OpenTheo

Mathematics for Human Flourishing | Francis Su & Mia Chung-Yee

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The Veritas Forum

For many people, math is cold and lifeless, a bunch of rules to follow---a way to separate people rather than a way to bring them together. It’s no wonder that many have anxiety over their math experiences. But what if we could see how math is tied to our deepest human longings---for beauty, for justice, for love? Would we see it---and ourselves---differently? Join mathematician Francis Su in conversation with Mia Chung-Yee as they discuss the broader implications of his new book Mathematics for Human Flourishing, which he wrote in collaboration with his friend Christopher Jackson, an incarcerated man who reshaped Su's own views of what math is, who it's for, and why anyone should learn it. • Please like, share, subscribe to, and review this podcast.

Transcript

Welcome to the Veritas Forum. This is the Veritaas 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 toward 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 history, don't be surprised if you're going to get an element of this in God. Today we hear a conversation between Francis Su, Professor of Mathematics at Harvey Mudd College, and Mia Chung-Yee, world-class pianist and Professor of Interpretive Analysis at the Curtis Institute of Music.

Together, they discuss the difficulty of mathematics, but dig deeper into the art and beauty that it contains. By discussing Francis Su's new book Mathematics for Human Flour-ishing, which he wrote in collaboration with his friend Christopher Jackson, an incarcerated man who reshaped Su's own views of what math is, who it's for, and why anyone should learn it. Host it through the Veritaas Forum at Cornell University.

I've been so excited about this conversation, looking forward to it for days, for a couple

of reasons. The first is like this is a rare occasion for cross-disciplinary conversation, something that I don't get to have very often in my world of music. And second, I know that after talking with you, I'm going to actually view my music differently.

I'm going to see it and hear it differently because of what you've shared. And so I look forward to learning from you. Thank you.

I look forward to having this conversation and learning as well. Well, I have to tell you your book Mathematics for Human Flour-ishing elicited a very human response in me, something that I really didn't expect. And for you to have shared something so paradigm shifting, you know, to view math in such a different way, in a way that reaches sort of with tentacles to so many different areas of life and connects our experiences, sort of bringing forth some universal truths.

I had to wonder what kind of personal experiences inspired this book. So I'm wondering if we could start off by sort of having you describe your own personal journey with math. Sure, yeah, I'd be happy to.

I guess I have been interested in math since I was a kid and I was fortunate because I had parents who knew how to get me curious about things. And they had friends who introduced me to math at an early age. I think maybe one of the first experiences that I had that convinced me that math was interesting and worth looking at was somebody who shared the, it might be an apocryphal story of a Gauss as a kid.

Basically, this, this friend asked me to sum the numbers from one to 100 and asked me if I could do it quickly. Right. And of course I had no idea how to do this, but when he explained how Gauss supposedly did it.

And I was amazed, right, it was basically, I'll tell you how it goes. You're not familiar with it. If our audience members aren't gas basically looked at the sequence of numbers 123 up through 100 and realize that if you pair them off.

The 100 and the one together make 101, the two and the 99 together make 101, the three and the 98 together make 101. You end up with 50 pairs of 101. And so you can immediately see 50 times 101 is 5000 50.

And, you know, remember thinking to myself, Oh my God, that is really cool. That's really neat. And it convinced me that there was something interesting about thinking mathematically that I wanted to try to understand.

So that's probably how I got started. I was fortunate, basically. And of course I'm interested in more people getting excited about math.

But, you know, another formative experience for me was, you know, over time, doing more and more math, you begin to get recognized for it. You begin to, you know, people

begin to praise you for it. And that in some ways was detrimental to my progress, because when I got to graduate school, I met people who were supremely talented in math much much more talented than I was.

And, and that was the first place that I really struggle with my identity as, as a mathematician. Right. It made me question if I was doing math for the right reasons because I was no longer the best at what I thought I was good at.

And much of my identity come from from thinking that I was the best. And then coming face to face with the fact that I'm not. And so that was sort of an experience of failure that caused me to think about math differently.

Maybe not a failure but like a disruptor, right, a disruptor that. But I actually came pretty close to, to leaving Harvard as a graduate student because I, I had, I had my research project wasn't going well. I felt like a failure.

And in fact, a professor basically said to me I didn't have what it takes to be a successful mathematician. And, and my, my whole sense of myself I think was shot by that, that remark and that's when I started thinking about doing something else seriously thinking about quitting. But instead it yielded great gifting to all of us because you've actually opened our eyes to new ways of viewing math through your book, for which I am deeply grateful.

I wanted to sort of share this quote of yours in the final chapter of your book you said, doing math is tightly bound to being human. And as I read your book I was sort of drawn into it, your message intellectually, emotionally, morally, I mean it just resonated in so many different ways. And so I wanted to give you this opportunity to share, you know, in some detail, what the book is about to introduce us to the important figures that you, you share the stage with in the book, and to give us more detail about your thinking.

Sure yeah I guess there are there are two ways that I like to speak about the book. One of them is sort of description of the purposes of the book. I mean, I like to say that the book is an inclusive vision of what math is who it's for and why anyone should learn it.

And part of the message there is that math, people often think of math as just a bunch of computations or skills that you learn algorithms that you learned to do certain things. I want to say that math is a lot bigger than that. I want people to think of math as actually building in us virtues, things like curiosity and persistence and imagination.

And these are all things that are that stick with us no matter what profession we go into, right? And that's actually a better reason to the answer, the better answer to the question, why do math. Why do I need to learn this stuff I mean that's that's that's a question that most of us had asked at some point another when we're, we're learning things that we think are feel tedious and boring. And, and I guess part of the reason the

book I wrote the book was to help open up people's minds about what it is that we're actually doing when we teach math and when we learn math.

And that's one, one way I like to describe the book and that's usually for someone who's interested in learning math or teaching math. But you know what the funny thing is that when the book came out and I, you know, I went to the local bookstore and actually saw it on the shelf the very first weekend it was out I was like, Oh my gosh, the books there. There was a somebody stand nearby who said, Oh, what's your book about.

And you know I go into this explanation that it just gave you and my wife afterwards she sort of kicks me and you know, not just me on the side she said you're not that really wasn't a really good answer. She said you talk about the stories. And, you know, of course part of what I do in the book is tell lots of stories, right? That's the, that's in fact part of the message of the book is that math actually when when taught properly is story telling.

And so the other way that I now because of my wife. The answer that question is I say basically the book centered around three stories story of Simone they who is a French religious mystic but who's older brother was one of the most famous mathematicians of all time. And she felt small compared to her brother.

In her mathematical abilities. The second story is is my own story in various hardships that I encountered and sort of crisis of self confidence in mathematics, which is a very common experience of people hit it at different stages. And then the third story is that a Christopher Jackson, when incarcerated man who wrote to me out of the blues seven years ago.

And we started a long correspondence and, and he is a contributor to the book he's contributed letters and, and a good friend now. And, you know, the book isn't really about me teaching Chris math it's really a story about what Chris taught me as a professional mathematician about how I might even think about my own subject differently. Yeah, I found Christopher Jackson's story very compelling.

And it made me think like there are so many other Christopher Jackson's out there. You know, he happened even though he's incarcerated, it struck me he sort of was experiencing this kind of euphoria and joy through math that almost freed him from his physical environment. And he was able to travel places through through x math exploration.

Wonderful. And so you think about all the others who are in the same situation who would benefit from that kind of exploration so thank you for raising the importance of of that. So, I'll just say a little bit Christopher story for a benefit of our audience he's, he's basically committed a series of crimes as a teenager.

And since he was a teen he's been in now prison for 14 years, and he's, this is the 14th year of a of a 32 year sentence. And that's been for a long time. And, you know, part of the question that the book opens with is, why is Christopher sitting in a cell learning calculus that he'll most likely not use as a freeman.

And at least for many more years, right, why is he doing that and that's sort of the big challenge for us all and you know when I say that people often say whoa you found like somebody who's really committed math and like like he sort of some sort of diamond in the rough. And of course Christopher is a diamond. He's a gem.

He has been gifted uniquely in various ways and all of the ways that we, we find that we have been able to have inclinations and propensities. But to say that, that I discovered or we did that that he's a disc, that many of us have because they've been overlooked. And so that is part of the message of this, of this, of this book is, is basically, hey, look at all the human potential that that's out there and how can we see that in each other.

So, what's your audience, as you write this book, who are you addressing this message to I would imagine there are multiple audiences can you sort of share. Yeah, it, you know, it was a hard process to try to write this book because, you know, on one hand I was trying to speak to people who have had really bad experiences and math. Sometimes even harmed by their experiences, or their confidence has been shaken.

On the other hand, they're professional mathematicians and math teachers that I wanted to speak to. And unfortunately it's all it's a calm. It's, it's not uncommon to find mathematicians who have a very elite view of math, because, you know, we've, we've been successful in this, and it, it's a side it's a badge of a stamp of self importance in some ways.

And, and so, it's in some ways to our own advantage to keep thinking of math as something that only the elite can do. So, I was trying to speak to those people as well. And at the same time I was also trying to open up a larger conversation about the broader purposes of mathematics the meeting behind what we're doing, and calling all of us to think a little more deeply about what are our deep human desires are what our longings are, and how math might might and should meet those desires.

As the response or have the responses to the to the book been generally very supportive I would imagine it, you know, sort of, you probably encountered mostly supportive, you know, encouraging responses but are there some challenging responses as well, because you're shaking up the status quo here brother. Yeah, yeah, yeah, you know I, the, the genesis of the book came out of a speech that I gave to a large number of mathematicians at a math conference and at the end of, at the end of your term as president of the math association you're asked to get a talk and so this was a talk that I gave and part of what I was trying to do is to call us all to think deeply about the bigger purposes of math education. And by and large the response was was very, very positive

but I did have one person come up to me after the talk and, and you know walked straight up to me, and you know to my face he said sort of angrily.

I really, I really disagree with everything you said in that talk. And it kind of took, you know, took me aback because I wasn't sort of expecting that kind of strong venom at least not immediately. And so I said well, I'd be interested in hearing more about what you know what you thought.

And he said I don't have time I have to go and he sort of just walked off, sort of like in the puff right and I think I think one thing that's hard is that it. And we're challenged to to broaden our scope of who can do mathematics it can be threatening. And in some ways I think that's that's how he reacted.

So interesting, you know, because when I think about math and sort of what you share you have this whole chapter on beauty. And I sort of wanted to make an opportunity for us to talk about beauty in the context of math and music. You know, these are beauty elicits a sort of affective response in all of us right and so I wanted to perhaps use this as a transition to the chapter that you wrote on the math and beauty.

And wanted to put this out there this whole idea of math as metaphor as music is metaphor for something a metaphor for truth. You know, something transcendent and just sort of use that as a lead in to that question of that chapter. Yeah, I mean math, math certainly has an ineffable quality for for those who who are able to experience it.

I actually thought I would prepare some slides on beauty so I'm going to share some here to try to get people a sense of what mathematical beauty is especially if you haven't haven't had a taste of it. And I think you may are going to see many ways in which it's very similar to to an appreciation for for musical beauty. So there's there's a quote that I like really like, which I opened the beauty chapter with and this is the quote by by David Blackwell, who says this about mathematical beauty he says, why do you want to share something beautiful with somebody else.

It's because of the pleasure she will get, and in transmitting it you appreciate its beauty all over again. And I really love this. This quote because it's it really captures I think what we do a lot like you know if we're if we're sitting together listening going to a concert, you know like it might be a concert that I've actually heard.

And I think that's the music before like why am I sitting through this concert again or why am I watching this movie over and over again. And, well you do it because you want to experience the beauty that you felt the very first time that you you saw it right and the and I think he really captured this captures this quite well. So, I'm going to put a little bit of artwork from the book, Carl Olson is a good friend who did a number of chapter opening pieces to try to, and my goal here was to try to make a book about Matthew human and I think he really did a good job and in accomplishing that by drawing this

picture and I love this picture because you see a figure reflecting on something beautiful and it's it's a this is actually a mathematical object known as a sympensky triangle and he I love it because he made it look like stained glass art that you might find for instance in a cathedral.

And what are we tempted to do we're tempted just to sit there and reflect, which is really, I think, amazing and that's what happens when you encounter mathematics mathematical beauty mathematics that seems really that that sort of captures your imagination. So I thought as an exercise for our audience I would have have you look at a piece of artwork and just reflect on this piece of artwork. This is a piece of art that I only recently became aware of it's called hope by George Frederick Watts was actually popular art around the turn of the last turn of the century before the one we just experienced 1886.

And invite you just to take a moment to view it and ask yourself what do you notice. And what do you wonder. Well, she doesn't if it's a she does not look very hopeful.

And she's holding a liar. Uh huh. Yeah.

So music here musical instrument. Yeah. That I can't tell but I think it doesn't have many strings.

Yeah, right. Right. So something something.

So interesting is happening as we experience this art together you're you're you're asking questions about what's going on and why is this this element there. Right. And so I'll just for your benefit I'll zoom in on the picture.

Maybe you can see it a little more clearly. Definitely does not have many strings does it. Like one.

Yeah, a single string. And I'm sort of picking it in a four Lord way right like like her her hope is is gone in some sense or maybe she's holding on to hope. Right.

This is part of the questions that were we asked when we look at this painting. One of the things that then you do is you start asking yourself. I want to know more about this painting.

Right. We we look at it and we're absorbed or fascinated. We look at the meaning behind the various elements here.

We begin to place things in relationship to one another. After we eventually look hard enough we might be surprised to find things we didn't see before. Right.

All these happen for somebody who engages in mathematics the right way. Right. So, you to engage in mathematical beauty is to actually sit and ponder and to think why is

this here.

Why, what is the meaning, where are the meanings of all the things that are going on in this picture. And, and then occasionally you'll be surprised like for instance there's there's actually if you look at the very top here you actually see a little star. And that is fate and out of view and its rays are shining on this, this lady who sits atop this globe.

And if you learn a little bit about the history you'll find out that this is a painting that was basically expressing the mood of pessimism at the time it's not unlike what's going on right now. And so this lady is sort of sitting atop maybe the burdens of the world holding on to some kind of hope and maybe out of her view she does not yet see but there's a star that is shining. Maybe that's a symbol of hope.

Martin Luther King actually used this picture refer to this picture in one of his his sermons. Called Shatter Dreams. It's beautiful.

So, as you think about Christopher Jackson in prison sort of how has the beauty of math given him hope. Yeah. Yeah, he would describe it as in some ways part of it is giving him a goals to focus on and a way to free the story of the story.

To free his mind even if his body can't be free. And I see that you know over progression of years now he's you know he started by studying you know algebra like basic algebra text right he worked his way up through calculus and at that point that's when he wrote being said hey I need help furthering my math education and and now he's sort of studying advanced textbooks and and he's you know engaging with ideas that's one of the things I think he he would say is he now lives in a world of ideas. And and and that's one of the wonderful most beautiful things about about mathematics that that fascinates him.

It's interesting because I feel like the world of ideas are just being drawn into a different headspace, you know, a space that's not full of things to do or work that needs to be accomplished or tasks that need to be checked off the list. There's something very deeply freeing for the imagination you went to a completely different mental space. Yeah.

Which we don't allow ourselves to enjoy very much in this day and age right with the cacophony of our lives from music is the same thing you know musicians are constantly producing right we're not allowed to sort of the art even though we're supposed to be artists. And so interesting irony but go ahead what is this image. This is an image that's a more mathematical image you might say it's produced by my friend Frank Ferris.

And it's you know one of the first questions you asked about this picture is how are these designs made right why why do we see these patterns and you know I could go into it but I won't hear except just to say that these patterns are are, you know, reflect certain

mathematical structures and math you could think of a think about as a study of patterns in some ways. And that's that's part of what, you know, that discipline sort of what produced this picture. Here's another picture you might look at and say, Oh, something interesting is going on here.

And part of what I, you know, want people to see is that, you know, as you begin to become a mathematical thinker it's hard to not look at any picture and ask yourself how these patterns in the rings are basically reflecting patterns in in rational numbers. And, and I won't go into that here except to say, there's something amazing here that's going on in, you know, opening your eyes to mathematics is to say what's the underlying structure what's going on in this picture. And, and so you never just look at a picture and then move on you actually look at a picture and say what's going on this is beautiful something amazing is happening.

I, you know, I talk about, I talk about different kinds of beauty right so one, one type of beauty I talk about in the book is just is just the beauty of the patterns immersive patterns right but then the next sort of level of beauty beyond that is, is to ask yourself what's going on with the patterns. And so then there's what I like to call wondrous beauty right the beauty of ideas. And to say that there's something you know interesting going on here is to say there's the ideas behind this are beautiful right basically this moon is exerting a influence on the rocks that form up the rings.

And it's perturbing some of the rocks that are whose, whose, whose orbital periods are in exact rational ratios with this moon, kind of like if you're on a swing and you push somebody and just the right way they go higher. This moon is kind of pushing these rocks on a swing around their orbit. And when they do it in exactly the right way, it pushes those rocks out of their orbit so you get these, these gaps right.

And then you're like whoa that's a beautiful idea and we see the effects of that. And so that's another kind of mathematical beauty. It's kind of like when I saw the idea of pairing up the hundred and the one and the two and the ninety nine.

You're like whoa oh my gosh. And you know part of what beauty does is it builds in us the virtue of reflection. It builds in us the virtue of looking for patterns where you don't expect to find them right it actually cultivates on us a disposition to more beauty.

It helps us begin to think there's patterns everywhere right and we look, we have habits of generalization. And so the beauty still is the beauty not just of ideas but of reasoning. And I love this picture there's lots of pictures like it, you know, this is a picture that describes this identity.

So it turns out if you add one fourth and its powers, it sums to one third. Okay. And that may be a little surprising like why in the world is that true.

And then if you look at this picture, you see that the colors in this left picture are basically one fourth of the entire square. And if you just repeat this pattern of smaller scales inside the blank and empty fourth, then you get inside here. This little square is a fourth times a fourth in area.

And it has a blank square and if you repeat the pattern inside there this is a fourth times a fourth times a fourth in area. So you see that the red areas actually are the, the, you know, the sum of the numbers on the left here. And they form exactly one third of this.

And then you can see why it's a third because at every stage. Each of these L shaped regions are, it takes up one third of those regions. That's like, whoa, that's actually kind of a beautiful proof.

Right. It's kind of beautiful demonstration that this idea is true and, and, and so that's kind of like what I like to call. The beauty of ideas, right? One dress, one dress beauty.

And now, of course, I'm not even remembering what exactly how, how I called it in the book. It's a certain inspiring beauty. And so the thing that's kind of amazing is after you see these kinds of beauty, you're like.

You might even achieve like even the more deep level of beauty, which is the idea that there's a transcendent beauty. Right. The beauty, just waiting to be found out there and it leads you to look for patterns everywhere.

And when you see a pattern all over the place, you begin to get excited. Right. You begin to say, whoa, that's like, there's, it's almost like the universe is speaking to you.

Right. And that's in some ways, that's the way people describe it. Right.

Or the famous mathematician Paul Erdisch actually had a phrase, had a, had, was fond of saying, whenever you see a beautiful proof, it's actually belongs to the book. Certainly he called it the book, the God keeps. And in which all the most beautiful theorems are kept.

Right. You know, if I might jump in and just add Christopher Jackson's letter from August 9th, 2018 in your book, he said, I'd say I'm drawn to mathematics because of its strength, its structure and its truth. To me, I've never seen an argument stronger than a mathematical argument.

Its structure is amazing. The least being how you can come from a variety of valid methods and still lead to the absolute same conclusion. Yeah.

Yeah. And that's going to transcendent beauty you're talking about. Yeah.

And there's this, you know, this amazing thing, like, if you, if you see a truth, like a mathematical truth, and then you read, you know, a paper, read, read some historical

document where somebody came up with the same idea and have the exact same reasoning. It's kind of like you're connected with this person across time, space, culture, you know, it's kind of like, whoa, how is that possible that two people, very, very different, would come up to the, come, come up upon the same truth. Right.

In some ways, it's very. Well, you know, so that leads me to another question, Frances, you know, before I want to also touch upon justice to, to move on to that and love. But is there an interpretive aspect to, to math? I mean, in the way that there is music, like you can have five pianists play Beethoven Sonata and all five of them will sound completely different, even though the notes are the same, the rhythms are the same, the expressive markings are the same.

But there's something in the spaces and the gaps in the relationships of these notes and rhythms that suddenly is different depending on the individual who is interpreting the pieces. Is there something like that equivalent in math? Yeah, in fact, in fact, there is, because, you know, when you, when I go to a math talk, when I hear the somebody lecture on a mathematical topic, I might know a lot about the topic and yet I'm still interested in going to the talk because each person has a unique perspective. On the, the, the truths that they're presenting and then present it in a slightly different way than I would.

And that, that kind of stuff I find fascinating. That's fantastic. So you like see it from a different, through different eyes, right? A different brain, if you will.

Yeah. So, if you think about math as a language, after all, much like music, right? And so there's that element of expression. And to your point, even affective response through aesthetic.

And that points to its universality as well, right? Like if we say math as a language, then then we shouldn't be saying some people are math people and some people aren't, right? We can all find ways of expressing ourselves musically, mathematically. And so sort of, you know, part of the, I think the justice angle of the book is, is to call people to think about math as something that's inherently human. And therefore all of us do in different ways.

We'll talk about how we use math in some ways to divide people rather than, or exclude people rather than, you know, bringing them in to this discovery and exploration that you encourage. Yeah. I mean, one way that happens, of course, is, is, is a certain elitism feeling like, okay, I'm good at math and, and therefore I'm going to lord it over other people or I'm going to think of math as, I mean, we do this unconsciously, right? We say, Oh, you're so good at math.

I thought I was never that good at math, right? Or something like that. And that's something that's, that's something I hear all the time, right? And, you know, in some

ways I joke that like being a mathematician is almost like being a priest, because, you know, when people find out what you do, they feel the need to confess, right? It's like confessing math sins. And, and part of that is I buy and do it as well when I accept that kind of praise, right? Like, it makes me feel good.

And, and so there's that, there's elitism. But, you know, there are other things that we do that I think are really harmful, right? We start thinking about math as one dimensional. Like it's only about being fast when in fact, for professional mathematicians, it's not about being fast at all, right? It's about thinking about ideas deeply and slowly, in fact.

But, you know, we, we measure people by their performance in some ways and some access and number of papers, you know, for professional mathematicians, the number of papers you've written, right? And that's really harmful. It's detrimental. And I would love people to see math as much more multi dimensional, right? It's growth in virtues, it's growth in creativity, it's growth in persistence, it's growth in a disposition to beautiful things.

And, you know, when, when employers are looking for, for a people to hire, they're hiring math majors, not for specific skills like factoring polynomials. I mean, they're hiring people because they're going to be persistent and problem solving. They're going to look at a problem from many different angles.

And those are all virtues. And so that's, that's sort of the piece that I wish people would see. And in some ways that would help, help change the profession and make it more inclusive.

And one of the themes that came up in your book that really resonated with me as a musician is this sort of professionalization of math or professionalization of music and the ways in which we, you know, engage in these wonderful disciplines in the arts, even sports, for example, as a way of reading out, as a way of identifying aptitudes and declaring, oh, you're worthy of going to college, or you're worthy of taking on certain jobs. And instead of saying, you know, what, what inherent value is there just to enjoy and pursue the discipline itself, what enrichment is there. And because we don't do that as a society, we're so utility focused, right? We miss out on the richness that these disciplines have to offer us.

Yes. Yeah. And we, when we see everything just for the, its utility and its value, it's, it's in some ways it, it, it demeans the, the, the practice, right? You begin to just see the, the outputs rather than, than enjoying the process, the discipline for what it is and, and the ways that it helps you grow as a human being as someone who's, you know, a fully formed human who has a desire for meaning, right? Who has a spiritual side in some sense.

Can you share some of the stories really briefly of injustice that, that you've, you've

come across in your experience as a teacher, as a colleague, deeply personal stories of, of people being delighted in the field of math. Yes. People viewed them.

Yeah. I mean, in some ways the, the, in the past, of course, there's been overt kinds of racism against people who we viewed as incapable doing math. You know, I think these days that it more comes in, often comes in the form of, of slights and, you know, I have, I have friends who are African American who are often mistaken for the, the help that conferences right the, the, the wait staff at conferences and not to say that being a person that is not certain is of less dignity at all.

In fact, it shouldn't be but part of part of what I think is hard about that experience is here's somebody who is worked to train well in some discipline and not being recognized for the professional strengths that they bring is it can be really hurting, hurt harmful. And even as an Asian American, I can say sometimes, you know, Asians are sort of cast as folks who are good at math, but not all of us are good at math. Yes.

So, you know, I am interested in math. I'm not great at math, but you speak to that as well Miss him, please. Yeah.

This is unbiased is harm everyone. Yeah. Yeah.

The harm Asians too, even though Asians are thought of as being good at math. And, you know, as you said, one of the problems is that you begin, you know, if you feel like you are not performing in the ways that people expect that can be very helpful. And also actually probably detrimental right like it's harder for someone to ask questions when they're expected to know something right like and so it can be harmful to one's own education to be in a place where you don't want to appear like you don't know what's going on.

And so, I think that's what happened when I got to Harvard, I was like, Oh my gosh, I'm kind of behind everybody else here because they've all had graduate courses and. And so I, you know, part of the much of the first year in grad school I spent just being quiet like I didn't say anything in classes because I was too afraid to ask questions at some point I was like, you know, this is not helping at all I'm just going to be that one who asks, who asked the question like a And the surprising thing is people came up to me afterwards and say, I'm so glad you asked that question because I have that question too. Yeah, everyone's just afraid right to come out and be honest and human.

And therefore restricts them from learning and engaging the material, you know, more deeply. It's unfortunate. It's unfortunate.

And so this is why, you know, when people think about math, we should think about math is exploring right it should be okay to brainstorm and not have well formed ideas. Boy is the product of our post industrial, you know, industrial era thinking right

everything is about productivity and monetization of skills and gifts and producing right results. The richness of the pursuit itself.

Yeah, I mean, in some ways that the Christian faith has has something to offer here as well, right, like, I mean, there's, there's the notion in in the Christian tradition that that. That you're your dignity, you have an inherent dignity, apart from anything that you do, or apart from how you perform morally or how you perform what you're able to produce. And, and, and I think that sort of deeply resonates as well as, as we think about our professions as we think about the way society measures us by the things that we, we do.

It can be very helpful to be to receive that grace, the grace of having dignity and not needing to prove it or earn it in in any way. Earning it. Yeah.

That's really powerful. I mean, you have this quote by CS Lewis. He said, and of course, as in the previous chapter, but you said, he describes the experiences of beauty as the scent of a flower.

We have not found the echo of a tune we have not heard news from a country we've never visited. And as we look at other people, you know, our desire, if it is to share beauty, is to share that with everyone unconditionally, right? These metaphors that math is the music is for something greater than ourselves. And to do so indiscriminately, generously, inclusively, right? Yes.

It's a very powerful, powerful message. So, I mean, in some, when you talk about math being about love, I mean, that is quite a stretch, Francis. But if you wanted to sum it up altogether, sort of theologically, mathematically, relationally, what would you say? How do you say that these things are connected? Yeah.

Yeah. I mean, I think when people read love as a title, the last chapter, the 13th chapter, they think, oh, he's even talk about how people love math. And that's exactly not what the chapters about, right? They say that explicitly, like, I'm not talking about loving that.

I'm talking about how you love people because of math and through math. And so that I think the basic message there is, we love people when we see the inherent potential in each person to think and reason mathematically. We love them when we believe that they can flourish in mathematics and in life.

And that's, and, and, you know, there's a difference between loving somebody conditionally and unconditionally there. Right. There's the, the, the conditional love is looking at somebody who's already performing well and saying, you have potential, you should go to Harvard or MIT or Cornell or whatever it is, right? And then sort of discounting the Christopher Jackson's who end up in in prison because of some mistakes.

He made as a teenager and in thinking they'll never amount to anything. That's conditional love and unconditional love says, I see you, I believe you have potential and I

am going to, I'm going to, I'm going to sit with you here and, and be with you in this space in this mathematical space. That's deeply convicting because it really, it does challenge us the way that we view not only ourselves, you know, regard to our sufficiency or insufficiency is a math but how we view other.

Others as, you know, worthy. A mathematical experience or a musical experience or not. Yeah, our kids, how we view our kids if we have kids in the future.

Wow, super powerful. Well, this has been really fun, Francis. And I think I just wanted to tell you that because of your book, you know, just in wrapping up this conversation, I have begun to think about music and human flourishing.

And, and how I will view music in the context of society at large very differently, especially for those who are not who are underserved, you know, who don't have the privilege and access to music. What would that look like, you know, providing that and pursuing that as an end in of itself, generously sharing that art form. So I will be thinking further about justice and love through the lens of music.

So thank you for that. You've inspired me. And I'm sure you inspired many in our audience to think about their own craft and disciplines in a new way.

It's a really deeply appreciative. And I know we are now supposed to move on to Q&A session. And I have the first question for you.

Why is it that math education for most people makes us miss the beauty in math. So that's a large question and I'll just try to answer briefly so we can get to as many questions as we can, but I would say one of the reasons is that we think of math as only skills and don't think of it as as the virtues that we're building. So an emphasis on skills on algorithm or performance on memorizing and computing things, but not understanding and in fact enjoying and understanding the meaning behind what we're learning.

And that contributes to a lot of the antipathy that people have towards math because, you know, it doesn't, it doesn't feel like freedom if you are being told to memorize things without understanding things. And that's not to say that you shouldn't learn to memorize things that I think are you'll find useful in the future but that's not mathematics math is part of what is understanding, right? So I'm saying, you know, I'm going to learn music by making people learn scales. And yeah, scales are going to be important if you're going to be technically proficient.

But that's not where you start, right? If you're going to teach some of the music, you're going to expose them to beautiful pieces of music just like I would expose kids to beautiful ideas. Especially that reminds me of an experience my own son had he's he's very good at math, but he never liked it until he came home from school when I picked

him up from school one day. And he was so jazzed because he'd been introduced to Mandelbrot set.

And how such a simple equation could generate such a complex geometric configuration. Yeah, and just the iterations of that, you know, equation plugging in different numbers would actually exclude certain areas and include some and then it created these beautiful shapes and he's like, he all the sudden that sort of transcendent beauty, it hit him. And now his attitude toward math is completely different.

Yeah, that's wonderful. And it's wonderful when we have, you know, people who are able to bring that, that beauty to to young kids. Well, another question here, how do we make time to explore ideas while at such a checklist focused place as college.

Yeah, that's that's a great question and not only that but also in high school. I mean, one of the, there's a lot of great things about the common core state standards, which, or things like it, which exists in other states that don't have the common core. But one of the criticism that the high school level is that there's just like a whole bunch of standards to get through.

And one of the trends right now is to try to help teachers understand the coherence between some of the ideas so that, you know, when you present an idea you can see how it fits, and its meaning fits into the larger picture, have that idea might begin to show up in over and over again later on in your career will help you teach it right now to the kids that you have. And so that's, that's something people are devoting a lot of thought to. I mean, personally as a math educator, I worry less about how much I cover and more about making sure students enjoy what they're learning.

And part of the reason is I know that if they really enjoy what they're learning, they're going to be motivated to learn about these things that I don't have time to cover later on. I might just wet wet their appetite or make them curious about about them. They'll pursue it in the off hours right.

Yeah, okay, next question is does math relate to religion. If so, how and in what ways does math lead us to the all powerful one. Yeah, that's a great question as well.

I, you know, I mentioned Paul Erdisch and the book of all the great greatest proofs ever that you know he posited existed and to my knowledge he didn't have any religious faith at all. In fact, he said, you know, you don't have to believe in God, but you should believe in the book. And one of the reasons I, you know, I think about that quote and his is basically in some ways when you have a transcendent mathematical experience you can't help but have the feeling like you're uncovering something that is universal in some ways.

And, and beautiful and, and, you know, whether or not you have any religious faith at all,

often people who are drawn to mathematics are drawn because of its beauty. And there's something transcended about that. And now that being said, you know, I think that there are many way parallels between the way people people pursue math and pursue religious faith.

And, you know, one of the many different ways right like one is an understanding of the infinite, right. And in some ways being a mathematician. When I think about the infinite, that means something to me that's a lot different than what it necessarily means to the average person who doesn't have a math training.

You know, in, in some ways it informs the way that I think about, you know, when I hear people talk about God as being the God of the infinite. My mathematical training actually informs helps me appreciate how wonderful and marvelous and beautiful that that and deep that that idea is, and how rich that idea is so in some ways, I think math might inform my faith. And in some ways faith might inform the way I think about mathematics right not every mathematician would necessarily, they might appreciate the beauty of math but in some ways, you know, it can fall into just a worship of mathematics itself.

Right, like this is the ultimate thing that's going to solve every human problem. And of course I don't believe that I don't think math and is going to solve every human problem but it does contribute in wonderful ways to a life well lived and one that is able to I think help us appreciate our spiritual side even if we're not spiritual. Do you think also I mean it's not just about math right because what we live in a hyper specialized time right I mean everyone is plumbing deep but narrow, but as we sort of have cross disciplinary conversations and start to see sort of recurring themes or patterns if you will transcend and send in experiences through these different modalities and languages start to see sort of an overarching theme right that connects all of these disciplines.

So I love this quote by Keats, I would on a Grecian Ernie ends with this quote beauty is truth and truth is beauty and then he goes on to say that's all you need to know. And sort of this interchangeability we don't think that way you know in our sort of contemporary time right there's like truth and then there's beauty but the connection of these two that there's this whole spectrum, right? And that's how I think of all the disciplines right whether it's mathematical truth to the beauty of music. Yeah.

Yeah, in some ways you know people argue when I talk about the virtues that are built by mathematics and you know I'll say you know the pursuit of mathematics builds creativity and curiosity and things like that and I'll say, well that's not unique to math. And then you know I say that exactly that's exactly my point like you know yes mathematics builds I think a very special kind of creativity and a special kind of curiosity. Certainly, the wealth of ways in which we can understand the world that have been given to us and I believe as a person of faith, have been given to us by God, I think help us understand the larger meaning of the world that we inhabit and ways to think about it

a certain currency to the way that I think about math I think lends itself to to when I look at music when I look at art and try to to assimilate its deeper meaning.

Good. So here's another question. I hope you can share the metaphor of the secret menu at Chinese restaurants, because I find that metaphor so powerful.

Thanks yeah that's that's an example I use in the book on this person's referring to the secret menu. And, you know, I actually like, I like this metaphor because it's something that's that's experienced all the time, because I'm Asian American. And when I go into a Chinese restaurant, you know, unlike him in the regular world where people often don't think of me as American, when I go to a Chinese restaurant they don't think of me as Asian, right, so I sort of get it from the other side, right, like this experience that you're not, you must not really like Chinese food right so because I speak perfect English they think I was, you know, I was born in the US and in that I must, must not like Chinese food so the thing that happens there is it's often kind of reverse racism is too strong a word but it's just a reverse assumption that they're making.

And you know at Chinese restaurants there's often a secret menu where they keep all the good stuff like it's all the stuff that that's actually the good stuff and the regular menu is filled with American dishes that are are catered to the to the American palate right. And so I go to the restaurant and I don't get the secret menu because I, unless I go with somebody who speaks Chinese fluently. And so, and so this metaphor I use because this is exactly what happens in mathematics, right, we show some people the secret menu.

And then to others we say oh no no you won't like that stuff on that menu. We say that to often to women and girls oh no no no you shouldn't go into a STEM profession because you know that subjects for boys. Or, you know I was never good math and therefore you, you don't have the jeans either as if as if there is a math gene which I don't believe there is everybody can have meaningful mathematical experiences in learning the language of mathematics.

That's the secret menu it's a I think it's a I think it's a helpful way for us to check ourselves and say are we just showing the secret menu to certain people that we expect to do well in math. Yeah, based on assumptions. Based on assumptions that we inadvertently make you know sometimes they're they're well meaning but they're, but they can be harmful.

Do you think of mathematics as in some way socially constructed or instead discovered. Or another way to ask are you a play tennis about mathematics. Yeah, yeah that is there there is that is often a question people ask is math inventors governing I would say it's both like I think of mathematics is something that I am uncovering because I might have exactly the same thoughts as somebody who's had a class that says someone had you know 400 years ago.

And, and so in some sense there's that's the platonic ideal that math exists independent of ourselves. But in that there's also the aspect of me creating the mathematics that I'm doing it is constructed I make choices about what definitions are interesting and important and I pursue the consequences of those studying those, those concepts. So there's a full in some ways on co creating right that that's sort of to borrow some theological languages I'm co creating mathematics, which already existed before me but yet somehow I am inhabiting this this mode of engaging with the world and I think that's what happens in all our lives in some sense right we there's this underlying reality for people of faith.

We feel that there's underlying reality that existed before us continues through us and after us. And yet we are participating in it with real agency and and it's, it's part of the richness of what it means to live life. Okay so next question.

What characteristics of God do you see reflected in mathematics. Orderliness, a love of beauty, a an interest in patterns deep complexity and richness. And there's no end to you know you see a very simple idea and math and then you realize oh my gosh it's layered and layered and layered and layered and that's, that's, I think reflects in my, my own opinion, something of God's character.

And then there's there an equivalent to like consonants and dissonance and mathematics like things that really resonate naturally aesthetically and otherwise with people and other math concepts that are sort of off putting that's a good question yeah I'm trying to think of examples and I'm sure I've had them where I encounter an idea or concept that feels really unnatural and ugly. And but then I realize it has its purpose right so in some ways it's kind of like the tension and resolution that you know when you in music where you have this chord that sounds really funny and then in results really nicely. In some ways when you're trying to construct an argument to prove an idea.

The idea itself might be really beautiful but the rap to get there. Sometimes can be ugly in some sense. And yet necessary in some ways and so I had that experience in mathematics.

I've never thought about that before that's a really good one. So the sum total of that is the human experience right, whether it's dark light sort of the symbiosis this complimentary experience right of consonants dissonance, whether it's evil and good, darkness and light. It's all part of the package in mathematics as well it sounds like as it is in music, which turns the message.

You know, I just thinking about this here does being you know the whole part of the package I think one thing that I maybe wanted to say to that question that just a while ago about what other qualities of God do I see it reflected in math. Yes, as I'm trying to encourage I want us to see math as more than just the actual subject itself but also the set of practices, the ways we interact with one another, the ways we love each other, the

ways we experience deep human desires like freedom and community and beauty and truth and meaning these are all chapter titles from the book. These are all things that I want people to associate with math as well and so in some sense, if I think about this richer and larger sense of mathematics.

I see I see God in that as well in the desire for community, the desire to have rich ways of knowing one another through doing math together. Beautiful. It says, let's say I think we have time for maybe one or two more questions many of the examples cited for beauty have specific symmetry or patterning.

What about the absence of pattern and or symmetry. Is that different beauty. Yeah.

Yeah, another thing that I like to challenge people out is, is, is your notion of mathematical beauty going to be the same as someone else's right and so if you're a teacher, maybe what appeals to you isn't what appeals to other people. There are people who study the lack of symmetry and lack of order. And I'm sure they find that beautiful for reasons that are quite different.

They do apply mathematics and study and model things and find that process of modeling itself, you know, creating a model to try to understand the world. Think about the pandemic and all the models that are going into understanding the spread of disease. Those I think are really beautiful, but in a different way it's a beauty of, of modeling the world and trying to explain it.

Okay, and then finally your last question tell us what we should read after mathematics for human flourishing. Whoa. Yeah.

What should you read. Gosh, well there's there's lots of, of, lots of great books there I guess someone I guess they're asking for a math book maybe a book about math. Probably along the same lines.

Gosh, now you're putting me on the spot here. What should they read. Well, let's see.

So for this crowd there's it's not a book but there's a speech. A few years ago by another president of the mathematical Association of America. That, that talks about parallels between the pursuit of math and the pursuit of religious faith.

And that's called religion Matthew which you can probably find online in some form. That's I think an appeal to those of you who have a come from a, a background of some particular, not necessarily Christian faith but some religious faith or at least believing that there's something deeper. To be understood in the world.

I think people would enjoy that. There's lots of great popular books out there that you know that I could, you know, I could, could name that sort of help people understand the beauty of math. I, I, I grew up studying reading books by Martin Gardner, who has a

whole collection of books and their sort of puzzle books or ideas about math that I think are really beautiful and you can find a lot of those books really cheaply now.

And worth looking at. There's a recent book by a mathematician called how to free, how to free your inner mathematician Susan D'Agostino. And, and so she talks a bit about how, about what mathematical thinking feels like and looks like and I think that book could appeal to, to another people who are interested in doing a little more math as well.

Wonderful. Well, I just have a very, you know, quick simple question. And that is how is Christopher Jackson doing right now in this time of COVID.

Obviously, incarcerated enjoying his math, but have you had recent communication with him. Yeah. Yeah.

Yeah, we're in communication through prison prison has a limited email system. It's not like email that he can email anybody, but I have to be approved and on a specialist. And so I just spoke with him today.

Actually, he's. It's, it's rough right now because in the prisons everybody is on top of one another. And, and COVID is, has made its way to the prison in various ways he's, he's escaped it so far.

We're trying to use so he's an official contributor to the book and, and in fact, he's getting a portion of the royalties. And, and so we're, we're trying to help use the book to help him appeal for compassionate release during this time. Right now he has no chance of parole the earliest that he could get out even with good conduct.

He is 2033. But because of the first step act, which reduced sentences like the ones that he was convicted for, but not retroactively. If it had, if there were a second step act, he would be free now because he's already served the 14 years necessary by the reduced prison sentence.

And so he's filed a motion right now for compassionate release based on his rehabilitation and the sentencing disparity that that came about because of the first step back. And so that's making its way through the court system right now and we're, we're hoping and praying that that will result in in release. But it's hard.

Yeah, and it's, yeah, it's hard. It's hard to, it's hard to, to, to, it's hard to have hope, you know, for him. And, and I guess one thing that I, I really hope is that we, we don't just continue to lock people away for, for small crimes, especially if, if they committed them as, as teens.

Well, Francis, thank you so much. This has been such a rich conversation. Yeah, thanks for having me.

It's, it's been a delight and joy to. 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.

[Music]

(buzzing)