Rationally Speaking #213: Dean Simonton on "The causes of scientific and artistic genius"

Julia: Welcome to Rationally Speaking, the podcast where we explore the borderlands between reason and non-sense. I'm your host, Julia Galef. I'm here with today's guest, Professor Dean Simonton.

Dean is retired now, but until recently was a distinguished professor of psychology at the University of California Davis where his work focused on studying the determinants of scientific and creative genius. He has over 500 publications including 14 books such as Origins of Genius, Darwinian Perspectives on Creativity, and most recently just coming out this year, The Genius Checklist, published by MIT Press. Dean, Welcome to Rationally Speaking.

Dean: I'm glad to be here.

Julia: For starters, I'm curious how your work on genius fits into the literature more broadly. Are there other people studying the determinants of genius? Is it a well-defined field or is the kind of research that's spread out between lots of different disciplines?

Dean: It's not something as focused as, like, research on creativity or giftedness or intelligence. Areas that are much more focused research, that are kindred to studies of genius but have issued much more attention.

I think it's interesting that, for the first time, there was a journal of genius. It just came out in 2016.

Julia: Oh.

Dean: Yeah. That's very, very recently.

Now, people have been talking about genius for ages, but usually with the focus on IQ or focus on psychopathology or focus on giftedness, some other thing that's related to genius but not quite targeting genius directly.

Julia: How would you say that your take on the question of what causes genius compares to your peers?

For example, just to give you a sense of what I'm asking: if we were talking about the study of human rationality, which is a field that I'm not a researcher myself in, but I've read and written a lot about it, I might say something like: "Well, compared to other people who've studied rationality, I would be more optimistic that we can improve on our evolutionary default judgment processes, but maybe I'm also more pessimistic than average about whether short term interventions would improve rationality," that kind of thing.

Dean: Okay.

Julia: Is there an analogous statement that you could make about your take on genius relative to other people who have studied the question?

Dean: Well, I think the main thing is that, in my research, I study actual geniuses that are universally recognized as such. Most of them are completely dead and have been dead for hundreds of years, but I do so using quantitative and objective methods. That's unique. There's a lot of for example, case studies of famous geniuses and biographies by psychoanalysts of geniuses and stuff.

But I actually collect massive amounts of data and set up huge databases, and then do detailed analyses or fit mathematical models. It's large. It's quantitative. It's objective. I'm studying actual geniuses. And I'm studying geniuses people have actually heard of, like Michelangelo or Beethoven or Newton or Einstein.

Julia: To clarify, you're defining genius in terms of recognized achievements, not in terms of, let's say, raw potential intelligence, right?

Dean: Right. Exactly. That's a very important distinction. Because even though I'll study the influence of intelligence or IQ on genius, I don't define genius that way.

Because one of the fundamental issues is how much is IQ a factor, how much do you have to have a high IQ, versus having other things going for you like motivation and other kinds of very important factors?

Julia: Well, then, would it be fair to characterize your research as the determinants of scientific discovery or the determinants of innovation? How is it different from that?

Dean: If someone is doing something quantitative and objective using historical or biographical data, then they're basically doing what I'm doing. Unfortunately, there are just very few people who do that.

Julia: Yeah. Yeah.

Dean: I think one of the reasons why is that the research requires an interesting combination of two diametrically opposed dispositions.

On one hand, you have to be really fascinated with science. You have to love math. You had a background on statistics. You have to love statistics, right, statistical analysis. That's absolutely essential. You have to love numbers.

At the same time, you have to be interested in the arts and humanities. You have to be willing to read histories and biographies and figure out ways to content analyze. Write, for example, on computer content analysis of the Plays and Sonnets of William Shakespeare.

Julia: Right.

Dean: There's a humanistic side to it. In a way, the term that's used, the technical term that's used for what I do is, “historiometry” or “historiometrics.”

And that pinpoints the contrast. The metrics part is measurement and statistical analysis, but the “historio” part has to do with the humanities, having to do with biographies and histories of universally recognized geniuses.

Julia: Given that the geniuses you are studying lived decades or centuries ago, what kind of objective metrics do we even have access to, since we can't test people? We can't give historical figures an IQ test, for example.

Dean: We can't give them IQ tests, but we can give them proxy versions of those IQ tests. In fact, it's very interesting that the person who actually created the first commonly used IQ test, the Stanford-Binet, which is created by a professor at Stanford named Lewis M. Terman, he also showed how it was possible to use the same definition that was favored at the time of IQ to measure IQ in historical figures.

It's changed now. Now, they look at the normal distribution, the bell curve.

But back then, IQ was defined as an IQ. It's an intelligence quotient. It's a ratio of your mental age divided by your chronological age, and then multiply it by 100. If you're average, then your IQ will be 100. Okay.

What he did is, he looked at a biography of Francis Galton, who I'll mention later. He looked at biography and when Galton would start doing certain things, when did he start writing, when did he know how to do a written check, when did he learn a second language. Just one thing after another, and then what was the typical age that you expect a child to do that kind of thing.

It turned out that Galton was doing things at an age that, normally, you don't see in kids twice as old. At five, he was doing what 10 years old ... and originally, IQ was defined in terms of mental age divided by chronological age. It was a very, very direct application.

There's actually some very interesting studies done by myself and others where you apply this technique by taking details of chronologies drawn from the biographies, to use multiple raters in order to avoid any kind of subjective bias. Also, we try to make them ignorant of the hypothesis being tested. There's all sorts of different things you have to do.

In fact, this has gotten quite a lot attention because I've done this for presidents of the United States. If you go online and Google “presidents of the United States IQ”, you'll get my research on that.

It's obviously tentative. These were estimates. They're not exact numbers. You have to do various kinds of reliability checks and validity checks, but the point is, it can be done.

Julia: Interesting. Has anyone ever validated this method by, for example, having raters go through the lives of currently living people and coding them in similar ways, and then comparing the estimated IQ to the actual IQ of the person?

Dean: That would be a very interesting study to do. I don't know anything quite like that.

But I do know research, including my own, where you find alternative ways of estimating the IQs. In fact, there's two alternative ways that has been used. One is to actually interview experts who have written biographies of famous people.

The other is to use biographies, and extract — not early development, but rather extract personality descriptions. Descriptions of the person's own biography like "This guy was particularly brilliant. This person had broad interests. This person made major contributions to multiple fields. He was very influential."

Actually, you know, I have to admit in coming up with these words, I'm thinking about the typical profile of Thomas Jefferson, the smartest president we've ever had in office. If you look at these descriptions, what contemporaries said of Jefferson, and compare them with his early development, they correlate very highly.

Julia: Oh, that's so interesting.

Dean: They correlate to about 0.70.

Julia: Huh.

Dean: There are some issues involved and I've addressed some of these issues.

One is, there is a tendency for there to be a certain bias, because a lot of this early development - to have early [records] of it depends on parents realizing that they have a really bright child.

Julia: Right. And I bet wealthy parents are more likely to realize that.

Dean: Yeah, wealthy parents, and there's a whole bunch of factors you have to control for - but the point is, that if you have a kid who is really brilliant, you still are saving what they do. You don't put it on a refrigerator with a magnet and then eventually recycle the paper. You actually have a box where you're saving all the stuff.

Julia: Yeah.

Dean: For example, for Francis Galton, we actually have a letter that he wrote when he was four years old to his sister, that just shows you how precautious he was.

Mozart, we have a record of his earliest compositions when he was six years old. Mozart's an interesting example, because now, we have an early record ... and this answers your earlier question, now, we have an early record of his incredible musical preciosity, but we even have a contemporary assessment of him.

He was actually given a test when he was a little kid. I think if I remember correctly, he was eight years old at the time. He did a tour in London and a scientist decided to see if this was a real guy, a real prodigy, and gave him a series of musical test. A lot of times, Mozart did better than his own father did on his musical test.

Julia: Wow.

Dean: It was actually astonishing. This was published in the Transactions of the Royal Society of London, which is the first major scientific journal in the world. This is not peripheral stuff. This is actually a direct scientific study of Mozart when he was a kid — and it backs up all the other documentation that he probably had an IQ roughly around 140, around there.

Julia: Something that just occurred to me — if our proxy for IQ for historical figures is evidenced from stuff that his or her parents saved, and contemporary reports of that person's brilliance at a young age... is it possible to disentangle the importance of the person's ability on their ultimate achievement, from the encouragement and adulation that they got as a young person?

Like, if we're trying to predict what is the ultimate cause of someone achieving something great... It seems like their innate ability is intertwined with the praise and support that they got for showing that early ability.

Dean: Yeah. This is an issue that, really, cannot be resolved. This is a major scientific question now in even how to devise the methods. Not just for studying historical geniuses, even for studying contemporary talent or giftedness.

Julia: Yeah. Yeah.

Dean: Because there's a feedback loop, okay? For example, one of the things they discover when you look at scientific development is, great scientists tend to end up at major universities, working under distinguished mentors.

In fact, one of the best predictors of whether or not you'll get a Nobel prize in some scientific field is whether you worked under a previous Nobel laureate. Well, the question is, what's causing what in that?

Julia: Right.

Dean: Because highly talented kids will identify highly distinguished mentors but highly distinguish mentors will identify highly talented kids. It's a feedback process.

If it works right, of course, it's a positive feedback loop that builds upon itself until finally, you have someone who had a very distinguished mentor who got a Nobel prize and then they go on and get their own Nobel prize.

Julia: Right.

Dean: It was very interesting. A concrete example of that is James Watson who is one of the co-founders of the structure of DNA.

He was looking for grad schools. He thought that, at one time, he would work under somebody who was working with fruit flies, because that was a major, major advance in the study of genetics. Then he made a decision that that's not where the action is anymore... He started moving more into the molecular biology of genetics and of course, [...] concerning the structure of DNA. He was making a choice of mentors according to where he thought the future action is, where the future breakthroughs were going to be. That's cool.

Julia: Yeah, it's cool.

Dean: The point is is that it's hard to discern the causal arrows, because it is a dynamic feedback process. It often starts very, very young, where a talent is identified and ends up being channeled into good schools and having great mentors.

But just to show it doesn't have to be that way, you have someone like Albert Einstein, who basically was on his own right from the very beginning. He didn't have any distinguished mentor. The people who were on his doctoral dissertation committee are not notable scientists.

They actually had a relatively low respect for Albert Einstein. And he had a low respect for them. He thought getting a PhD was a farce. All he wanted to do is do science and didn't see why he had to get a PhD.

In fact, it's interesting — just to show you how little respect he had… In one year, it's called "Annus mirabilis," his miracle year, he came up with four papers. One was on the photoelectric effect. Another one was on Brownian Motion. The third one was on the theory of relativity, the special theory of relativity. All of which are considered to be major breakthrough papers in theoretical physics.

And the fourth one was on how to estimate the size of an atom. It's very dinky paper. I think if I remember correctly, it's only two dozen pages long. And that's the one he chose to submit for his doctoral dissertation.

Julia: Why? Did he think it was the best, or why did he choose that one?

Dean: No. He didn't think it was the best. He thought it was trivial enough that they probably would sign off on it.

Julia: He thought that they were more likely to sign off on a trivial paper…

Dean: That they probably wouldn't even grasp what the [others were about].

Julia: Oh, I see. Oh, man. That's really funny.

Dean: He published these papers in 1905. It wasn't until 1921, 16 years later, that he finally got the Nobel prize for those contributions.

Julia: Yeah.

Dean: Even then, the prize citation only mentioned the photoelectric effect paper — because people still weren't sure about whether relativity was true, even years later. For him to try to get a dissertation signed off on special relativity, forget it. It's not going to happen.

Julia: Well, since we're speaking of Einstein, I have to ask: the unusually high rate of Jewish people, people of Jewish cultural descent in the ranks of high achievers… like, Jewish people are vastly overrepresented among Nobel laureates, for example. What's your explanation for that?

Dean: Well, there's actually a lot of things going on there. First of all, if you look at your ... Jews are more highly represented on per capita basis. Only in those countries where Jews were, I want to say, emancipated — had relatively more freedom than in those countries where they were oppressed. You see a lot, on a per capita basis, in Switzerland where Jewish people had much more freedom than in Russia, just to make a comparison.

In fact, it's interesting, Freud is probably the most famous Jew in the history of psychology. He was born shortly after the emancipation of Jews in the Austro-Hungarian Empire.

Julia: But presumably, the non-Jewish members of those countries were similarly emancipated and they were less represented than the Jews.

Dean: I said there's a whole bunch of factors going on here.

Julia: Yeah, yeah. Sure.

Dean: Okay. Another factor is multiculturalism — that there is a strong tendency, in general, for people who grew up in two or more cultures... in particular, one, it required them to learn two or more languages, going to Hebrew school, for example. That also increases creativity.

For example, second generation immigrants have higher probability of great achievement than the ... this is why it's really ironic. I don't want to get into politics right now, but one of the things that made America great was that we had an open door policy attracting all sorts of very, very talented, creative people from all sorts of different nationalities. As you know, Albert Einstein ended up here.

That's another factor. Another issue is, what kind of values a particular subculture places on learning. In Jewish culture, there was a tremendous emphasis ... well, I just mentioned Hebrew school. Now, you go and you study the book — the word is extremely important, being able to interpret the word is extremely important. You have that cultural emphasis that makes it so ... being a Rabbi, being a teacher is highly valued in Jewish culture. That means, you have to be a learned person.

Julia: It's high status. Yeah.

Dean: I think there's a lot of things operating. In the case of European Jews, they all kind of converged to produce... Well, until the Nazis showed up, they had very, very impressive output.

Julia: One last question on the Jewish issue. If I'm not mistaken, I think, European Jews have a higher average IQ than other groups. Could that alone be enough to explain the higher representation?

Dean: We don't know why. This is the interesting thing. In Israel a lot of advantages that supposedly Jews have disappeared. When you have a whole nation rather than having a minority group, then something changes about the contextual factors in producing achievement. And so it's really hard to know whether or not ...

I mean, this is always a dangerous thing to start talking about. Some people think there are innate racial differences, some higher, some lower. And other people say there's so many other factors involved that until we can guarantee that there's an even playing field and everybody is growing up in the exact same circumstance it's really, really dangerous to start making inferences about any innate different between people. So ...

Julia: Well, I was just referring to the observed difference in scores, without necessarily attributing that to innate ability, versus education, versus whatever.

Dean: Here's the interesting thing — okay, let's get back to the Jews ... their verbal IQs tend to be much higher than average, but their special visual IQs are not necessarily higher. And in fact the Japanese tend to have very high visual spatial IQs. So you often have, and if you look at the cultures it's very ... I talked about in Jewish culture, there’s a big emphasis on learning, on studying, on interpretation. Verbal intelligence is extremely important in that particular culture.

In Japan, there's much more emphasis on visual and also holistic rather being analytical and more synthetical and looking at holes. And they've actually done experiments where they show that Japanese see the world differently. When you give them a picture for example, they not only notice the foreground but they're also more likely to notice the background. They'll be able to tell you, for example, the color of the background — when someone in a western culture won't notice that, because that's just background information so you would ignore it.

So, cultural differences do determine what kind of intelligence that we have because what is valued in the culture tends to develop in that culture. If it's a verbal culture then verbal intelligence will be emphasized.

Julia: Okay. Interesting. Let me zoom out a little more, because I've been going deep on the IQ or culture factor. Would it be fair to say that you think genius breaks down into part innate skill, part hard work or smart choices, and part luck? And would anyone disagree with that breakdown?

Dean: I don't think so, I mean, it-

Julia: You don't think so... Sorry, I asked you two questions at once. You disagree with my characterization of the breakdown, or you don't think anyone would disagree with that breakdown?

Dean: I think it's a reasonable breakdown. I mean, it's kind of simplistic but it's ... first of all, intelligence is just definitely a factor in genius. And geniuses are smart people. Part of the reason why they're smart people is that they have to master domains that require high intelligence.

Particularly that's obviously true in physics and mathematics and chemistry and things like that. You can't master those fields without having a certain minimal IQ. And I should say, mathematical verbal IQ — because if you're talking about an architect then they have to have a certain visual IQ, right? Or visual spatial IQ.

Julia: Right. Would the proponents of the “10,000 hours equals mastery” theory disagree with that too? Or does that 10,000 hours theory-

Dean: Well that's a bit of oversimplification. And what Malcolm did was he took the original rule which was the “10 year rule” and converted it into hours. But the original rule was the 10 year rule, that it usually takes about 10 years of intensive study, before you can attain world class performance levels.

A lot of that research was done in areas like sports and musical performance. It gets more complicated when you start looking at creative genius.

I have a whole section in my forthcoming book about this, is that the problem with creative geniuses is that they also have to be very open to experience. There's a personality dimension called the “openness to experience” dimension. They have to have broad interests, they have to have broad curiosity, they have to be willing to pursue things off the beaten track. A lot of times things that seem to be irrelevant turn out to be relevant, and the only reason why they find that out is because they just have wide interests and broad curiosity.

I mean, let me give you an example from Charles Darwin. Charles Darwin was trying to figure out the source of all these different species on the planet. You know, he saw all the tremendous diversity on the Galapagos Islands and he realized that the islands are very young, that had to happen relatively quickly, so how could you have all these different cinches of stuff there. And he found the solution by reading a book on political economics. A biologist has no buisness reading a book on political economics!

It was Malthus's essay on population, in which Malthus argued that the population grows geometrically, whereas the food supply at best grows arithmetically. And so you're gonna end up with competition. You're gonna end up with what Darwin's word was, struggle for existence.

As soon as he read that book he realized that was the key. That species produce more offspring that can possibly survive, and so that provides the engine for selection. Only those that are better adapted are gonna survive to produce their own offspring.

So the point here is that he was reading something that had no relevance whatsoever to what he was working on.

Julia: Right, yeah.

Dean: It was recreational reading, but it provided the key. And there's so many examples of that in the history of science, where just reading something or encountering something that is totally irrelevant... So what that means is that you have to have just this broad curiosity, this openness.

And that is kind of antithetical to the view of this 10,000 hours thing — or, sort of, the “drudge theory.” Where you study and study and study and study and focus and focus, focus, and get rid of any superfluous hobbies, and don't play the violin or sail on a boat like Einstein used to do. You know, he used to play the violin, he used to play Mozart violin sonatas.

You know, because, that's gonna be a distraction. Well, guess what? It's not. It turns out to be an essential part of being a creative genius is having that kind of breadth, and that means this could take you away from that meticulous, methodical study, study, study.

Julia: Maybe you need both the diligent, repeated practice, and also the interest in random other things — and to get both those things, you just need a ton of energy.

Dean: Yeah, you do need a ton of energy.

Julia: That's been my anecdotal perception of the people who achieve great things. Just, wow, you have so much energy.

Dean: Well, when you think about it, these are people who might spend a lot of time doing mathematical equations, working out the implications. Einstein had to spend a tremendous amount of time working out the mathematical implications of his theories. It's not like you come up with relativity and say, "Hey guys, look at this", you know? You actually have to work out the implications. But at the same time he still had intellectual energy left for other things that he wanted to do.

Julia: Right. Yeah.

Dean: And so I think that general kind of tremendous drive and energy and curiosity ... so even when you're taking a break, you're not sitting there in front of the TV set drinking a beer and watching an old movie. Unless you're interested in cinema.

Julia: Right. Or beer.

Dean: Yeah, or beer.

So, that's very, very important, that kind of energy level. And that's something you can't train. Some people have tremendous amounts of energy they can channel in a lot of different directions — and sometimes they almost overwhelm. Sometimes it's not very good to be married to some of these people. Because they're always doing something and always active and, you know, their significant other says, "Don't you ever slow down? Don't you ever stop? Don't you ever smell the roses?".

Julia: Right.

Dean: They will smell the roses if they're botanists, you know?

Julia: Right.

Dean: Well, we mentioned luck. I mean, luck is obviously important, okay, at a very fundamental level. And it starts at the very beginning. The luck of being born at the right place at the right time. If Einstein was born 15 years earlier there would be no context for his contributions. There was no need for relativity theory, there was no need for a photoelectric effect.

So, he was born just at the right time. If he was born later or earlier it would have been someone else with a totally different name who we would be talking about right now.

Julia: Yeah. What do you think about the idea that some innovations are just in the air at a given point in time, and they were going to be discovered by someone soon, because all the pieces were already in place? And so the quote unquote “genius” was just the person who happened to get to it first? Does that undermine a deterministic theory of genius?

Dean: There's some truth to that, but it's often overly emphasized. Because it's a common argument amongst people like in sociology and cultural anthropology, where they'll tell people that creativity, and particularly scientific creativity, is not really an individual phenomenon. Because there's something called, they call it the multiples phenomenon or independent discovery, where you have two more people come up with the same idea at the same time.

Julia: Yeah.

Dean: Okay. There's some problems with that.

First of all, a lot of times these ideas that different people come up with, they're not actually the same idea. At a superficial level they look like they're the same idea. But they're not. I mean for example, Gray came up with the telephone and Bell came up with the telephone, but the telephones themselves were not the same kind of telephone.

There was actually another person who came up with a theory of relativity, I think his name was Hasenohrl, who died in WWI. And it was promoted by the Nazis as being the true theory of relativity — but it wasn't the same theory as Einstein’s. Darwin's theory of evolution by natural selection was not equivalent to Wallace's theory of evolution of natural selection. The problem is we just sort of generalize.

The other thing is that a lot of time, you can show that when a discovery is made the ideas were actually around for a long, long time — and the question is why did it take so long for this to be discovered?

I mean, a good example of that is Mendel discovered the laws of genetics... And then 35 years later, three people working in three different countries, three different nationalities, rediscover Mendel's laws. Well, why did it have to be rediscovered when all the pieces were in place for it to be discovered 35 years earlier? See, it just doesn't make any sense.

There's so much ... it doesn't become inevitable at a particular point in time. Rather, the pieces are there, sometimes they're not, sometimes it takes a long time. The people who came up with ... hope I can pronounce this correctly ... chromatography? I don't know if I got that right.

Julia: That sounds right to me. Chromatography.

Dean: But it's one of those things where you put chemicals on little strips and you let water go up the strip, and then things will go up at different rates — and looking at the colors of that, you can sort of do a very nifty chemical analysis.

Julia: Right. Yeah.

Dean: And the people who got the Nobel Prize for that, I can't remember their names, they said, "we really didn't deserve the Nobel Prize because the ideas that we put together had been around for about 50 years, and we just happened to be the people who put it together". But why did it take 50 years?

Julia: Yeah. It's funny, I just recently released an episode with Ed Boyden — the neuroscientist who invented, or who helped invent, optogenetics and expansion microscopy. And he's only, I guess, in his late 30s. Those are both inventions that are revolutionizing the ways neuroscientists study the brain.

And I was asking him about his process of thinking and discovery, and one thing he said was very similar to what you're saying — like, a lot of the pieces are in place for these discoveries or these innovations for decades, and just are going untapped.

And he talked a lot about the importance of choosing the right questions to work on, as opposed to just working on a thing that happens to be within reach — there's like someone in your lab who's working on a similar thing, or there's something that's kind of hot and trendy, and so you work on that. He emphasized the importance of zooming out and asking, "What are the most — if our field's gonna really advance, what are the most important things we need to solve?"

It's kind of similar to what Richard Hamming used to say when he would walk around Bell Labs and ask researchers, "What do you think are the most important problems in your field?", and then like, "Why aren't you working on them?".

Dean: Yeah... I have one observation about this idea of choosing the right questions — because to me it's a hindsight problem, okay?

Julia: Oh, interesting.

Dean: You often don't know whether or not you've chosen the right question until after the fact. If you turn out not to be able to solve a problem, you chose the wrong problem, okay? If you solve it but you find out the answer is trivial, you chose the wrong problem.

It's only when you choose the problem and it turns out that the answer is profound that you chose the right problem.

But I would argue that most of the time in advance before you start working on the problem, you don't know what the outcome is going to be. And let me give you a ... go back to Albert Einstein again, he's always a favorite example for illustrating creative genius. There's no doubt that he often would choose the right problems. The relativity paper attacked a really legitimate problem, and so did the photo electric effects paper, and to a less extent so did the Brownian motion paper. The paper estimating the size of the atom, that turned out to be a very trivial problem and even worse he got the wrong answer.

Later on, he tackled ... of course later on from special relativity to general relativity, at that point he tackled the problem that he may have gotten over his head. He could not do the mathematics on that problem. And he had a hell of a time working through it. And he ends up, actually, in competition for a while with a mathematician, Henri Poincare, and barely won the race. But you know, he tried to tackle the general theory. He was at a sort a limit of what he could do, but he lucked out — and that was actually the paper that became the final push for the Nobel Prize just a few years later.

And then he tried to tackle a unified field theory that would unify all the forces of nature into one grand theory. Spent 30 years on that. It totally failed. A few days before his life he was still working on some kind of a solution. And when I say fail, I mean, sometimes catastrophic failures. He would come up with a version of the unified field theory and people would say, “That's very fine Einstein but according to that theory the universe doesn't exist.” Shit, you know, it was a total failure.

Now why did he pick a problem that he couldn't ... you know, people say in retrospect, "Einstein your problem was is that you didn't believe in quantum theory and so your theory doesn't have quantum, modern quantum theory". And of course it doesn't have quantum theory because he thought he had defeated quantum theory and showed it was implausible.

But the point is you only know in retrospect. So I think that that idea's kind of… unless you can say, these are the properties of a good problem and that those are reliable predictors of what's a good problem, I think it's mostly hindsight bias.

Julia: It still feels to me like we can guess with better than random success at which problems will turn out to be — if we could solve them — which problems would be revolutionary break through problems, and which wouldn't.

Just intuitively, if you look at, I don't know, two scientists, one of whom is trying to cure aging and one of whom is studying the wingspan of different beetles. Certainly we don't know for sure. Maybe the beetle wingspan question will turn out to unlock some big secret.

But if you had to bet on one of those scientists ... assuming they're equal intelligence, equal funding, whatever ... if you have to bet on one of them making a breakthrough discovery, wouldn't you bet on the former?

Dean: I might bet on the former, but I wouldn't be surprised if I lost the bet.

Julia: Yeah, well, there's a ton of noise. It's not ... it’s so far from deterministic, but-

Dean: Take for example one of the major breakthroughs in our understanding of molecular biology involved the study of viruses that attack bacteria. I mean, that's to me analogous to your wing example. I mean, who in heck cares about the colds that bacteria get from these viruses?

I'm being facetious there but the point is is that there was no reason to think that studying bacterial viruses would give us major insight into genetics. Just like studying the genetics of fruit flies that gave us major insight — “Oh that's cute ... oh you can tell when the eyes are gonna be red and when the eyes are gonna be blue and whatever…” That doesn't sound very interesting. But it turned out to be profound.

Julia: Okay.

Dean: So, I don't know if you know in advance. The big problems that look like obviously they're important ... here's one for you, boy, I'm gonna work on a perpetual motion machine. If I could solve that, that would be a very big thing. I would get all sorts of Nobel Prizes.

Julia: I mean, you also have to have some basic understanding of what's possible, and not just what would be cool if possible!

Although I'm not a great person to make that claim, because I spent like a year when I was a kid trying to invent a perpetual motion machine, despite knowing that it was impossible. So, I don't have the moral high ground here, but ...

Dean: I guess you should know the patent office won't even accept inventions of perpetual motion machines.

Julia: That's probably smart. I mean, there's probably a lot of quixotic would-be inventors out there, hoping that they'll be the one…

Okay. I wanna shift gears a little bit and ask you about: You've tried to describe not just the predictors of who's going to make a genius achievement, but also the process that they go through that produces innovation. And you've described it as a kind of Darwinian "winnowing down" of lots of ideas into the best, and sort of iteratively improving the ideas over time.

Do you want to just give the better explanation of the theory?

Dean: Lewis Paul had a nice quote about that. He said a student of his asked, "How do you come up with all these great ideas?" I mean, you know, he ended up with two Nobels, albeit one was for peace, but anyway. And he said, "It's simple. Have lots of ideas and throw out the bad ones."

Julia: Yeah.

Dean: So it is basically analogous to Darwinian theory. You know, Darwin says that every given generation produces lots of offspring, there's tremendous variation in their fitness and so only a small percentage are gonna survive and reproduce and the other ones are gonna be weeded out.

The point about that that's very, very important is that the mechanism for generating these ideas, these variations, has to be — to a certain extent, it doesn't have to be 100%, but it has to be to a certain extent — unable to anticipate the future fitness or the future truth or the future beauty, or whatever it is, of the idea. There has to be a willingness to just throw out some possibilities, and then select through them, and see which ones work, and which ones don't.

Julia: Yeah.

Dean: It's a tremendously inefficient process. But evolution, biological evolution, is very, very inefficient.

Let me give you an example, and let's move out of science and go into the arts. Probably ... Well, most people think that the greatest single work of Pablo Picasso is his Guernica, where he depicted the horrors of war, because of the bombing of Guernica during the Spanish Civil War. It's so well known. It's like archetypal. It's like the Sistine Chapel of the twentieth century.

Fortunately for us, he actually saved the sketches that he did, as well as he took photographs periodically of the canvas. He actually took six separate photographs in various conditions.

What's astonishing about those sketches -- and I've actually published an empirical study on this, where I content-analyzed the sketches -- the amazing thing is that, it doesn't look like he knows what he's doing. He produces ideas, and they end up falling by the wayside.

For example, in the initial canvas, he has, right in the center of it, there's a dying warrior. The dying warrior stays in the canvas in various ways, but the most dramatic thing about the dying warrior is that he thrusts up a fist, his arm, straight, vertically up, and his fist's clenched. It basically divides the picture into two, and it's very, very dramatic, and it's like the international salute, or whatever it's called. That didn't stay.

It was an idea, he realized, the whole painting would have to rotate around that arm. So, all that remains of that arm is the hand at the top, he turned into a lamp that overlooks everything.

He did a series of sketches. There's one woman who's carrying a dead baby, and he did a series of sketches of just her face. He added more and more anguish, and more and more tears, and more and more wrinkles, and more and more colors, and more and more everything. He finally decided it's not going to work, and he goes back to one of the earliest sketches.

In fact, what's interesting is for a lot of the images in Guernica, the image he ended up finally using was actually produced relatively early, but he didn't realize at the time that that's the best he could do, and ended up wasting lots of time producing other variations.

He had the horse on wheels. He had a bull that was actually Minotaur. It had a human head with horns. I mean, he had all sorts of crazy ideas in there, and he just ... God, he was already 56 at the time he painted that. He knew a lot about painting. Why didn't he just paint it? Well, he probably could have just painted it, but it wouldn't be a masterpiece. He had to go through trial and error, or generation in task. There's a lot of different words for this.

Julia: Yeah, interesting.

Dean: But the main point is, you've got to produce lots of ideas, and throw out the bad ones, just like Linus Pauling said.

Julia: I mean, that's very intuitive, or that feels very intuitively plausible to me. But it also seems like there are multiple mechanisms by which that could be the driver of genius?

If we think that geniuses are better at this process of winnowing, there's at least three ways in which they could be better.

Number one, they could just be better at generating more ideas than other people do. Call that quantity. Number two, the ideas that they generate could be higher average quality than other people. Call that quality. Number three, they could just be better at winnowing down to select the good ideas from the bad ones after they generate them. You could call that discernment.

Dean: Right.

Julia: Have you studied and/or do you just have any intuitions about whether the quantity, quality, or discernment hypotheses —

Dean: Oh, that's one of the major areas of interest for me.

Julia: Oh, cool.

Dean: The relationship between quantity and quality. One of the things you find is on average, quality is correlated with quantity. The more ideas you produce, the higher the probability that you're going to produce a really good idea, okay?

Julia: The max quality — not the average quality of the ideas, but the eventual quality of the end idea?

Dean: The maximal quality, yeah, that's an important distinction, okay? It's not the average quality, it's the maximum quality-

Julia: That makes sense to me.

Dean: As you know, you studied statistics, there's something called a scatter graph, right, a scattergram. There's going to be a distribution around that, okay? So, there's some people who have hit rates that are higher than the regression line. You hit the regression line, and that's between quantity and quality. So, some have hit rates higher, and some have hit rates lower.

The ones who have hit rates higher are perfectionists, that's what we call them. Then the ones who have hit rates lower are the mass producers. There's absolutely some mass producers that, even though they mass produce, they don't have a single hit. Now, they're not going to go down in history, but there'll be people talking about Joe or Jane who's working in a lab on another study that's not going to pan out, you know?

Now, because of the distribution, because there's generally a positive interrelationship between quantity and quality, most of the points are going to fall close to the line, okay? But there's still going to be this scatter. Every once in while, you're going to have someone ... Mozart is one of the more perfectionists, even though he was very prolific.

I mean, God, over 600 works in a 35-year lifespan. His hit rates were actually very, very high. One researcher estimated that when he reached his maturity, 70% of the works Mozart produced entered the repertoire, the permanent repertoire-

Julia: Wow.

Dean: ... like most of his late symphonies and his quartets and his piano concertos-

Julia: But are there discarded drafts, just like there are discarded drafts of Picasso's Guernica? Or was he just hitting it out of the park all the time?

Dean: Yeah. Unfortunately, we don't have very many drafts or anything, but yet... there's this really great scene in Amadeus. You know the play and the movie? I don't know if you ... Have you ever seen it, Amadeus?

Julia: Yeah, I've seen the movie. Yeah.

Dean: Yeah. There's this great scene in there where Salieri, supposedly his enemy -- in fact, by rumor, he poisoned Mozart, but that's not true -- looks over the manuscripts, and he's just blown away that what's there is basically finished. There's very few changes, and very few revisions.

Where if you look at Beethoven, for example, his musical manuscripts are a disaster. Sometimes it takes him a long, long time just to get the melody right, you know? It's more like Picasso's way of thinking.

On the other hand, there is a letter, some people say it's apocraphyl, we don't know, but there is a letter that Mozart wrote to ... I can't remember if it was a member of his family... where he described his creative process. He had a phenomenal, absolutely phenomenal brain, with like a huge working memory, so he could do everything in his head. He talked about going through various kinds of revisions in his head until he got it right, okay?

Julia: Wow.

Dean: In a way, he's still doing that trial and error, but he doesn't bother with writing it down.

Just to show you what a great memory this guy had, there is this famous episode when he was 14 years old, where he went to the Sistine Chapel to listen to a piece of music that was the state secret of the Vatican. It could only be used in the pope's private chapel. It was the Miserere by Allegri. It's extremely complicated, a choral piece with ... I forget how many parts, eight, nine parts, God knows.

Mozart listened to it and left the chapel — I think he listened to it twice — and wrote it down without a single error.

Julia: Wow.

Dean: When you have that kind of working memory, you can do it all in your head. So, when you finally sit down to write it out, you don't have to make any changes. Not everybody has that ability, and most of us have to do sketches and revisions, and things like that. But there's some people that can pull that off. So, the point is the process really hasn't changed. It's just that it's internal rather than external, but you're still doing trial and error.

Also, I should say one more thing about Mozart. Just in fairness, Mozart, unlike Beethoven, stayed more within the bounds of the music tradition that he inherited. So, it's much easier to not have to engage in trial and error when you're still using the same forms that Handel used and other of your predecessors. He might have changed that later on, but at the time he passed away, he was still pretty constrained by the classical musical tradition. So, that made it a little bit easier for him.

Julia: Okay. Interesting. I have so many more questions I want to ask you, but we're already going over. Maybe I'll just pick one more. Your description of how Mozart was able to replicate this entire piece of music from memory, it made me wonder if there's a correlation between genius and being on the autism spectrum, or having Asperger's syndrome, or being on the spectrum somewhere?

Dean: Yeah, right. There is, in fact, evidence for that, but it's kind of complicated, because ... Something we didn't really talk about is there's a very important contrast to be made between artistic genius and scientific genius.

Julia: That was my runner-up question I was going to ask you about. So good, yes.

Dean: Yeah. Scientific genius tends to be more towards the autism end of the spectrum, and so you see lots of evidence of high-functioning autism, which is no longer part of the diagnostic manual, but it's very popular in culture, public culture. High-functioning autism, you see a lot of evidence of that in people like Einstein and Newton.

I mean, you think about it, there has to be this tremendous ability to focus on working out the implications of equations, and double-checking your math. I mean, it's really, really compulsive work. Or even more compulsive, when you think about it, when Newton did his classic experiments in optics, he had to grind his own lenses.

Julia: Wow.

Dean: God, that is a very arduous, tedious thing to do. So, you have to be pretty on that spectrum, being able to engage in repetitive behaviors, over and over and over again, okay, until you finally get that prism exactly right.

Artists, on the other hand, tend to be way over on the other extreme. They're much more emotional, much more expressive. The pathologies that they exhibit are much more likely to be things associated with bipolar, for example. We're really talking about two different kinds of people, although, I have to say, there's variations within each.

Within the arts, for example, there are highly expressive arts, and then there are more formal arts that are more constrained. You look at a Jackson Pollock, he's doing highly expressive work. Someone like Piet Mondrian is doing highly formal, or Escher. You see that same kind of thing along that same kind of a spectrum. The more expressive, the more irrational the form of creativity is, the higher the tendency to have a sort of psychopathology of bipolar nature. But the more rational, coherent, logical, the more you see it more towards the autism end.

Julia: Interesting. Okay. Well, I'm going to finally wrap up this episode, even though I'm sure I could ask you a dozen more questions easily. But before I let you go, Dean, I wanted to ask if you could name a work, a book or article, or even a play, that influenced your thinking at some point during your career. Does anything like that come to mind?

Dean: Yes. The book that most strongly influenced me was the first book that was devoted to the scientific study of genius, and that was a book called Hereditary Genius by Francis Galton. As the title suggests, it had the hypothesis that genius was born, not made, and he tried to demonstrate that by looking at family pedigrees, and showing that geniuses in a wide range of fields are more likely to be in families where there are other geniuses in the same field.

One of the best examples he gives is the Bach family, where the number of Bachs in the part of Germany where the Bach family was active who were musicians was so big that sometimes, when they needed ... like some special event, and they needed, like a wedding or whatever? They wouldn't say, "Go get a musician." They'd say, "Go get a Bach."

Julia: That's great.

Dean: Johann Sebastian Bach himself had four sons, actually five sons, but four in particular who became extremely famous in their own right. In fact, in Mozart's day, in Haydn's day, when they talked about Bach, they actually were talking about one of Bach's sons. So, that's an example of a genius being born.

I would not recommend anyone read this book at all. First of all, his theory was tremendously overstated. The family pedigree method has a lot of problems with it.

Julia: Yeah, I feel like he couldn't really distinguish between genetics versus the influence of early childhood education — or, if your parents are playing music around you, maybe that's going to make you, create a passion for music, or something like that.

Dean: Well, yeah. Exactly. I mean, in the Bach family, all the kids, once they reached a certain age, were expected to play an instrument in family gatherings. I mean, come on.

But the main problem with this book is because it was written in 1869 in Imperial British Empire, it's full of racism and sexism and it's extremely embarrassing, but he was-

Julia: Is it really not worth reading at all? Even ... Would you say, "Don't read it at all," or would you say, "Read it but just keep in mind..."

Dean: I think there are some sections are brilliant, and very, very important. For example, he was the first person to suggest that intelligence was normally distributed, and actually provided some evidence for the normal distribution. He argued that genius was just the upper end of that distribution.

Julia: Huh. That's a pretty modern description.

Dean: That was his first contribution.

... But he also, even though the family pedigree method has problems, it was his first attempt to try to study genetics. He introduced other techniques later, not in that book, but in later publications. For example, he was the first person to introduce the twin method-

Julia: Oh, interesting.

Dean: ... as a way of trying to tease out nature and nurture. The very term, nature/nurture issue, comes from the second book that he published, in 1874.

But there's certain chapter that I would stay away from. He has a chapter towards the end called The Comparative Ability of Nations.

Julia: Oh... sounds promising.

Dean: That's where he ranks races. Now, in all fairness, he's somewhat objective, because he doesn't rank the British as the great race. He puts the Greeks, ancient Greeks, above the Brits. But he puts the Brits above everybody else, of course.

Julia: Okay. Well, I mean, it sounds interesting, and worth looking into, despite being imperfect and of its time.

All right. Well, we'll link to that if any readers want to check it out with your qualified recommendation, and we'll also link to some of your work, including your most recent book, The Genius Checklist, which touches on some of the ideas that we've been discussing in today's episode.

Dean: Oh, yeah. Definitely.

Julia: Dean, thank you so much for joining us. This was such a pleasure chatting with you.

Dean: Well, yeah, it was great. Thanks for all the questions. It was great.

Julia: All right. Thanks for all the answers. This concludes another episode of Rationally Speaking. This concludes another episode of Rationally Speaking. Join us next time for more explorations on the borderlands between reason and nonsense.