TRANSCRIPT

Math Professor Ken Ono Is Connecting Swimming, Ramanujan, and Hollywood

He got a call to consult on the Hollywood film The Man Who Knew Infinity, starring Jeremy Irons and Dev Patel. The director was so impressed with his knowledge of the life and work of Indian math prodigy Ramanujan that he invited him on set. By the time the credits rolled, he was an associate producer on the movie. But Ono's own life would make a fascinating big-screen story: a high school dropout pushes away from an intellectually gifted family and his father's academic legacy, only to be given a chance at college and advanced studies in the very field he avoided for so long.

Fred Lawrence: This podcast episode was generously funded by two anonymous donors. If you would like to support the podcast in similar ways, please contact Hadley Kelly, at hkelly@pbk.org. Thanks for listening.

Hello and welcome to Key Conversations with Phi Beta Kappa. I'm Fred Lawrence, Secretary and CEO of the Phi Beta Kappa Society. On this podcast, we feature conversations with leading scholars who are part of our Visiting Scholars Program. They travel to colleges and universities across the country and deliver public talks on their specialties. To attend a free lecture, please visit pbk.org for a full schedule.

Today, it's a pleasure to welcome Ken Ono, Thomas Jefferson Professor of Mathematics at the University of Virginia, and the vice president of the American Mathematical Society. He has published several monographs, over 180 research and popular articles in number theory, combinatorics, and algebra. Professor Ono has received many awards for his research, including a Guggenheim Fellowship, a Packard Fellowship, and a Sloan Fellowship. He was also an associate producer on the 2016 Hollywood Film The Man Who Knew Infinity, which starred Jeremy Irons and Dev Patel.

In 2017, he participated in Phi Beta Kappa's (En)Lightning Talks series in Atlanta, where he was a professor at Emory University, and it has since received an astonishing 32,000-plus views. Professor Ono will be a Visiting Scholar for Phi Beta Kappa in the 2020-2021 year. Welcome, professor.

Ken Ono: Nice to meet you, Fred. It's great to be here.

Lawrence: Good to have you with us. You're a scholar, a teacher, and athlete, a movie producer, and of course, a Phi Beta Kappa Visiting Scholar to be, so there's a lot to discuss. Before we get to all of the remarkable work you've done, I want to go back a little bit to the

route that brought you to where you are. You're not the first distinguished mathematician in the family. Your father was a distinguished mathematician, a number theory and algebraic groups scholar, who I believe was invited to the Institute for Advanced Study by the great J. Robert Oppenheimer.

Ono: That's right.

Lawrence: And your brothers include the president of the University of British Columbia and a music professor, so what was in the drinking water in the Ono family?

Ono: Wow. Where to start? My parents grew up in Japan. They immigrated to this country in the 1950s, and it was a very difficult period for them, quite frankly. They were raised at a time when the Japanese citizens were told that their emperor was a god, and you have to think about how their reality would evolve at the end of the war.

Lawrence: Right.

Ono: And so, what saved my parents, and you could ask them, they're still alive. They'll tell you that my father's passion for mathematics is what sustained them shortly after the end of World War II, and it turns out that the United States and the Allies held a number of conferences to help rebuild the university system, and my father was one of the many Japanese budding mathematicians who were discovered, who ended up getting some training in the United States. My father ended up proving some important theorems in number theory, and he ended up getting a great position at Johns Hopkins, and that's where they raised us, our little Japanese family, in the suburbs of Baltimore, Maryland.

Lawrence: And of course, today it's not quite so unusual a story for someone to come from another country and have an academic career here, but at the time your father was doing it, it was still quite unusual.

Ono: It was quite unusual. Remember, Japan attacked the United States in Pearl Harbor, so it was a major risk, a gamble, for my parents to pursue my father's academic dream in a country that they were quite frankly brought up to hate.

Lawrence: And had been at war with until relatively recently at the time your father came here.

Ono: That's right. That's right.

Lawrence: So, in terms of people who listen to this podcast, and wonder the various routes to distinguished academic careers, yours starts with an interesting couple of twists. You were actually a high school dropout, weren't you?

Ono: I was a high school dropout.

Lawrence: What's the story that leads from that to the University of Chicago? Not exactly the most obvious path.

Ono: No. So, it is true that as a young boy, I demonstrated some talent for mathematics, and I was one of the first students that participated in the study out of Johns Hopkins run by the famous psychologist, Julian Stanley.

Lawrence: Right.

Ono: And from second grade on, the plan was for me to be a mathematician and go to the best school, write a great thesis, and ultimately end up as a university professor.

Lawrence: So, really from the time of childhood, that was part of the discussion around the dinner table? You knew this was the path that was expected?

Ono: Oh yeah. Right. So, during the summer break, my dad would set up a little table by his desk in his office. While he was doing his very complicated research, I had to do my geometry problems.

Lawrence: We're of very different backgrounds, but very similar experiences. When I brought home a 99 on an exam, I was asked what was the missing one?

Ono: Yeah. So, when you're a teenager, when you're in middle school, and when you're in high school, I have to say that wasn't fun for me.

Lawrence: Right.

Ono: And for me, mathematics, well into my twenties, mathematics meant going for perfect test scores, being able to solve problems quickly. It was really robotic stuff. So, I didn't like it, and you know, when I was young, the last thing I wanted to be was anything that my parents thought I should be, and so by the time I got to high school, I was really quite sick of tests, and quite sick of the what I thought of as the mindless pursuit of grades. And so, I dropped out. It was a very difficult time. But to make a long story short, the University of Chicago had this program where they would accept applicants without high school degrees. I think they probably still do. And I got strong support from Julian Stanley. He said, "You know, you should probably give this a shot."

Well, over the course of the next 10 years, I had some great mentors. I reconnected with my parents, who I love, and I end up now choosing the projects that engage me for sheer joy. So, I love what I do in mathematics. It no longer means anything like test scores, or the pursuit of perfection. It's not a competition.

Lawrence: Right.

Ono: I view my work in the mathematics a lot like I think most artists and musicians would view their craft.

Lawrence: All hangs by such a slender thread, doesn't it?

Ono: It does. One of my first meetings with Sally after a few lectures and a course I took in the fall of 1988, he asked me to come into his office and meet, and he said something like this. He said, "I figured you out, Ono." What do you mean, you figured me out? He goes, "You're good at math, but you don't want anyone to think you're any good at math. And you're not in some ways very different from me." And then that's when he told me his story.

Lawrence: Wow.

Ono: Our relationship was very important to me. By the time I was a senior at the University of Chicago, it wasn't clear to me that graduate school in math would be the right path for me. I wasn't the best student, but this guy, he took a major chance on me, and he said, "Look, I'm gonna pick up the phone, and I'm going to get you into graduate schools. On one condition, that you agree to go and really give it a shot. Ignore all the other baggage, right? The expectations. I believe in you, and I'll make these calls, but you have to promise to give it a try." And I'm so glad he did that, because had I not followed up on his advice, he knew what was better for me than I did. Right?

And quite frankly, my parents knew what was better for me than what I did. I had to give myself permission to explore difficult questions, and some of those first questions are related to who am I? What am I really meant to consider or do in my life? And you know, a good mentor will help you come to grips with that.

Lawrence: And the straight line is not always the fastest route between two points.

Ono: I took a very long path to travel a very short distance.

Lawrence: Well, let's talk a little bit about the teaching part of math. How do you think about the act of teaching math, and actually I want you to think about it in two different categories. The people for whom clearly this is their route and their passion, and they're going to be either doing graduate work in math or maybe even becoming academics in math. And then those for whom this is one piece of what they have to know in order to do other things. How do you think about teaching those two different kinds of students?

Ono: Ah, that's a great question. I teach a class at UVA, it's called Transitions to Higher Mathematics, and the reality is that this is the final math class for many of the students that take it, so that it's called Transitions is somewhat of a misnomer. But the point of this class is to emphasize the need and importance for abstract thinking, and so one of my main goals in teaching this class is to address exactly your question. I really want our students, and the students that take my courses, to understand why certain facts are true. Why is it self-evident that the Pythagorean theorem is true?

So, on the very first day of class, I could ask, "Doesn't everyone here know the Pythagorean theorem?" And every hand goes up. But why is it true? Somebody prove it for me. And every once in a while, out of a class of 30, two or three can do it. But I know the vast majority, they know $A^2 + B^2 = C^2$. I can draw a picture. I can find you numbers A, B and C for which that works. But they don't really know the Pythagorean theorem.

Lawrence: Which also means they haven't asked themselves why is it true. They believe it to be true, but they haven't asked themselves, "How do I know it's true?"

Ono: That's right. That is exactly the point. You can recite a fact, but it doesn't mean you know the fact.

Lawrence: Right.

Ono: And so, I don't cover a lot of territory, mathematically speaking, in this course. But the students in this class I think end the course with having a much greater appreciation for

very critical thinking skills, and for really being able to confirm whether statements are true, false, or suspect. My hope would be to convince people that not only does mathematics help define the world as a tool for the sciences and engineering, but is also at the same time an art. Something that one can appreciate, just like they appreciate music.

Lawrence: And you have had experience using math in perhaps some surprising ways. Some of our listeners, right? You're doing some work with swimmers using mathematics.

Ono: Oh, yes. Yes. One of my undergraduate thesis students a few years ago was a walk-on swimmer at Emory University, division three. He in fact didn't even make the original varsity team, but over the course of a few years, he was one of our top math students, and he developed into a world class swimmer, and in fact, he's a leading candidate to make the Olympic team. His name is Andrew Wilson.

And because of the time that we spent together talking about mathematics, and because the fact that my son is also a competitive swimmer, we decided to try to develop some new mathematical models to enhance swimming, and I discovered that there were some tools that could be put to use that surprisingly haven't been used before. In somewhat of a secret project, I've been traveling the country with the assistance of the U.S. Swimming Team. Russell Mark is the head technical coach for U.S.A. Swimming. He was also a very mathy guy, and we're testing some of the Olympic hopefuls.

The idea is that we can collect data using these very special accelerometers, which are waterproof, that collect data that is far more useful than ordinary videotape, which captures about 24 shots a second. My accelerometers capture acceleration data in all of the three standard directions 512 times a second, and we can find and spot minute imperfections that can be perfected. And at the world class level, if you find a tenth of a second at every flip turn in a 1,500 meter, that's-

Lawrence: Then you've done a piece of work.

Ono: Then we've done a piece of work, so we're very excited about that.

Lawrence: So, without giving away any secrets, can you give us an example of some insight that your approach gives that might otherwise be lost, that could help a swimmer?

Ono: Well, we wrote an article for USA Swimming that was published last summer. It was in Splash Magazine.

Lawrence: How extraordinary. And speaking of extraordinary uses of math, and an unusual role perhaps for an academic mathematician, you were an associate producer of The Man Who Knew Infinity.

Ono: That's right.

Lawrence: Which is the story of the extraordinary career of the famous Indian mathematician, Ramanujan, and maybe the equally extraordinary story of his mentor-mentee

relationship with the Cambridge professor, G.H. Hardy, so let me… I do want to talk to you about Ramanujan in a second, but first, how did you get involved in this project?

Ono: When this film was going into production, I received an email from Matt Brown, who was the writer-director of the project, and he said he wanted to Skype with me the next day to discuss the artwork for the film. They needed help with figuring out what should be on the chalkboard, or what formulas should be on notebooks and things like that.

Lawrence: So, they wanted a verisimilitude of what the math might-

Ono: They wanted a mathematical consultant.

Lawrence: Got it.

Ono: So, we Skyped the next day, and what was supposed to be just a brief introduction to the art department turned into a very long conversation, and Matt discovered that I certainly knew a lot about the story of Ramanujan, and that my knowledge could be helpful for them on set. And the next day, he emailed me and said, "Well, how would you like to come out to Pinewood Studios and help with preproduction?" Great! And before I knew it, I was out there in Pinewood Studios working with the art department, and then working with Matt on tweaking the script, to get it to be real. And then the actors showed up, and Matt said, "You know the story better than everyone else. I wrote the screenplay, but you really know the story. So, I want you to help us with rehearsals. It'll just be five of us. Some of the actors, me, and there's some staff."

Lawrence: Dev Patel.

Ono: Yeah, Dev. Yeah, the meeting started with… I walked into a room with Matt. Dev Patel and Jeremy Irons were already there. I'm kind of frightened. These are famous people.

Lawrence: Pretty intimidating crowd.

Ono: Yeah, we sat around a table, and we went over every scene of the film, and after a few minutes, Jeremy Irons stopped and said, "Look, does this sound real? You see, I'm not a mathematician. I don't even like math. I think it's quite boring, quite honestly. But my job is to pretend to be a math professor, so you have to help us sound like mathematicians."

Lawrence: It has to sound right.

Ono: And you know, quickly, he's got this awesome voice.

Lawrence: Right.

Ono: And these piercing eyes. If he gives you an order, you kind of do it. He elevated everything about the project. And so before I knew it, I was helping the actors learn how to be and portray mathematicians. I helped with the script, and within a few weeks, I was an associate producer.

Lawrence: So, tell us a little bit about the Ramanujan story, and his extraordinary rise to unimaginable heights, really.

Ono: Yeah. I'm so glad that you asked that question. If you've never heard the name Ramanujan, read about him in Wikipedia. Maybe buy the book, The Man Who Knew Infinity by Robert Kanigel. Ramanujan, his name should be a household name. I'd like to think of him as almost as important as an Einstein and a Newton.

Ramanujan was born in the late nineteenth century in South India to a Brahmin family that was not very wealthy, and just to remind the audience, India at the time was just part of the Great British Empire. It was a colony. And so, try to imagine how difficult it would be to be an Indian of any kind under such circumstances. It turned out that Ramanujan, unlike anyone I've ever studied in my years as an academic, turns out that Ramanujan believed that his ideas came to him as visions from his Hindu goddess, and he recorded his findings in notebooks. These notebooks survive to this day, and these notebooks are full of more than fascinating, exotic formulas. They're full of formulas that have often inspired major theories of mathematics.

So, Ramanujan was untrained, and in fact, because of his love for his notebooks, he was unable to study in college, and so he ended up dropping out of college. He dropped out twice. But for whatever reason, his family and friends continued to support him, and so he found work as a clerk, and they still let him pursue his crazy mathematical ideas. And one of his friends said, "You know, you really need to send your mathematics to someone who might be able to appreciate all of that." And he wrote a letter to G.H. Hardy, who-

Lawrence: Who was at Trinity College, Cambridge.

Ono: Who was at Trinity College. This is the same Hardy of the Hardy-Weinberg law from your genetics class.

Lawrence: Right.

Ono: He was a brilliant man, and it turned out that Ramanujan had written the right person. Ramanujan had sent him many pages of mathematical scrawl, some of which was false, some of which was well known, but some of the formulas were so fantastic that Hardy recognized that you couldn't fake these findings. You couldn't fake these claims. And so, Hardy arranged to invite Ramanujan to Trinity College to study with him. A two-time college dropout invited by a celebrated British professor.

Lawrence: And probably not only the first time he was outside of South Asia, probably the only time he was outside of the Tamil region of South Asia.

Ono: Exactly, so to call this an extraordinary set of events is an understatement.

Lawrence: Right.

Ono: Ramanujan accepted the invitation, which was quite difficult at the time, meant he had to leave his caste, and he ended up spending about five years in England working with Hardy, where he proved some fantastic theorems. And keep in mind that not only was

Ramanujan an Indian, a so-called black man in England, this was also at a time when England was in the midst of a bloody World War. But despite all of those disadvantages-

Lawrence: World War I.

Ono: World War I. Despite those major disadvantages, Ramanujan and Hardy together laid the groundwork for much of modern number theory, and we're still studying those papers today. It wouldn't take you a very long literature search, Google search, to see that his ideas have now populated many areas of science, from signal processing, the stuff that goes into your cell phones, to the study of black holes. Ramanujan's ideas are all over science.

Lawrence: There's a whole journal dedicated to applications of his theorems and work.

Ono: Yes.

Lawrence: In other areas, isn't there?

Ono: Yeah, there is a journal called The Ramanujan Journal. I think it's a three-year backlog, there's so much work that's based on his ideas.

Lawrence: You know, we teach in many ways. You teach in your classroom. You teach through your writing. But obviously, the movie itself has been an important classroom for you, if you will, for hundreds of thousands, millions of people. So, I was gonna ask you for two book recommendations. I think you've already given us one, and so you may want to use The Man Who Knew Infinity as that. Two book recommendations. One is a math-related book for non-math people, so you may decide that that's already The Man Who Knew Infinity, but you'll tell me. And then the other is a non-math-related book that you'd recommend to your math colleagues.

Ono: A non-math-related book. Oh.

Lawrence: Just in your travels. I can tell you from the Key Reporter and the American Scholar, our two periodicals in Phi Beta Kappa, and even from book references on this podcast, among the very most popular things we do at Phi Beta Kappa are book lists. People love to know what our scholars are reading, so I'm giving you a little more time to think, but what would you recommend to your math students to broaden them, and to your non-math colleagues to tell them a little more about math?

Ono: Well, I might disappoint you here, because I think I have a book that would be of interest to both communities.

Lawrence: Even better!

Ono: And actually, what makes it even better is that the author of this book is one of your current Phi Beta Kappa Visiting Scholars.

Lawrence: I think people are gonna think we planned this.

Ono: We didn't. This is completely organic. So, Francis Su, who is an incoming vice president of the American Math Society, he was a former president of the Mathematical Association for America, and professor at Harvey Mudd-

Lawrence: An extraordinarily gifted lecturer.

Ono: He is a gifted lecturer. He is a very spiritual man who thinks very deeply about the role of mathematics in the human condition. I might not get the title of his book right, but I think it's called The Mathematics of Human Flourishing. This book was published maybe two or three weeks ago. It's a best seller in the mathematics community, and it's not what you expect. The word mathematics is in the title, but I think it has a lot to offer all people who are curious.

Lawrence: Well, that's a great recommendation, and another way in which you'll be continuing to teach people through all that you've done and will continue to do for us next year as a Visiting Scholar, and we're delighted to have you in the Phi Beta Kappa family.

Ono: All right, my pleasure, Fred.

Lawrence: Thanks for sitting down with us today.

Lawrence: This podcast is produced by Lantigua Williams &Co. Cedric Wilson is our sound designer. Hadley Kelly is the Phi Beta Kappa producer on the show, and our theme song, Back to Back, is by Yan Perchuk. To learn more about the work of the Phi Beta Kappa Society and our Visiting Scholar program, please visit pbk.org. Thanks for listening. I'm Fred Lawrence. Until next time.

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