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Is Beauty A Guide to Truth? A Physicist and a Philosopher discuss some Big Questions

September 16, 2021



The Veritas Forum

Beauty inspires humans to great feats of imagination and discovery. Can beauty also help us find truth about the world and ourselves? Might beauty contribute to the advance of science or reveal the presence of God? An Oxford physicist and a Virginia Tech philosopher explore the relationship between aesthetics, science, and human meaning. • Panelists: Dr Ard Louis, Professor of Theoretical Physics at the University of Oxford, where he leads an interdisciplinary research group studying problems on the border between chemistry, physics and biology. • Dr Ben Jantzen, Associate Professor of Philosophy at Virginia Tech, where he studies inference and language in science: the contents and character of the natural world and how we come to know it. • Moderated by Vivek Mathew, Executive Director of Chesterton House. Sponsored by Bradley Study Center at Virginia Tech and Chesterton House at Cornell University. •

Transcript

[MUSIC] Welcome to the Veritas Forum. This is the Veritas Forum Podcast. A place where ideas and beliefs converge.

What I'm really going to be watching is, which one has the resources in their worldview to be tolerant, respectful and humble to the people they disagree with? How do we know whether the lives that we're living are meaningful? If energy, light, gravity and consciousness are in the street, don't be surprised if you're going to get an element of this in God. Today we hear from Artily, a theoretical physicist at Oxford University, and Ben Jansen, an associate professor of philosophy at Virginia Tech, as they explore the relationship between aesthetics and science. In a talk titled, "Is Beauty a Guide to Truth?" hosted by Virginia Tech.

These forums aim at exploring big questions, and we certainly picked an ambitious one for today. "Is Beauty a Guide to Truth?" It's a very difficult puzzle because there's something to be said about both answers. Yes and no.

On the one hand, it seems like beauty couldn't be a guide to truth, just because it seems so different from truth. Beauty seems to think of it as subjective, varying from person to person, maybe culture to culture. There are different standards of beauty.

Truth feels kind of objective out there, and mind independent in ways that beauty just feels like a bad match. On the other hand, you have this situation where plenty of scientists describe themselves as being explicitly guided by considerations of aesthetics and beauty, whether they call it elegance or simplicity or parsimony. And so you have this puzzle even within the sciences, let alone the fact that perhaps scientific truth is a small portion of truth.

So we couldn't ask for two better people to help us think through these puzzles than Art and Ben, who each spent decades thinking through aspects of these issues, and we're really glad to have them here. The plan for today is going to start with Art, where he'll present a kind of opening walk us through how he thinks about these issues, and then we'll turn over to Ben to also give us an extended kind of presentation and how they think. And then they're going to actually talk to each other for a little bit and let them kind of, we have no idea where that will go.

They don't know either. We'll let them kind of explore some of this territory together, and then we'll open it up to you. And Art, I'll turn it over to you.

So take us away. This is a very famous quote from the romantic poet John Keats, who wrote "Beauty is Truth, Truth is Beauty." That is all you know on Earth and all you need to know. And this idea that beauty and truth are linked together is very old.

It goes back to the ancients. And you'll find that again and again spread throughout the scientific world as well. Interesting, he's also famous for another quote on this topic where he, in another poem, Mlambia says, "Cold philosophy will conquer all mysteries, empty the halted air and gnomed mine, and unwave the rainbow as this Earth well made." And my colleague Richard Dawkins wrote a very famous book called "A Weaving the Rainbow." I don't, I think Richard Dawkins is a great popularizer of science.

I don't always agree with him on philosophical matters. But this particular issue I do agree with him, which is the feeling of odd wonder that science can give us is one of the highest experiences of which the human psyche is capable. And very often those feelings of odd wonder are all the sense of the sublime, the sense of beauty.

These things are linked with one another. I've got a friend that writes university, Leid Howard Echlin, who's one of the leading sociologists of science and religion. And she was telling me that in one of our big surveys on how scientists think about religion, she noticed that as she asked these kind of big questions, scientists kept moving back to aesthetic considerations.

So the idea that they love their science because of the beauty, that they have these kind of experiences of the sublime, these experiences of awe when they discover something new. And that beauty could vary a lot, and I'll talk a little bit about that beauty varies, but this sense of beauty was very, very common. And so she's now started a project looking at beauty in particular.

What's kind of fascinating about this is that also the motivation for beauty correlates very much with the kind of the society and how well people are doing in their field. So scientists who consider those technicians and scientists who are saying they're thinking about leaving the field, were much less likely to have this experience of beauty. So whether scientists are fooling themselves or not, sociologically, these kinds of considerations have played a very important role.

That's what Dawkins was trying to unravel, explain in his book on reading the rainbow. I'm not giving one example of beauty. This is one of my great heroes, Paul D. Rock, physicists at Cambridge, the other place that I'll still be my hero.

And in the 1920s, he was thinking about the following question. So you probably know that special relativity, Einstein's theory of high speed was worked out in 1905. That's a theory about things that were very fast.

And in the 1920s, Aaron Schrodinger, he called him Schrodinger's equation, which is a theory of very small things. And so what you rock was thinking about is what happens to take something that's very small. You try to make it transform according to the equations of special relativity that are with transformations.

So in special relativity, you also have constants like $E = MC^2$. When it moves, you get this extra P here. So you get some Newton terms.

The question was, could you get this energy equation for a surely equation to transform in the correct way, according to the theories of false things. I mean, here you have two very different aspects of the world, fast things and very small things. And when you put them together, it turns out, in this case, you rock looked at electrons, which have spin up and spin down.

So they've got two components. No matter how you try to put them together, the only way that you can make it work is if you have this extra particle. This thing, which we now call the positron, and very famously direct policy equation, although the idea of some kind of other matter out there was insane.

And he later said he published it because it was beautiful and beauty is a guide to the truth. Now in 1932, quite as a discovered, the positron at Caltech. And so this thing was discovered after it was predicted by this incredible beauty of mathematics.

And I remember as a student first taking a course in advanced quantum mechanics and

learning this, this derivation by Dirac thinking well that can't possibly be true how could two such distinct theories, when they combine predict something so it can be crazy about our natural world. And I actually spent the whole night trying to see where Dirac was wrong. And of course that's the hubris of youth.

And of course I bow to the great monster because this is the only way of doing it. And so this kind of idea that you can use elegant mathematics to predict something about the, about something really unexpected about the world is a kind of something very beautiful. And I think it's incredible.

I think during equation is one of the most beautiful things that has ever been created as beautiful as the most amazing painting, the most amazing piece of music, as beautiful in fact as the most amazing mountain really exquisitely incredibly beautiful. And Dirac was very strongly influenced by aesthetic considerations when he went down the direction. So this idea of matter and antimatter.

So the idea of matter and antimatter comes from these two theories combined together and it's absolutely beautiful part of the way the world was very elegant very, very satisfying to see. And I think that's all aspects of I think that we have when we describe something that is beautiful. I have a quote from a report on one of the great French mathematical physicists who said, a scientist does not study nature because it is useful.

He studies it because he delights in it. And he lightens it because it is beautiful. If it weren't nature were not beautiful it would not be worth knowing that nature were not worth knowing life would not be worth living.

And I put this at the end of my lecture sometimes because I want to inspire inspire my students is that science is incredibly beautiful. And the sense of beauty the sense of aesthetic that we have when we work on it is one of the great drivers of our discoveries. Now beauty is complex.

And so the kind of beauty you see here quantum mechanics may not be the same as the kind of beauty you see in other parts of nature. And I'm very interested in biological complexity. So let me give you an example of that.

So here is a here is a picture of the genetic regulation of an equal i bacurium each little dots is a gene each arrow is a regulator that tells the other genes turn off which turn on. And so the idea of biological biological complexity is not just the number of genes you have but also how they regulate each other or how they interact a bit like the logic of a trend district chip. And if I write these down a sense of equations, it looks a little bit like this which is not particularly beautiful elegance.

Nevertheless, I believe as a physicist that there is some kind of beautiful underlying picture to this which is much simpler and more elegant than these equations that I've

written down. And her collaborator, Brendan by the by the Nara young interview people on this what they noticed was that the kind of beauty that inspires scientists very lot from field to field from biologists who might look at beautiful things in nature to physicists who like elegant equations. But the idea that beauty was very much present and very inspirational for them was more or less a universal.

Science can't be used and we've rainbow is that I gave you one little example, which I think is a project I'm going to use to explain something about how Christians might think about beauty. So, let's think about the question of equality of human value I hope that all the people the audience would agree that humans have equal value. And how would you measure that it's just some kind of empirical measure that you can use to get at that so can science help you well, how would you measure the value of human life.

I think I can give some facetious examples like, by chemist the value of elements in your body so if you have gold fillings you're worth more than so without gold fillings or if there's yellow just as your brain, psychologist how smart you are and anthropologist how the community values you can you call me so much economic value produce. I think we all sense instinctively that if we use these kind of scientific measures to try to calculate the value of human life we're unwavering something incredibly important, because we sense that human beings have intrinsic value. It turns out that actually driving the intrinsic value of human beings from a purely kind of naturalistic point of view put you on a kind of metaphysical quick sense.

And it's easy to kind of take a niche in turn and then say well therefore this idea is invalid and perhaps even dangerous. Christians would normally make this kind of an argument based on the fact that we're all made and loved by God is linked to what we call the doctrine of creation the idea that God created a world. And he created human beings and loves them and if there are value comes from that now that is I think a much more promising way of trying to extract something about the value of human beings.

I'm just contrasting that the show that science cannot often extract these kinds of things about the world, although you might be able to use science to help be sharpened to the question that you want to answer. And I want to use that because I want to talk about beauty in a slightly different way and be slightly take a staring step and talk about feminine beauty. So here I got a picture of some models on a catwalk.

And one of the fascinating things about this is that the each of these people look remarkably similar to each other's a very narrow aesthetic value. And even when you diversify it in quotes, and you add people of color for example you'll notice they actually look the same as a brain else have to just slightly tweet. Now compare that to the kinds of people you have in the audience or for example someone like myself who grew up in Africa and then traveled around Asia, not even in the UK.

The way that people look very dramatically. The kind of local aesthetics that people have

for what they consider to be beautiful can vary dramatically. So why is it that we have an incredibly narrow view of beauty in the fashion industry.

And I would say it's because our ideas of beauty are twisted. And I want to end with this quote from CS Lewis, a great Oxford writer, who has a lovely book on called the scruity bladders where these two devils are writing to each other about how they want to tempt somebody. And scruity writes to warm wood God is a heatless heart he makes no secret of it, of his right hand or pleasure forever more.

His road is full of pleasures. There are things for humans to do all day long without his minding in the lead sleeping washing eating drinking making love playing for playing working. Everything has to be twisted before it's been used to us.

We fight under cruel disadvantage is nothing is naturally on our side. And I want to say that beauty one of the dangers of beauty that it's so easily twisted and the example I just gave you feminine beauty ideals in the Western kind of fashion industry, where they all look very similar to a particular type of Northern European woman. There's something deeply and fundamentally twisted about that beauty image.

And the other things I think about beauty and truth is that beauty can can be deceptive beauty, I think in order to truly understand the link between you and truth. We also have to understand something about the wide diversity beauties that are there. And I think this links very closely for Christians at least to the idea of a document creation from a world that was made with incredible diversity.

And if we should expect beauty to have incredible diversity as well. And thank you for your time and the better. Thank you very much for including me in this conversation.

Let me offer a sort of a different framing of our question so when I was a much younger man, I prospected for dinosaurs in the Badlands of southern Alberta. I clearly remember walking the rim of a deep canyon with two team members when we happened upon a rock. This rock was smooth and had been dropped by a glacier is about the size and shape of the wheel of a small car.

None of us had to speak to the others. We immediately stopped walking. And two of us crouched down and hoisted that rock up onto its edge.

And we flipped it and it kept flipping down the side of the hill thump thump thump gaining speed. Eventually it finds its natural axis of rotation and now it is spinning like the wheel. And that rock left it dove, it skittered, it gouged like a living thing.

It's running down this topography. We can't see you from the top of the canyon. And like a living thing at the bottom of the canyon, it darts into a scrubby patch of bushes and trees with a crash.

For a moment there's a pause, we all thought the show was over. We had just started to turn when that rock came out on the other side of the grove and started climbing up the other side of the canyon. When finally it collides the block of sandstone and annihilates it in a cloud of dust.

That event, a rock rolling down a hill was one of the most beautiful things I, and I think my companions had ever seen. At the very least it has clearly stuck with me for all of these years. As a young student of physics, I had a similarly formative experience of beauty involving wheels.

I recall the first time I graphed how the simple and austere principle of conservation of energy dictates the speed at which an idealized wheel rolling down an idealized canyon must be going when it reaches the bottom. That gave me a similar thrill of having glimpsed the beautiful. Now I share these two recollections to illustrate at least two faces of beauty.

Art has already pointed out that beauty is complex. And I want to point to two very different aspects. One I'm going to call the beauty of experience or beauty in the experience.

This is beauty that emanates directly from our participation in the world, like watching that rock careen down the canyon. The other is beauty in the apprehension. This is beauty in the apprehending or grasping a representation or story about the work.

This is the sense of understanding the aha moments of getting how conservation of energy gives me that speed. These two aspects or sources of beauty take on radically different significance, depending on which of two views of the world you happen to hold. One of these views, I'm going to call platonic.

In this view, all the phenomena of our day to day existence, what we experience at the scale of medium sized dry goods emanates from a few principles, perfect and regular in their operation. What we might call laws of nature set. Everything we experience in the moment is some shadow of these principles imperfectly presented to us.

This includes the beauty of the experience. From this platonic view, the greatest possible experience of beauty is apprehending those original principles. In the world of fine arts, Michelangelo and a vow of Neil Platonist is a good representative of this attitude.

Think of what he says of the statue of David being revealed in the stone, not crafted. That statue, the figure that we get, is a reflection of, and is meant to be a reflection of, some ideal form that can't be realized in the experience. The beauty lies in the ideal human form that statue reflects.

Over the world, we might call Aristotelian in honor of Plato's contrarian students. In this view, the nitty gritty phenomena we access in our experience, the phenomena that

display infinite detail of pattern and variation are the substrate of the world. Any principle we use to summarize or describe those phenomena are themselves but poor shadows of the happenings of the experiences.

The beauty of experience is a gift of the world in this view, while the beauty of apprehension is a byproduct of the stories we tell. We seek to organize or to find pattern to help us conceptualize this beauty of experience. Artistically, I think the Aselmans represents this attitude.

She's a Lafayette American artist famous for her drawings of desert pebbles and ocean surfaces, drawings that replicate in extraordinary richness. All the details we tend to abstract away when we imagine such a thing, we remember such a thing, rather than stand in its presence. So, what does beauty then have to do with truth? Again, it depends on which of these views of the world you talked.

For the Aristotelian, the central question is what is true of this beauty? The beauty of experience provokes us to try and organize in detractable patterns, but there's no necessary connection between the beauty and apprehension of any of these patterns we might nominate, and they're actually being true of those things in the world. For the Platonist, the central question is which beauty is true? If we assume that there are these laws or principles that determine the phenomena, and furthermore that these laws are comprehensible, are apprehendable by beings like us, then there is a close connection between truth and the beauty of apprehension, the beauty of that aha moment. That which we find beautiful to apprehend is a good candidate for the true principle that generates the world.

Now what do I think about this connection? You might have guessed by this point, I'm going to risk the Thielian. And from that view, you know, recall that the beauty of apprehension is about our descriptions of the world, stories we tell. There are many beautiful lives, and I am suspicious of beauty as a guide to any sort of truth.

But even if the Platonist is right about those underlying principles, I still don't see any reason to take that that extra premise. I don't see any reason why those principles, those laws should be comprehensible to us. And I suppose I would point out that, as, as already mentioned, there's, there's variation from discipline to discipline with respect to scientist's sense of beauty.

But I would suggest that the sense of beauty scientists individually cultivate is even more idiosyncratic than that. And that what it is likely indicative of is the history of recent scientific successes, that which we created that which gave us a moment of beauty of apprehension, sticks with us. Right? That's what we seek in the future.

It's not a guide, right, as much as it's a, it's a summary of the history of our success. It's not a guide to the creation of future success. And I think now we get to it.

Thanks. So we got both of these kind of views laid out in table. Are do you want to kick us off and I'll let you two have the floor for a little bit.

So I'm just trying to think of the direct experience, and also myself with this Aristotelian or platonic. And I don't think I think you're a bit of a play to this. I don't think that's what he is getting at, or what subsequent physicists are getting at.

I think what they're getting at is, if you have a number of different, what you're often have is you've got a phenomenon you had to explain. You've got multiple explanations that seem consistent. And so what this strand of physics has shown is very often picking something that's that is relatively simple or elegant or has a certain kind of beauty to it.

So it's not the case that this always works. But it works often enough that people are very struck by it. And so I think in theoretical physics, for example, this idea that on beauty, it's something so often hard to explain, but people recognize it.

One point second, right on something say this is a beautiful derivation or beautiful equation people will bind or say yes they recognize it, but it's not so easy to put into words. What we exactly see. I don't think that.

So there's a, I don't think that we need to make this distinction quite between having to believe that there is some kind of deep media that is that we're going towards, or that it's in the upper hand and I think these things are in the way. So, if you finished your thought there's there's lots of things I'd like to say to that but I'll try to stick with two and see if this takes us down an interesting path. So, the small thing has to do with the direct example itself.

So, maybe that's the best choice of beauty guiding us in the sense that in that particular example and we can let this go by the wayside but it looks to me as though what direct is doing is an example of, of constraint search it's not that he had a sort of of possibility is selected from amongst them the most beautiful, rather he had to let's say empirically well motivated constraints you have a sort of a symmetry constraint and a conservation constraint. And that imposed on him this this you know supposition of the of the positron. So, put on the table other examples were kind of Gellman's Omega minus where the claim at least was that the way at which it was arrived at and again, I'm a little skeptical of this was was by selecting from amongst the options.

So let me ask you. With respect to to sort of a shared sense of beauty in the community as a guide. So, if we take it so, if we if we don't want to commit to this sort of platonic supposition that the world will be such we can apprehend it, and that the principles are really sort of simple out there we just, we just need to identify them by their hallmark of beauty.

So, if we take those suppositions. Then one way this sort of link is, is often defended as

something like a meta induction this we've, we've, we've come in our in our arduous journey to being professional scientists we've we've seen what works. And that gives us a sense of beauty now this happens all the time right like I've soldered thousands of solder joints, I actually have an opinion as to what constitutes a beautiful solder zone.

I did it before I do now, and it has a lot to do with with one that will work. And I take it the idea is something like this is true of science. I think it's good beyond that so I think there may be something in solder joint to work well, and then what you find beautiful is the fact that it works well and but probably the fact that it works was also linked to some aesthetic considerations about the joint looks like and regular etc etc.

And that's interesting and it's not that that's true. I think in the case of the science it's, it's not just that we are somehow in culturing into this and therefore now we believe this is beautiful we've worked hard now we think it's beautiful. I think you can't have an experience like watching special activity and quantum mechanics combined to make antimatter about thinking that something deeply beautiful about it.

I think your rocks point with the beauty was not the head of constraint service when he ended up with it was that he ended up with something so crazy it seemed absurd. And then he just said look it's such a beautiful elegant equation it must be true and therefore he published it anyway. And that's the sense of beauty that it was right so the attempt to be able to this is so beautiful it must be true, and therefore it published it and then it was it seemed fantastical or just bizarre, and maybe some kind of mathematical weirdness and possibly wrong but that's the sense of beauty that there is so he would using beauty as a between multiple ways of trying to make this work, a way that that made that actually added an extra kind of on the sides about the world that seems ridiculous.

Because he felt that that was the more statistically beautiful one to do. Now of course that has not experienced has sociologically infected the community for good or for real and so that we all like to do something like Iraq again. And there have been steps that were things of similar nature happened and in our film why are we here that made with David Malone we did a long interview with Frank Wilczek because very reasonable prize winning physicists who has written a very beautiful book, a very nice book on beauty.

And he talks about discovering the strong force, and if you look on the I think somewhere they've linked the, or interviews that we made, but he talks about the discovery it is that we teammate, basically when he was 22 or 23 years old it was just pretty amazing age to discover how one of the four forces would be to work, but he said you know there are lots of different ways to think about it and we you know beauty was a very important guide into the one that we chose and the one that actually ended up working the one that gave some of the classic freedom. And so the experience and and real check has done as many times again and is, it is work. And so the genius like Wilczek of course is that he knows when to use this and when not to when the start of the stop.

And so there's no surprise winner, and other words of us are not. But but it's fascinating to see how that continues on as the European the European tradition. And of course we're influenced by that right so our hero and Wilczyk and Gilman and do I do that again so now I've moved now into looking at biological systems these are much more complex and much more than I think there are much less amenable to this kind of approach.

And biologists, in fact, are often very suspicious of this kind of approach there's suspicious much more generally of of kind of inductive reasoning of this type. And I think for good reason, but I never less think as a physicist that there are aspects of biological world that are going to be a lot simpler a lot more direct in once we understand the property and so I think the reason I think there's good kind of pragmatic reasons to be suspicious of inductive arguments that's because the next of arguments have to be constrained by data and I think data often can not. So I've felt by work on evolution evolutionary theory which is often presented in ways that I think are aesthetically not very attractive I think it's one of the reasons for a lot of lay opposition to evolutionary theory.

And one of my kind of goals in life is to try to make it more a more beautiful theory and more aesthetically pleasing theory which I think it can be in the Senate property. And I think it's so doing it'll also make it more palatable for many people who find it difficult. Okay, I'm going to jump in here because we're actually a time to start letting our audience ask some questions and we have some already on the table so I'll just throw this out to both of you because I think it applies to both of you.

So the question from anonymous viewer asking, I think your views on, do you think beauty beauty is intrinsically a trait, or is it something that only exists from a secondary point of view, or is it something that exists because we label or create something as beautiful. Each of you hinted at aspects of your answer it'd be nice to just splash those out a little bit. Is it a philosopher.

Sure. So, in my view it's a little bit of both. I suspect, or I think that there are aspects of beauty particularly, actually both of the sorts I described beauty in the experience and beauty and apprehension that are inescapable and almost certainly consequences of being the kind of thing that can respond adaptively to a world.

So, you make a thing with a with a mind that that gives it, or at least the minimal sort of mind that gives it the ability to respond to an environment and might, and for a variety of reasons I think that such a thing must have something along along the lines of the experience of beauty, just like it has something like pain and positive affect or pleasure. But beauty is also highly malleable and in that sense can be constructed I mean, are pointed to the, to the folks on the catwalk and to cultural variations in ideals of beauty. You know there's also, as I was trying to suggest with the mention of soldering there's there's a sort of sense of beauty that comes with habituation and familiarity I mean

there's a very robust psychological effect the more you, your, your exposed to a thing that the in so far as you're not harmed, the greater your sense of affection regardless of any other effects of the thing.

And, you know, the, the sense that that derives from our repeated toil in a particular area is usually a very compelling emotion or experience of beauty so I think it's a little both are. I guess that's not to get uncertain I think that it's a bit of both I think the reason is that a tendency to say because you are cultural variations in how we see certain new things are for this is nothing but not I don't think that's necessarily although, you know, it's defining beauty perfectly is a famous philosophical black hole and many philosophers have fallen down never to come back up again. On the other hand it's a little bit like this is a very famous judge I forget what the name of forget that the judge do you remember this man but he was asked how he could distinguish, you know, art from pornography and he said, you know, I can't give a definition but I know it when I see it.

And I think this is the same thing we know we we do know when we see it very often, even if we can't necessarily always give it a complete fixed definition. That's why I want to emphasize that beauty is a complex thing. One of the things that you see in the experience of scientists and beauty is also you know you get the sense of, of all, or a sense of the sublime.

One of the things we noticed when we made our film which future lot of scientists lost in questions about beauty asked them how did they feel when they made discoveries and on this one we started talking about the sublime which often even brings a kind of sense of terror sense of fear like you've touched something that you really know something very beautiful the kind of thing you see when you walk around a corner up a cliff up a cliff and suddenly you see these incredible things and this that you sense a sense of something larger than yourself. I think beauty does that to us it centers us. It makes us feel like we're part of something bigger than ourselves.

And I don't think that is just a kind of a psychological adaptation. I think that is, I think that is a kind of something about our world as a thesis obviously as a Christian I believe that's something that God has made put into the world as signs of transcendence that tell us something about the way the world is I mean the world could very well not have this, the world could not have elegance and work and not have the intentionability. Those are all surprising things about the world and on theism I think they're more likely.

And so I look at that as my own, you know my own kind of lens that I look at the world with and I think that I think that's the important part of how I think about that and I think well beauty is part of that. I recognize it has heavily culturally and historically colored. We have a couple questions that I think are for hard.

Do physicists all really agree that the direct equation is really beautiful to this very

disagreement about it they have different taste about it. And a follow up I'll combine this with another one. If so, even if they did agree.

Could this be just because you're trained in graduate school you're socialized in a certain way. And I'm sure most of us lay people when we saw your slide with direct equation we didn't, we didn't think wow that's beautiful we're like what does that mean we squinted our eyes. And so we have to be trained like you'd have to like habituate us as Ben said into this sort of thing.

And these questions might be pushing at you know maybe there's this other explanation for beauty. Yes God made the world with beautiful. And this is disagree I think this is what this do and everything but that is a pretty vast majority view.

And no I think just obviously we are on we are socializing the thinking of a certain things but in certain ways. But I think that many physicists experience of direct equation is one of surprise of all and a beauty in a way that's is not just because we're trained to think about it that way so even if nobody told me it is beautiful I might go back and say it is beautiful and it's a very common experience. And so the experience is a very commonly shared but even in fact I'd say one of the problems with physical education is that it doesn't emphasize nearly enough the sense of beauty and as well as often ignored in education, it becomes kind of wrote.

And so you're doing lots of pop and sets, but that beauty is something that you see on the side the fact often it's linked to understanding so just like you may, you know if you're not trained in music you may not appreciate something about a very subtle piece of music I appreciate Max fumes for example if you all you listen to your whole life is a country music as an example nothing wrong with country music but you're not going to appreciate the fumes in a way but if you're trained classically you will. And that's that's just normal as to where the world is right there's certain types of beauty that you need some training and understand what is beautiful about them. So, I'll share a quick comment there.

Two things about the agreement in the sense of beauty. You know, we certainly don't have time to try to do some kind of some kind of proper sampling but there are cases like for example the vortex theory of atomic structure where where the community at large hail this as a as so beautiful it must be true and nobody remembers it anymore. And there's a little bit about some, some confirmation bias in what sets the sense of beauty, but I guess I also want to point briefly to, to pretty large divisions in science.

There's a pretty nice article recently in nature perspective by Ben MacArthur on the differences in the sense of beauty between the physical and the biological sciences. And they line up kind of interestingly with the, the platonic and Aristotelian perspectives that I had sketched. So, so maybe it's not quite so uniform across the sciences and, and maybe not quite so.

Maybe unanimity isn't such a guide to truth within a given discipline. So, we have a question coming about whether beauty is objective or subjective, which is a classic kind of part of the discussion literature on beauty and philosophy. If it's just subjective the question goes on is it then a different category kind of beauty.

I'm guessing they're talking about this sort of mathematical or, you know, the sort of beauty that guides the fundamental physics. And it sounds like just to clarify for the audience it sounds like in the background. Are you thinking of beauty is like look it varies quite a bit.

And yet there's this core unity which has it was cries out for explanation. And then Ben are you thinking, no, no, no, even if there's unity, we have other explanations for it and we need not appeal to anything like a transcendent kind of objective beauty that help help us as lay people understand where you're each coming from so. So, I think you summarize it well so I'll hand it with the better.

Okay yeah I would want to draw distinction so I don't, I think I actually disagree to a large extent I think there is an objective phenomenon of beauty in the sense that it is an essential part of of one's experience of the world it's like it's like color it's like pain. There, there's no avoiding it. But what I am critical of is not what I'm not saying is that the sense of beauty is is somehow subjective or purely constructed.

What I'm concerned about is the connection between that experience. And this other thing which is rather abstract which is this these claims that we make about the nature of the world based on some sense of beauty we get from apprehending that story that explanation. And I think it's critical of the connection between what I take to be a real phenomenon of beauty, and this other thing this this this understanding of how the world is.

I think we're we're we also agree is that we both agree that science can be extraordinarily beautiful. And we both give it all to that. And I think we don't think necessarily those concepts are purely subjective in the sense that I think that anybody else, you know, so one of the things about the beauty and physics one of things that some sociological study is that these ideas of what was beautiful were widely shared across different cultures might have many other aspects of beauty like say on human beauty that might vary quite well.

And so the idea would be this is quite quite similar. The interesting study, but I want to keep doing the film as well as Senator Zaki, who's a neuro neuroscientist in London, who was going through Michael it's famous mathematician did a study with a brain scanner of having conditions look at equations, ranked in beauty, there's a part of your brain that lights up and you see something beautiful. And so what they notice is these mathematicians from a wide range of different cultural backgrounds all more or less, you know, agrees on which equations were more beautiful.

And so the point is, is simply that's, you know, there's a core that's between the same, so you're supposed to see people in front of beautiful painting or beautiful landscape, the same bit of the brain would light up. So the point was, is there the bit of the brain that was lighting up when they sell his mathematical equations was the same as as their experience of beauty and other contexts. So, one of those neurocorla is a correlates with the experience of beauty, and what is fascinating is how much on this is shared across cultures.

It's more complex because one of the points is that some of the equations people like this, they like to just because they look beautiful so very famous the orders equation each of the. So, I buy is minus one is. Beautiful it's all pretty to look at right there are other equations like I wrote a direct equation in one way, you can write it in many different ways some ways are more beautiful than others.

You're actually an interview Sir Roger Penrose, who is just one of the prize actually last year. He's very much a playness and a big believer in beauty, even I was talking about the York equation I started putting on the board he insisted I wanted to do it in a slightly different way which is more beautiful using spinners. And that's just that's just an aesthetic point you can actually write the equation in many different ways.

People talking about the beauty they're not talking about how you write it and talking about what it actually means. That sort of gets to what I was saying so that neuro biological study you're speaking of, but some of the many of the participants in that study didn't know what the equations meant they had they had no way to interpret. So to them it's this experience of a visual object, and there we're talking about this sort of what I was calling this beauty of experience and we know that people like things that are somewhere on the edge of chaos right enough order but enough disorder to spark our, our beauty there but you know the question is, does that have anything to do with what the things actually represent are true, you know what they say about the world are so.

And I guess I would say broadly that, look I think sometimes in the short run certain of those rules do line up with with what's necessarily an inductively apt procedure but just as often they don't. And maybe it's a good time to segue into, we talked about this that the three of us a little bit before, where if we raise this, this scope of truth to be beyond just empirical sciences beyond natural sciences, and there are some surprising points of agreement between the two of us, and that's just some further disagreement. So, I guess some further disagreement, why don't you each kind of go, say how you just sketch out how you think of that so are do you want to begin.

So, I think the question is, can beauty be a guide to empirical truth, and then the computer be a guide to truth, simple literature so like there's more than to truth than just what the empirical sciences say which is you kind of suggested. So, much longer conversation. And I think I'm also a little bit more heads in the tread in that direction

since I am a scientist and not a philosopher or sociologist but I do think that beauty, at least we're using a very important part of our world and it has a lot to do with human flourishing so I think beautiful architecture is important, not just because we think it's pretty to look at but can I think it leads to human flourishing in certain ways.

It has done well. I mean Elaine Scarry on was a professor of English at Harvard is a really interesting set of ideas books, a book actually about beauty and justice, which he links the two. And this is because beauty, I think what beauty does to us is it creates a sense of transcendent creates a sense of centering to us it also creates on a sense of motivation.

And so I think those are kinds of directions I might go. Very briefly on this question. So I think yes there are links to truth there.

But they're more, they are, I think, and interestingly I think they're harder. There's this harder to pin down the sense of the reading and the sciences which are which are pretty strongly felt. Okay and Ben so yeah you've been pushing against the idea that beauty can be a reliable guide in the natural sciences.

How does your answer change if we were to just expand to truth in general. Well, that that's an awfully large bucket of things to think about. So, I would say from, from a sort of platonic perspective, I might not be so worried about it it's not really a different question and kind of what I'm trying to do is sort of, you know, ascertain the, the, the right simple principle because I think that when I see it because I will think that that beauty and apprehension is telling me about about this truth.

But from my perspective from this sort of Aristotelian perspective, it's even worse once we leave the empirical sciences and the empirical sciences, you can cultivate the sense of beauty that that is a sort of meta induction on theory construction on, on, you know, ways to attempt to, to grasp a certain sort of pattern. So, I'm not going to pack that for the audience so a meta induction, like the induction on an induction you want to just say in simple terms what do you mean by this. Yeah so you, you've, you've built laws that do pretty well with a wide range of stuff over and over again.

And every time you get some new phenomena you build a new law and you start to recognize patterns. And it's like if you're doing something like soldering you do it over and over again you start to recognize patterns in what makes it good. And you come to see those as beautiful.

And so the thought is that in a scientific context, this is one of the arguments for connection between the theory and science is that, you know, look, we get to do this over and over again and we see that hey when we appeal to, to symmetry, that gets us a theory that that does the job and so more and more we see symmetry is beautiful as, as just, you know, when we apprehend the theory with symmetry we see it as a step

outside of that context where you don't have this feedback from the world over and over again, then I worry there's from an Aristotelian perspective there's just, there's nothing to guide your, your tuning of your sense of beauty in this case and that sense is malleable particularly we're talking about apprehension and if I don't already know the truth it's pretty hard for me to develop the sense that connects the two. All right, thanks and we have a follow up question kind of from someone asking about Sabine Hossenfeld I believe some people claim the beauty is currently leading physics astray and it mentions Hossenfeld and parentheses. I think you can think about this and this might be Chris for your mail ban but Art why don't you start.

Yeah so so I'm quite familiar with that literature. I think she has a, so the point that she's giving out a little bit is to say this using beauty as a guide has been very subtle now, at the moment, what she's really saying is, I think is the following. It's been a very, very long time to combine quantum mechanics so that really this the standard model of the theory of the strong force in the, in the weak force with gravity, and the actual actual weak force, the mechanism of gravity and not succeeded gravity we have this general theory of relativity it's completely different from these quantized pictures of the world.

And a lot of the, what's happened is people have used mathematical ideas and use beauty as a guide so string theory is a class example my colleagues who work in string theory will say it's so beautiful it has to be true, it's a very, very common, that has guided the field for the last 30 years, and her argument is well perhaps we should take a step back and not use this kind of European way and try something different because it hasn't worked. And I think that's fair, right, I think that's a fair argument she's not saying that beauty hasn't worked extremely well she pointed out her, she's saying, given the failure we have had so far, perhaps we should just let us, but another aspect of our argument, which people like George Ellis have pushed on, is that's when you're theorizing without experimental constraints, you keep doing this for a long time, at some point you're moving into something that's more like philosophy than traditional science is the case, then you might want to think about this as a kind of philosophy of cosmology rather than just science per se, and therefore you might want to adjust some of the way that you do make your claims, or how you might do your arguments I think that's just because, you know, in the news today I saw that people in Fermi laughing they might have found a fifth force but we're still very far from seeing anything that would help us to strain these theories, and so that case that others and others, we ought to be careful about claims that we make. And if I understand you right, Art, never did you say something like, it's so beautiful it has to be true like beauty is this subjective experience of beauty are necessarily a guide, it sounds like you're saying that you're not an optimist, and it's haunting and mysterious and a deep puzzle lie is that fair, that's not something that's summarizing yes the author and this will say that this is played in a very important role in physics and what is being critiqued here is the idea that we've done this for a long time and perhaps we should allow a few other voices at the table,

and I think, I'm all for diversity in time and approach it and I think that would be a good thing to do. And the point is that this idea of beauty, so beautiful must be true is such a strongly felt in physics and this has pushed a field on for a very long time, and these ideas are extremely beautiful, and right, beauty isn't like the equation is like beautiful beauty is there's something incredibly elegant about this thing worked together there's correspondence between theories and different limits that somehow link together in ways that seem so beautiful that they must tell us something about the way the world is.

And just to clarify Ben, so we don't have the wrong impression, it doesn't sound like you're saying scientists should revise their practice of science by appealing to beauty here and there when they like in the side try to justify a choice by hypothesis. Am I right and saying that like you're okay with that you're just thinking reflected on what's going on behind that is that right? I'm, I suppose I'd say I prefer in terms of methodology if people were significantly more direct so there is in the sense that there are some, some clear and hard headed ways to look at the development of inductive development of the theory that you're going from your observation to next construct this is where I would point people is to what's called formal learning theory now is that there are two things that play here, one is sort of the logic of the problem and what we want to explain what would get us there, what would reliably get us there insofar as anything does what's the strongest guarantee we can have how do we go there. And I am saying that I don't think the sense of beauty is that I think that it you know I think what Dr. Hausenfelders book shows about the current state of physics is maybe that it really is a sort of, you know this attachment or use of beauty and appeal to recent past successes and is not itself a productive method for guaranteeing us for progress, but what as a psychological fact human beings are able to do right so a lot turns on what we expect our theories to be. If our theory is to be something that can be apprehended by one person, then we are severely sort of limited in which of this pieces of this logical space we can explore so when you ask me if I'm, if I'm trying to tell scientists to change their practice.

The answer is it depends on what you're willing to understand a theory of physics to be if it is to be the traditional sort of thing where we can write down a simple analytic expression, something in a mathematical form that's closed and say, this is how the world works. If that's the constraint, then we probably are permanently hobbled by our various limitations in which case, you know, various appeals to beauty are okay but let's not mistake them for for guarantees. If we take a broader view of what a theory can be, which actually sort of allows into the discussion things that are beyond an individual apprehension, then then it's a totally different question.

Then it's a question of sort of what we can achieve collectively or piece me that's a much longer conversation. If you like this and you want to hear more, like, share, review, and subscribe to this podcast. And from all of us here at the Veritas Forum, thank you.

(buzzing)

