the, why does this have to be so complicated is, why does it have to be so difficult to do something helpful, then in any of these realms? And I know for a fact that a large majority of you have the desire to do that, figuring in some of the things you want to do with the rest of your life. And what is really easy is to come out of a course like this saying, it's really impossible to change anything because it is so incredibly complex. It is really hard to do it because of how complicated it is.

But it's not impossible. It's really hard to do it because it will require not only doing vast amounts of work of collecting vast amounts of information, but then trying to synthesize it and trying to intuit when you should stop paying attention to the vast amounts of information. It is doable, but it will be incredibly hard, because down the line, every time one of you guys will choose to try to do something with a level of excellence that comes to people here very easily, every time you choose to do something, you are facto saying no to 20 other things. And some of those other things will be very, very important things to you. And those are tough choices to make. And it will be doable but hard because something

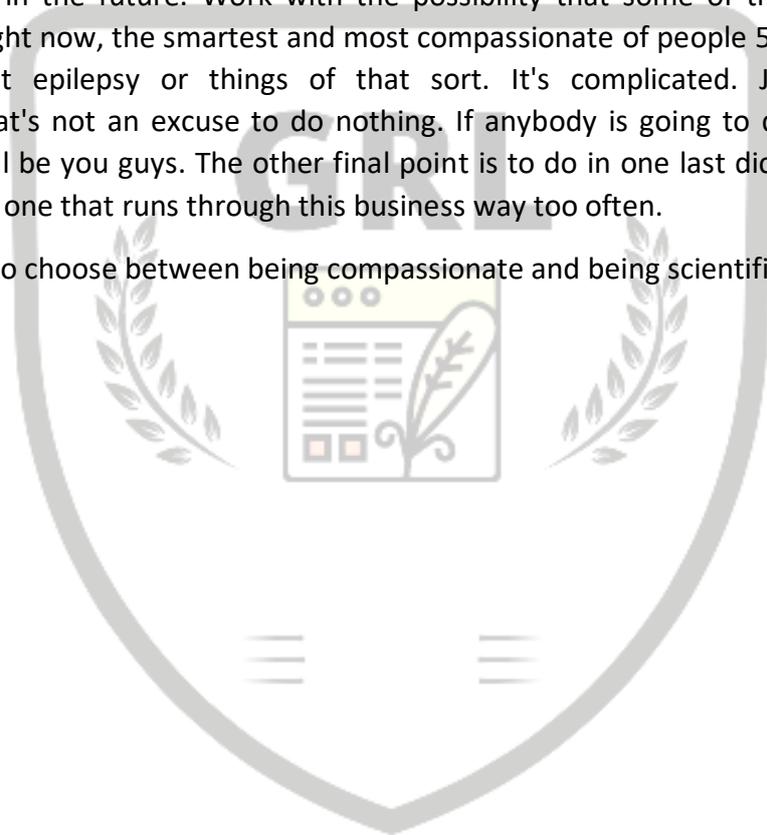
that's probably utterly inconceivable to you guys, but which is, at some point you're going to get tired. And it gets a lot harder to try to turn all of this into how can you make things better. But you guys need to do that. Here's a story. And this was about my father. My father was an architect, an architectural historian. And part of his career he taught in NYU, but McCarthy Era. Things didn't work out, and he wound up teaching in this crappy little architectural night school in Brooklyn for years and years on end. This was as flea-bitten of a place as you can possibly get. And every now and then I would go to see a lecture of his. And he was a spectacular lecturer. And he would do this thing. One of the lecturers, he's in there and he's putting up pictures of the most beautiful, important buildings on earth, and Versailles and the pyramids of Giza, and this or that incredible palace, and all of that. And here's these guys sitting in this night school who are, like, working as draftsmen during the day, and this is really a ragtag bunch, and putting up these pictures of the most beautiful archi and you know exactly what it is to inspire these people, to move to the grid. And no, that's not what he's doing. He's putting up these pictures, and he's yelling at these people saying, for too long architects have been whores of the wealthy.

What they do is we build their palaces, we build their mausoleums, we build their forts. And there's Versailles and there's the Giza and all. And I do not want to see you being the whores of the wealthy and the whores of the powerful. You are to and he's yelling at them. He's yelling at them about this. And these are folks who they're going to be lucky if they do, like, illegal garage extensions in Canarsie in Brooklyn someday. And he's yelling at them about this. And I'm sitting there thinking, this is the stupidest thing I've ever seen. And it took some time to realize that no, in fact, this was not at all stupid. And in fact, this was something remarkably respectful he was doing, because he was saying to them, you have the capacity to sin. You have the capacity to do wrong. And implicit in granting the power to people like that, and also intrinsic in that is, thus you have the capacity to attain a state of grace through the work that you will do. Great other story, Robert Oppenheimer, when the first atomic bomb was tested, and went off, made an amazing statement, which is "Now even physics knows sin." and the statement there being that even something as abstract as physics can, on some metaphorical, some secular level, know sin. Even within the realm of putting together buildings, if you do it toadying for the wrong people, this could count as a state of sinning, and intrinsic in that is the possibility of a state of grace, even in worlds like being a physicist or being an architect. It's not hard to see that one for you guys, though, because of who you all are. All of you here are privileged. You are powerful. You will have powerful resources and connections your entire life. And it will constantly intersect with the last 10 weeks. And it is guaranteed that some of you, at various points, will have 30 seconds to decide with somebody in an ER who has taken a vast amount of pills to try to kill themselves.

You need to decide, is it them? Is it their disease? Is there even a boundary? Do I give the command against their will to have their stomach pumped? Every one of you, at some point, will make decisions about quality of life, if you go into medical professions, as to when you pull a plug. Almost certainly, some of you in here will be judges someplace or other, wrestling with some of the exact issues brought up. Some of you in here will be legislators deciding how money should be spent, what things money is a waste on. And you guys will

be in positions like that, because if anybody will wind up with those powers, it will be guys. And if you remember any of this stuff, what will seem the easiest thing to remember is, it's so complicated, it is impossible to fix anything. It is impossible to make things better. And so I want to finish the class with two final thoughts here. One is, even though it's complicated, you've got to do something. Wonderful, cool thing I heard about in archeology. And I don't know if this is really true or urban legend. But when you excavate a site, what you are supposed to do is excavate only about half of it. You leave the other half for the people in the future with better techniques and better understanding, and leave something intact there to keep from your blundering hands. And the next person who then excavates does only half, and half at every juncture, saying, leave the possibility that people will be thinking very differently in the future. Work with the possibility that some of the things we feel certain about right now, the smartest and most compassionate of people 500 years ago, felt that way about epilepsy or things of that sort. It's complicated. Just because it's complicated, that's not an excuse to do nothing. If anybody is going to do it and make a difference, it will be you guys. The other final point is to do in one last dichotomy, one last artificial bucket, one that runs through this business way too often.

You don't have to choose between being compassionate and being scientific.



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