TPWKY - Special Episode - Adam Kucharski

EW: [00:00:00] Hi, I am Erin Welsh and this is, this podcast Will Kill You. You are tuning in to the latest episode of the T-P-W-K-Y Book Club where I chat with authors of popular science and medicine books about their latest work. Since starting this series a few years ago, I've gotten to cover some amazing books and I appreciate so many of you reaching out with your suggestions for books to feature. Keep those recommendations coming, please, and if you'd like to take a look at the full list of books that we've covered in this series, as well as get a sneak peek at one that are coming up in future episodes, head on over to our bookshop.org affiliate page, which you can find on our website. This podcast will kill you.com under the extras tab. On the bookshop page, you'll find several podcast related lists, including one for this book club and the T-P-W-K-Y Kids Book Club, which if you're not following us on social media, you absolutely should be because Aaron Updyke has been putting together videos, reviewing children's books. It is such a great resource for sciencey kids books for all ages. And if you wanna share your thoughts on these episodes. Make topic suggestions. Submit a firsthand account. You can get in touch with us using the Contact us form on our website. Two last things before moving on to the book of the week, and that is to please rate, review, and subscribe. It really does help us out. And second, you can now find full video versions of most of our newest episodes on YouTube. Make sure you're subscribed to the exactly right Media YouTube channel, so you never miss a new episode Drop.

Belief is a powerful force. It shapes every facet of our lives and transforms perception into reality. What we believe to be true is not always what is actually true. Something I'm sure we can all relate to. Maybe you've debated with a friend over the answer to a trivia question, like you both know the right answer, but your answers are somehow different. Or maybe you've had a heated exchange with a relative who firmly believes that the moon landing was faked. How do we decide what we believe? How can we know that what we believe is the truth and how can we convince others of that? These are precisely the questions that Adam Kucharski, who is professor at the London School of Hygiene and Tropical Medicine, asks in his latest book, proof the Art and Science of Certainty. Kucharski, who is a mathematician that works on infectious disease outbreaks, explores how we are inundated with information and increasingly misinformation that we have to evaluate to determine whether or not we should incorporate it into our decision making. This extends beyond personal decisions. Which route is best to take to work, what to make for dinner? Our world is built upon structures of proof with varying degrees of

support. That car that you drive to work is manufactured under rigorous safety testing, meaning there are established guidelines for what is considered safe and how to test that. Same thing with the food we eat, the medicines we take, the buildings we spend time in. We don't question so many of our beliefs. To do so would leave you frozen, uncertain of which direction to move in, what to trust. You'd have no time to actually live your life. But when we do scrutinize our certainty, we might find a gulf between our beliefs and someone else's and those beliefs and the objective truth. Where does that incongruity originate? Why are we skeptical about some things and not others? What does it take to make up our mind and what does it take to change it? That answer might not be the same for everyone. An enlightening blend of philosophical, musings, political commentary, statistical exploration, and personal reflection. Proof is a fascinating read, particularly as this unceasing flood of information, both good and bad shows. No sign of stopping. Let's take a quick break and then get into things.[00:05:00]

Professor Kucharski, thank you so much for joining me today.

AK: Thanks for having me.

EW: I am thrilled to talk with you about your latest book Proof, the Art and Science of Certainty, and before we dig into the various forms of proof and how we determine a threshold for proof or what different types of proof exists for certain situations. I wanna start at the very beginning. What is proof? Is there a standard definition?

AK: Yes, I think that's a, that's a great question and that I think. My background's in maths. So, um, I think a lot of my kind of training was around this idea that you can have. This definitive knowledge that something is true. And I think it's something that people grappled with, uh, across fields. I mean, one of the stories that really struck me was Abraham Lincoln when he was, um, uh, training to be a lawyer, uh, came across this word demonstrate, and you this kind of beyond reasonable doubt, this certainty. And he's like, I don't really understand what this is as a concept. And he actually went back to all of these ancient Greek mathematical texts to, to understand how can we, you know, take what the knowledge we have. Build on that, prove new theorems, use that to, to prove subsequent knowledge. But I think one of the things that was really the motivation, um, for the book and something that I think anyone who works with information and decision making and evidence, uh, happens across very often is it can become quite, uh, shifting concepts.

I mean, even in mathematics, things that people thought were proven. Turned out had some hidden assumptions or human judgments that were kind of lurking there and caused a lot of that, uh, to collapse. So I think it's, it's, it's a kind of fascinating concept 'cause it's something that's, that's so important in life. Not just having knowledge that we gradually accrue, but for many of the things we care about, whether it's dealing with emergency, whether it's a legal case, um, whether it's even just a kind of minor business decision in our, in our day. We have to work out where we set the bar and how we evaluate what we've got. And I think for me, that was really the launching off point to explore this, you know, how do we converge on certainty and, and what happens when it goes wrong.

EW: Thinking about the difference between proof and certainty and truth. Like what is the relationship between those concepts?

AK: Yeah, I think that's a, that's a great question. And without going down the, the kind of philosophical rabbit hole, it could have been a book on you. What is reality? Um,

EW: yeah.

AK: But I think the way that I approached it is just to look at how people have thought about this in, in different fields. And again, even going, going back to to Lincoln and, and much earlier there was this. This appeal of this certainty, um, this idea that there could be this universe truth. And it's why a lot of fields ended up borrowing, um, for mathematics. You see it in the US Declaration of Independence. You know, we hold these truths to be self-evident. Divisional draft was we hold these truths to be sacred and undeniable. But Benjamin Franklin didn't like that 'cause it sounded like they were kind of appealing to, um, some divine authority. And self-evident is that it is just borrowed directly from, from maths. It's just a given truth. And unfortunately, it turned out all of these things about equality weren't self-evident. But I think that that story of how you think about these things, and even when we see in, in the legal world, a lots of it was originally derived from concepts around maths, around probability. If you talk about, you know, some of these thresholds, um, preponderance of evidence, you're saying it's more likely than not and you're kind of boring. A lot of these kind of probability based ideas and even in the world. Kind of more experimental design as that kind of developed. Mm-hmm. A lot of it was about. I mean, actually some of these early studies were almost trying to discount some of the influences of religion, you know, wanting to understand cause of effect in the world rather than just appealing to some other influence.

And then it, for lots of people, it became this question of how do you take the evidence you have and how do you link that to a conclusion, um, that you want to make? And where do you set the bar for that? Do you try and get ever closer to certainty? And there's actually a lot of. Statistical tension about a hundred years ago. I know statistical debates kind of sound a bit boring, but it was actually this, this real, you know, people just, you almost like wouldn't talk to each other because it was this tension between do you just try and get ever closer to the truth or do you have a framework that allows you to make decisions? And I think a lot of times in life we don't get to do the academic, I'm just gonna sit on the fence. Yeah. I just, I don't know. And I'm just not gonna do anything with my, you. With, with life or actions that often we have to decide, we, we, we do something or we don't do something or, you know, we say someone's guilty or we let them go free, or there's these decisions we have to make. And so that process of, uh, interacting with evidence is, is much more pressure. And I think that was, that was one of the real big tensions that. Never fully got resolved. Actually, even how we teach statistics at school, we kind of smushed together these two very different philosophies. One of this, this ever higher bar for evidence, [00:10:00] and one where we are sort of outlining a framework to make a decision based on the knowledge we have.

EW: When it comes to public health and medicine, there's a lot more pressing, you know, need to make decisions. Yet this decision is often dragged out for long periods of time, and sometimes that is at the urging of, you know, someone who has incentive to drag out a decision. So one of the examples that you talk about is Austin Bradford Hill, who is talking about this relationship between cigarettes and lung cancer and saying, oh, we have the, we have some evidence, and there's still a lot of skepticism. But we have enough to make a decision. We cannot use uncertainty as an excuse for inaction. Do you feel like that, like we've ever truly learned that as a society or has it been, you know, players like the tobacco industry saying, oh no, this uncertainty, you know, we need to push for more and more and more evidence?

AK: Yeah, I think that's a, that's a really good question. I think that's a really good example of, you know, almost kind of weaponized certainty. Yes. That you can always. Set the bar higher and in, in any aspect of life, you can set the bar higher and higher and higher to the point where you just won't do anything. And in action of course is in itself a decision. And I think Bradford Hill's work, you know, he was extremely thoughtful in how we approached this 'cause something like smoking. You can't really design it like a, a try. You can't get people to randomly take up smoking and see if they get cancer. Um, there's obviously ethical reasons, right? There's also just timeline reasons. You know, if you look at the, the timescale of the intervention versus what happened, you might have to wait decades to have that clear signal. And so he did a lot of

honing, uh, work with others, linking together the various. Sort of non-random data sets you, you had available. 'Cause one of the, the criticisms of course, is any data says, yes, smokers more likely to get cancer, but maybe there's a genetic reason that makes them more likely to smoke and, and get this. And, and he outlined a lot of the ways we can think about cause and effect. And I think that's. A very useful set of concepts.

Even some of it's the, the obvious ones of the cause needs to become before the effect or that, you know, if you have the strength of association, more of cigarettes makes you more likely to get cancer. If you see that across multiple countries, or if you can start to think about, you know, the biological plausibility we see carcinogen in, um, in other kind of situations as well. None of those things on their own is conclusive. You can start to build, um, this evidence-based and he, he made this really good point that. You know, any knowledge we have, even if it's very confident, knowledge is always subject to further refinement. But we still have that knowledge at that point in, in, in time and we can seek further information. There's been lots more studies of, of smoking since the early ones, but also that's information that we have to do something with and I think we often particularly. In, in the situations with emerging threats or, or kind of early concerns about things, whether it's, you know, a health intervention we think might be be harmful.

I mean, one of the examples are, are given, um, the book is the work at the FDA around thalidomide, which was this treatment for, um, sickness in, in pregnancy. And, you know, there was actually a lot of concerns about safety for babies. And the FDA blocked it as a result. But on the other hand, you get things where there might be. A lot of value, for example, in reducing smoking for, for health outcomes, and even if there's uncertainty. And Bradford Hill made this nice point of actually the, the standard you should apply for, for taking action kind of depends a bit on the situation you're dealing with. If it's a fairly cheap action to take, if it's not too disruptive for people. But actually in his argument, he said smoking is something people really enjoy. So we need a kind of higher barrier for if you're gonna, and I think it's a, it's, it's a reasonable point if you're gonna tell a lot of people to change how they live their lives. That the evidence you need is perhaps different for something where it's, you can take some action and you, and you can un unwind that. So is those kind of trade-offs that you, you have available that obviously need to play in as well?

EW: Let's take a short break and when we get back there's still so much to discuss. Welcome back everyone. I've been chatting with Dr. Adam Kucharski about his book Proof, the Art and Science of Certainty. Let's get back into things.

Right. The thresholds for certainty is it can be different depending on the situation. And then there's also these personal thresholds for certainty or, or evidence, you know, how much information do we need? And, and one of the things that you discuss in your book as well is sort of what happens when evidence flies in the face of our personal beliefs and how sometimes even despite a mountain. Of evidence, we can just still feel like that's not possible. We can't reject it. It's not an intuitive truth. You know what, what happens? Like what does [00:15:00] this show us about sort of the personal nature of proof and certainty?

AK: Yeah, I think that's one of the things that, that really kind of struck me in researching that. I mean, even in, in some of these kind of mathematical puzzles, uh, examples, it's things that, you know, I'd, I'd come across as a, as a kid and convinced myself, oh, that's just, that's the answer to the puzzle. And it was only years later when I was explaining it to someone else or someone else had asked me about it. And I, I sort of went through the thing that convinced me and I realize it just didn't convince them at all. And I think that's a really interesting gap. I think we, we focus a lot on, you know, how science works, how methods work, what convinces us, and you see this in even a lot of studies around political beliefs that people will often try and convince others with arguments that convince them. And then you get this gap and it's almost like that just fails. And I think that's a really interesting step to, to explore. Well why does that fail? And one of the things that I find even just kind of in some of the modern tools we have in the modern era, quite striking, is. Where we have this desire to explain things.

Um, so yeah, a few years ago I was talking to a bunch of people working on AI and there's a lot of, so. Concern about things things like self-driving cars that we don't understand why they make mistakes. We need that explainability. We can't have things we don't trust. And actually in medicine, we have all sorts of things that we know work, we know how often they work. We don't fully understand the physics and biology. Something like anesthesia for example. Um, you know, you can control the effect it's gonna have. But actually all the underlying biology and kind of physics mechanisms, there's still more work to be done. Things like defibrillation. You know, if you give a heart a shock, you can kind of reset it. Again, some of that's understood, but there's, there's still those kind of gaps in knowledge. But we know that these are useful tools and even, yeah, if you run a clinical trial, you can assess how effective a treatment is, but that on its own will just tell you the effect. It won't tell you necessarily all the mechanisms that are going on, um, to explain it. But there's these tools that we've got and we've got the evidence. To take action and use these things we're very happy with. And there's other areas of life where actually that inability to

explain something kind of really bothers us. You know, if even if self-driving cars were much safer than humans.

As humans, when I start looking into the book, humans are not good at driving. You know, it's not a massively high bar, but I think it would still make people uncomfortable even if they were say, twice as safe. In cities as well, very well defined. I think it would still bother people if every now and again there was just an accident that we had no real idea what was happening. And I think that's really important to bridge. 'cause I think that, you know, particularly when you get that gap in understanding, that's room for other explanations, um, to, to kind of creep in. And I think that's where we start to see, you know, emergence of things like conspiracy theories, whether it's things with kind of incorrect logic, often it is that gap between what we're seeing and the understanding of why that's happening. I, I think humans have this very, in many ways, very powerful desire to explain what they're seeing. But in some cases where the explanation is very hard to untangle, it can lead us astray.

EW: That's fascinating to think of the, the gap between. Understanding and what is happening. We don't understand how anesthesia works or how Tylenol or acetaminophen truly works, but we do understand how vaccines work, for instance, and yet there's so many conspiracy theories and misinformation surrounding this thing that we do know how it works. I guess what good does evidence do if we do not take it into account and are not open to it?

AK: Yeah, and I think for me a lot of it is, is just understanding at what point that breaks down. I mean, even if you. If you look at some of the, the, the COVID vaccines, for example, you know, or, or even some of the kind of other, you know, debates around kind of climate intervention, other things, you know, often it gets very into, you know, debating some e element of the technology. And I think often it's actually just. People disliked some of the, the, the control that was exerted over them through mandates or for other things. And actually, you know, if you've got an intervention that you're unhappy with, you can disagree with the intervention of say, look, yeah, for example, we know that intervention works, but I disagree with how you're implementing it. Or you can disagree that the intervention actually has an effect. Or you can go even one step down and just say, you know, actually I think there's, there's sort of deeper problems. Or maybe the disease isn't a threat. And I think often those kind of leg levels get, get tan, tangled up. And I think in a lot of the conversations I've had with people, often they're, they're sort of deep down concern, or the thing that they're approaching it with isn't necessarily that they've just out of nowhere decided that this isn't a threat or that that technology doesn't work. It's actually, in some of these instances, things are a bit more marginal and you could say,

you know, you could make an argument either way, even if the underlying intervention is, is, is. Effective or is gonna have this, you know, you can make this moral and this, it's not just about an sort of epidemiological question. Um, and so I think kind of understanding where those drivers are and also just in our own arguments, I think sometimes, you know, I have the conversation with people and I think I'm just arguing about the kind of, the nuances of whether intervention is a good idea or not. I, they're actually arguing whether it's a problem in the first place we see it. Vaccines are, I guess, an example [00:20:00] that's more polarized. But even something in climate, you know, you can have. A lot of people who just agree on the nature of the effect of climate change. They agree on the different levers that we probably have available society, but they might strongly disagree about actually how we prioritize those and all of the trade-offs. And I think it's just understanding what level we're on and where the evidence might stop and where it might then just be other things that are, are filtering in on a personal level.

EW: This idea of proof and certainty and truth, that seems very intuitive in a lot of ways today, but this maybe wasn't always the case. Like when did the concepts of truth and the need for these self-evident truths or certainty or proof, when did these come to be? And then, you know, in what fields or what areas were they initially applied?

AK: Yeah, I think that's a great it. It is easy just to think of like the world and, and sort of science and evidence just always was as it is. I mean, even in mathematics, this idea that we had a universal truth wasn't, um, the same throughout history. If you go back to the ancient Egyptians, ancient Babylonians, they were much more focused on problem solving. A lot of their texts are kind of these. These kind of puzzles and very much things around kind of practical everyday problems. And even if you look at, you know, their formulas for an area of a circle, they're quite approximate. And if you're, you know, if you're building something that needs quite a large circle, you're probably gonna be okay using those, but it's not gonna give you that really precise truth no matter what problem you're working on. And that's something where the ancient Greeks, uh, mathematicians like Euclid came in and tried to put things on a much more solid footing. So you've got these. Concepts like pie, but if you want the area of a circle that will just be universally true and you won't have this issue if your kind of approximation breaks down. And it was then, I think that as it sort of came into the enlightenment era, was very appealing for people that you could have these undeniable truths about the world. And I think that's where a lot of other fields started growing them as well. But even in, yeah, in medicine, if you look at this, this study of cause and effect, a lot of that.

It was the, the sort of medieval Arabic world that a lot of that started to emerge. So a lot of the, the kind of superstition, this idea that disease or conditions just kind of come out of nowhere and it's, you know, bad people or you know, someone's a witch or this kind of stuff that was going around in, in much of Europe at the time. Um, there was a lot of early writings even around sort of the 11th century saying, these aren't supernatural. There's natural causes. And we can study them. Yeah, we can study them. We can work out what the cause of effects were. And a lot of early attempts to try and think about concepts that we'd now call things like having a, a control group or thinking about how we kind of, you know, would divide and treat some people and not treat some people and then compare the difference. The conclusions didn't always. Work out. I mean there was, I think one of the, uh, the earlier studies was someone who'd identified correctly the symptoms of meningitis, but then concluded that bloodletting was really effective for it, which probably something in their study design had gone astray. But again, it just kind of really in, and it's one of the things you look back on and you think it's just, it's pretty obvious that we should be doing it that way.

But even coming into the 20th century, if you look at something like analyzing a medical treatment, a lot of the early studies. Did an alternation method. 'cause if you think about it, rather than randomized patients, you could just say, well, the first patient that comes in, I'm gonna treat the second, I won't the third I will fourth, I won't. And on average, you should get something that any other sources of variability should balance out. And the difference between those groups should be on average down to the treatment effect. But Bradford Hill actually, who, who did a lot of the, the pioneering work in the early, um, sort of clinical trial space. Noticed that the groups were often, I balance, 'cause what was happening is patients were coming in and doctors were maybe subconsciously they're like, oh, maybe that person looks a bit ill, I'll involve them. Or maybe they don't meet the diagnosis. And it, and actually a lot of the early randomization wasn't statistical, it was just, it was to sort of keep humans from themselves. 'Cause we couldn't trust subconscious judgment. So a lot of the, the early randomization in medicine wasn't about the statistical properties, uh, of the trial design. It was just about making sure humans didn't muck things up, basically with their internal biases.

EW: Well, I mean, we'll find a way, I'm sure somehow, some way. Uh, but it's, it's, it's interesting to think about this idea of like self-evident truths. Thinking back to, okay, yes, there's superstition and this person is a witch based on these signs or whatever. Was that also viewed as proof

AK: the story of those? This, this RA by ordeal is a fascinating one as well. 'Cause they were used for, for a long time. You could have trial by orde, like by water or by fire, whatever. And you could also choose trial by ju. So basically the big criminals always pick that and people start to notice like, oh, you know, if, if God is deciding which one's innocent, God tends to pick the bigger one, like pretty much every time, which is, I think there was that that came in. But actually one of the reasons they stopped using them is, um, a lot of the religious scholars became concerned that they were basically trying to. By running those trials, you're essentially trying to get God to do your work for you. And that felt for them a bit awkward 'cause you're, you're sort of on demand saying, Hey, can you come and make a decision for us? Which they, [00:25:00] they sort of got quite uncomfortable with. But even those early systems, I mean, early juries in England were kind of fascinating because they, they weren't, the structure that we had today, they, they kind of did their own investigation. So of often someone was accused and then they went off and accused someone else and kind of did their own thing. And it was, it was only over time that system kind of evolved of having. That way of converging something. And I think that's, you know, we, we talk a lot about the, the sort of problem of black boxes, but to some extent, juries and, and talking to legal scholars is kind of interesting with this, that it's not so much about getting to the truth. It's having a system where you can reach a decision and you've got kind of that finality or semi-final finality to that decision. And having a system that works rather than, you know, you are a hundred percent convinced of that. And I think we, we see that. Kind of across different fields of that emergence of, of truth, and as you said, what, what's kind of obvious and what's self-evident?

I mean, one of the other things that I found kind of interesting was how many mathematicians were, were deeply, um, influenced by religion. So Newton, for example, Isaac Newton driving all these equations and theories about planets and planetary motion, he saw that it was God keeping the universe in balance and he was essentially just. Um, observing divine influence. So for him, although he was doing a lot of this scientific work, he saw that there was this external influence keeping it all in place along the way. So, so even quite far through history, you had these kind of other baseline explanations, um, going on. I think even in the modern era, I think the way, the way sometimes we tell the story of science, I think is sometimes almost a bit dis disingenuous. If you read a scientific paper, it's kind of, yeah, there's this problem and I decided to run this experiment and I got these results. But I think there's also just that element of like why, what was the hunch that made you think that that might be an interesting thing to investigate? What was that spark of in inspiration? I think even in this era of ai, it's a really interesting question because you know, AI can kind of process and mimic human decisions as we write them down. But I think there's often that kind of spark or that idea that would lead you to do something

that just people wouldn't have tried before. And that's much, much harder to articulate. So it's not necessarily. That kind of obviousness that we might have had in another era. But I think there still are those things which are quite hard to explain in where that, you know, evidence might have initially sparked from.

EW: One of the things that you mentioned was the use of proof and evidence in the legal system, and I feel like this was a really fascinating discussion in your book as well, where this is employed as like, you know, proof beyond a reasonable doubt or innocent until proven guilty. What is this show us about like the variable level of evidence needed to make a decision and I guess like the different forms that proof can take in this setting.

AK: It's a really interesting question about how different societies have even set that, that balance. I mean, essentially in a legal case, there's two main errors you can make that someone can be guilty and you can let 'em go free, or they can be innocent, you can convict them and. William Blackstone, who's legal scholar in the um, 1760s came up with what's known as Blackstone's ratio. He said it's better for 10 guilty people to go free than one innocent to be convicted. And Benjamin Franklin actually and sort of was even more cautious, he said It's better for a hundred guilty people to go free of one, innocent to be convicted. Seeing that as the kinda balance, um, other. Cultures, particularly some communist regimes in 20th century set it the other way. It's like it was better for 10 innocence to be imprisoned than warn guilty to go free. 'cause there's this kind of, you know, trade off on where, where they're seeing it, um, as the worst error and actually some analysis looking at US legal cases, obviously they don't try and target these error rates, but you can sort of infer how people are valuing this. A lot of them seem to land between that kind of Blackstone and Franklin. Ratio of error, but then it's of course, yes. The, the different evidence and how it makes it its way into the courtroom. Particularly some of the examples historically of, of kind of things like early probability. And again, one of the challenges here is what, um, once scholar I talk to called the weak evidence problem.

And I think a lot of how we navigate life is around probabilities that are quite likely, you know, a lot of probability theory was originally developed around like dice games and things. You know, you can study and you can quantify. But in legal cases, we often have this weak evidence problem where you know, someone ends up in some extremely bad looking situation from a guilt point of view, and you're like, well, it's extremely unlikely. This is just a coincidence. But then if you think about it, you're like, well, this person, you know, might just be a normal everyday person. Well, it's extremely unlikely too that they're guilty. So you have these two extremely unlikely events, and a lot of statistics

just isn't equipped to handle that. And so there's this notion, it's called the prosecutor's fallacy, where people say, well, this is the probability. That, that would all be a coincidence and therefore that's the probability that innocent. But of course, you've got to weigh it against the fact that it's extremely unlikely. They're guilty as well. And we see this even in other areas. So the, the work we do dealing with like emerging [00:30:00] health threats and. You know, pre COVID, there were some studies, and actually we did a TV show where you sort of say, oh, it's, you know, a pandemic could just be round the corner. Or there was another study that the World Bank I think put it at 1% and you're like, W well what is that? That's, is that

EW: right?

AK: Are we, was that a good prediction? Was that a bad, and is these these very unlikely events? I think in legal cases, again, for that weak evidence problem, it's less about do we definitively work out with high probability? Which of those is true? And it's more just. We have to converge on the best explanation for what we've seen given those two possibilities. And in reality, we, we may never have certainty about where we are. And I think it's something that, that kind of struck me both thinking about that and then also thinking about a lot of people who, you know, have to plan for emergencies and very unlikely events thinking a lot of the way we traditionally think about probability. Can very quickly lead us astray. 'cause I think we're so used to having this idea, well I can just be 99% sure that, that this happened. But actually it's much more about that balancing act that we have to perform.

EW: Let's take a quick break here. We'll be back before you know it. Welcome back everyone. I'm here chatting with Dr. Adam Kucharski about his book Proof. Let's get into some more questions.

Thinking about this in the context of COVID, when, you know, things were evolving very rapidly, the situation was evolving rapidly and the general public. And, you know, of course, uh, government officials wanted answers and wanted decisions. You know, what is the best thing to do? Wear masks, not wear masks, sanitize groceries. All these things that were just constant questions and need, and people wanting hard answers, like just yes. Period. End of, as someone who was on the informational front lines of the COVID pandemic, what was your relationship with uncertainty like at that time? Did you struggle with feeling like, we don't have enough information yet? You know, how, how did that feel, I guess, in your, in your position?

AK: Yeah, I think, I mean, those, those kind of situations are enormously tackling both in terms of evidence generation and communication. And then obviously the political decision making that comes off the back of it. Um. I think in many of those situations I found it useful to, you know, kind of convert in some cases, uncertainty around the exact estimate to. Just, just to kind of broadly what situation we're in. So for example, when I, I think it was the Delta variant emerged and we did a lot of the work identifying the, the early advantage it had, and it really wasn't, you know, was it 30%, was it 40%, was it 60%? But essentially all of those were big problem, and it's kind of arguing like, is this, you know, is this a disaster or just a catastrophe or just very, very bad. And it's like,

EW: right, right.

AK: Yeah. From a, from a policy, you don't need to kind of necessarily communicate as that. You can just say like, we are very confident. That it's gonna take off a couple of things. I think that that jumped out for me. I think what one was the need to triangulate across data sources. I think sometimes people have this idea of science that you go out and you run a study and that study gives you the answer. It doesn't give you the answer. And. There were quite a few, you know, of the early skepticism were saying, well actually this study wasn't definitive and this study wasn't definitive. But once you start to look at all of those, you know, you start to look at the evacuations flights, you start to look at the taste testing data and the contact tracing and the big testing of, you know, some of the cruise ships. You start to look at the clinical data, all of those signals start to drag you in the same way. And again, e each bits of those evidence on their own might have problems, but you can start to bring together and draw that into a conclusion. I think we saw that across the pandemic, that if you, if you view it very much as like, I'm gonna get the perfect study, it's gonna give me the answer. Your struggle, but often you can actually find a lot of complimentary data sources that all, you know, for variants or a lot of the early severity, were all pointing in the same direction. I think it's harder, obviously, when they're, they're pointing in different directions as we saw with, you know, some of the interventions where it was less clear because different countries, different economies, certain things did affect behavior and other things, um, in different ways. But I think the other challenge that kind of jumped out, and I think a lot of the health issues we deal with. In us, UK and the modern era are non-contagious. So they're very much kind of individual, you know, things like cancer, things like heart disease. So it's very much individual focused. So you, you have someone who's ill, do you treat them? Do you not treat them? If you don't treat them, that's some, someone who's one person who's gonna get worse. But contagious health threats have this dependence where you know, a problem can get worse and that problem can then accelerate

in, in very different ways. I think that was something that was. Was quite a challenge to communicate because I think a lot of people had this notion of you've got normal life and then you could do something else.

That's not normal life, and we'd obviously just prefer it to be normal. But I think as we saw globally, you didn't get that, that that status quo. I mean, that was, that was gone and, you know, no country had, they had varying levels of [00:35:00] normality, but no country had like just, you know, pretend absolutely nothing happened. You either had, in varying degrees, depending on the, the structure of society and advantages they had in kinda like terms of demography and healthcare and other stuff. Big changes in behavior or borders, whatever, or you saw a huge amount of death. And I think that's something that's, that can be from an evidence point of view, much more challenging. Because I think just in life we're much more used to those kind of linear problems where, you know, like with cancer or something, user event, tragic events that happen sort of distributed across the population rather than something that the worse it gets, the worse that Worseness accelerates.

EW: You mentioned how we have these different data sources, these different, you know, studies that are all leading us in a certain direction, and we have, by this point in time, developed ways to measure both the quantity and quality of of evidence. I really enjoyed your discussion on randomized controlled trials because this quote unquote gold standard of medical studies that might not always be the gold standard. And I was, um, hoping you could tell me a little bit about the times when the true gold standard might not be, for instance, an RCT, but it might be something else entirely or it might be unethical to do a randomized controlled trial in that situation.

AK: Yeah, I think we, we've seen quite a lot of examples where treating it as that kind of cookie cutter, this is, this is the only method we can use, can lead into problems. I mean, smoking and cancer is a very well known one that we, we, we couldn't just have inaction because you can't get that level of perfection. I mean, actually even the first randomized control trial in modern medicine, uh, which is 1947, so streptomycin, uh, a trial for tb, Austin, Bradford Hill, who, who led that? Made the point that actually Streptomycin had some very promising looking lab data and, and kind of early signals, and he suggested it would've been unethical to withhold it from patients if it was available. But actually it was 1947, there were currency controls. The, the UK and its postwar state couldn't get enough dollars to buy streptomycin. There wasn't enough to go round. So in that situation they said it would be ethical to randomize 'cause there's not enough of it. So there's not enough of it. You might as well randomize and just learn something along the way. And I think we've seen that

in, in, in other situations. I mean, another sort of examples that you see where things are very difficult to randomize. You can think about natural experiments. A lot of the, uh, you know, well known one is the Vietnam draft where people essentially randomly assigned to go to war base on their birthdays. A lot of economists have done Nobel Prize winning work using that to understand the effects of war on subsequent life outcomes because it's not something where you can. To fully design that, you know, experiment, but you can then make use of what you have available. So I think. A lot of it just comes down to this issue of we want to understand cause of effect and the benefit of randomization is a lot of the other things that would influence whether or not, you know, someone's getting a vaccine and someone's getting the disease because you're randomizing on the vaccine on average, those will cancel out as effects.

So it gives you that, that quite neat benefit. But of course you've also got the challenge that. You might run a population in one group and one population that doesn't generalize to somewhere else. You've also got the time issue. So for diseases that evolve, you know, you might run a trial now against flu or COVID or something, a year later, that's gonna be a different variant. And to what extent can you carry over those conclusions? I think we see a lot of examples. In the literature where for, for instance, someone might run a trial in one population for one disease, for flu, for example, and then see a very different result when people look at population patterns elsewhere because it's, it's a different immune structure. It's a different strain, it's a different time period. And yeah, I think we can't just say, well, that study from a few years ago is the gold standard. We're only gonna use that one. We have to think about how these things move along. I mean, that being said though, I think in COVID. There were missed opportunities, I think, to, to, to gather much stronger data. I think it's, it's very hard to justify running those kinds of studies as a threat increases, I think when epidemic's going up, you know, taking the time to kind of try and randomize. I mean, I think essentially countries have to take that threat as the evidence suggests, but I think particularly as countries lifted measures. That was often just done in quite an ad hoc way, and we could have done much more kind of staging in the uk there was some early studies, for example, of can we use rapid tests so people test themselves every day rather than quarantining for like a week or two. And then in practice, a lot of people just didn't bother. But apart from that, you know, I think there's, there's a lot of these debates we're still having and we probably could have got better answers for that with some higher quality studies. So not necessarily even an RCT, just, just making use of what we had with more observations.

EW: One thing that I, I feel like during the COVID pandemic, especially the, the early months, was this desire from the public to have the answers. And I feel like there's a lot of variation in how willing someone is to say, I don't know.

And I'm, I'm wondering your feelings on this. Do you feel that scientists in particular have a difficult time [00:40:00] saying that they don't know the answer to something? Like, do we need to embrace uncertainty more? In as scientists or do you feel like there's that we are embracing it, but just not communicating it Well.

AK: Yeah, I think that's a really good question. It's kind of how, I guess, how personality and politics and all these things play as well. And I think, I mean there, there's, there's been good reviews of evidence showing that the overstated certainty just, just undermines trust and confidence. We, we, we are, whether it's kind of vaccines or it's other things. So saying, you know, this is a hundred percent safe, there's absolutely no risk, and if there's even a tiny risk, you then kind of undermine that. Yeah. One of the challenges with kind of that over certainty, I think particularly once you make that public statement, it's very hard to back that. And we saw that with some of the airborne, right? Yeah. Some even. Health organizations say it's not airborne fact. It's very difficult to then walk that back. But I think it's fine in line 'cause you don't just wanna say, we have no idea. You want to try and communicate, um, the way the evidence, I think some countries did that better than others, particularly on their re you know, sort of Denmark, Singapore, spring to mind on their reopening where they said, this is the data we are looking at to do this. That might change and this is kind of how we have to work things through. But I think. One of the, one of the difficulties I think, uh, because any emergency that goes on for that long is, you know, you have some people who have very loudly said something's, you know, a hundred less, a hundred times less severe than it is.

And then they're kind of very nailed on to, to having to. Keep promoting that. And I think it is, there was one, the, one of the government advisory committees I sat on, you know, so a lot of the kind of early alpha variant, early delta variant, a lot of this early severity came out of this, this group. And there was a phrase that became used quite a lot, which was, tell me why I am wrong. If you have that discussion where you want to get criticism, if you present stuff, and yeah, especially people are more senior and say, is this, is this correct? It's very hard for people to kind of come in. And say, oh yeah, actually, um, I supported a problem, especially if there's yeah, power dynamics or um, seniority and other things. So I think there was a lot of that thing where people present work and be like, right, tell me why I'm wrong. Tell me what I'm missing. And I think that's quite a healthy attitude in that kind of environment to be much more, you know, looking for weaknesses and be able to kind of lay out. And I remember actually, I think it was, when was it the gamma variant? It was sort of emerging in Latin America, and I gave a immediate interview and when they wrote it up, it was basically, you know. Dr. Kucharski doesn't really know was the kind of open, but in that situation we, we didn't, and it, it is hard to do because I think, you

know, especially people asking you questions around your area of expertise, I think in terms of how to balance that. Not just saying, I don't know, but saying, well, we do know this. And we can make some judgment.

And there was this, this wonderful study in the, it was 1951. It was by the CIA analyst, and it was about words we use when we're unsure and words about judgment. And he basically realized that people use probable impossible to meet all sorts of things. And they all, yeah. Had kind of different notions. And he said, your humans will go out of their way to making a judgment about something. Um, that will often, you know, the risk is you get the uncertainty where we're like very hazy and like, oh, it's, you know, it's a definite possibility. And actually in some cases, like with, you know, if you've got an emerging threat and you've got experts, you do actually want them to put a number on it. You know, even if there's uncertainty, you want 'em to say, I am 60% sure that this is the case. Um, and there's been a lot of nice work, you know, even around things like super forecasting where. People make those predictions and you can go back and then look. 'cause you know, if people are well calibrated in their uncertainty. Yeah. If you say you're 50% sure about a list of things, about 50% of the time those things should happen. So about half the things on that list, um, should occur. So there are these situations where I think we can get better just about thinking about our own uncertainty. And one of the things that I actually tried to do, I've tried to do in a lot of kind of emerging threats, is even just, just writing down what you think's gonna happen. Because I think we're we're great. Um, you know, uh, the human mind at like, kind of rationalizing, oh yeah, maybe. I did think that. And so yeah, I did quite, quite a lot of like where, where you could state, I actually think the vaccine's gonna be pretty good. Or, you know, I think this, and like, and this is where social media, when it was maybe slightly less polarized was quite helpful. 'Cause you could just put a post out. And I, I think I was always very careful I didn't delete any of my tweets during COVID because I was like, I actually want that record. And there were some, I got wrong. You know, I, I was in Singapore, um, in Feb 2020 and their policy was Don't wear a mask unless you have symptoms. Not, and I think I tweeted, I was like, yeah, that seems like a sensible policy That seems quite a evidence-based. And now we probably, you know, with some of the studies, not look back on that as, as being the best post. But, so yeah, it's, I think it's almost that as well as overstate certainty. I think it's also holding ourselves to account, even if it's just, you know, privately about how confident we were and what played out.

EW: I wanna to close out by asking you about the subtitle of your book, which is The Art and Science of Certainty, and I wanna know about the art part of this. What is, what is the, the art [00:45:00] aspect?

AK: So I think for me it was the more I dug into this, the more I saw these other elements beyond kind of pure logic, pure observation coming in. I mean, even if you look at. What was, was essentially a bit of a mathematical civil war in the late 19th century where a lot of these ancient Greek theorems, you know, things about the properties of triangles started to break down because people started to draw shapes on spheres and other structures and come up with functions that these supposedly proven theorems didn't hold, and I think one of the reasons that was, that was really controversial was there was this idea that there's a universal truth out there about the world. And actually in this situation, it, it kind of depended on what assumptions humans were making and what we were willing to, to kind of define. And, you know, even in this supposedly pure, pure subject. There's still these, these debates around, well, it kind of depends on which one you want to pick, and that will change the answer. I think even in, in science, it's a lot of these, these situations where, you know, we can accumulate the evidence, but then you have disagreement about where you, you set a threshold. I mean, this kind of 5% cutoff has become very popular. This, this sort of P value or you know, the chance. Get a result. That extreme, um, if there was nothing going on or we will know, no hypothesis, uh, was wrong, but that was kind of arbitrary. I mean, it was partly picked just for convenience that this was, you know, a hundred years ago, the calculation was just a bit easier if they picked a value.

Um, one, one Fish did a lot of this work, just easier to pick a value around, um, 0.05 and others who were more pragmatic, you know, working in, in business on something and thinking, well, actually the evidence is a bit weaker, but that's still useful to it. So there's this kind of human. Balancing act. And you know, we saw again things like legal cases where how much you value different types of errors depends a lot on the individuals. I mean, one of the, um, examples that, that I find fascinating in the book was Einstein when he moved to the US got very angry about peer review because he sent something to a, said something to a journal and it came back. He's like, oh, we've got another opinion on it. And he was like, whoa, whoa, whoa. Like, why haven't you just accept, accepted my work? And actually, max, max Plank, who published some of his like amazing early papers plank, made that point that actually I would rather kind of publish a few things that are a bit, you know, nonsense than this is me paraphrasing than miss a really important idea. So for him, his threshold was like, I, I wanna set the threshold low. Admittedly, mainly amongst kind of physicists. He, he knew because I don't want to set it too high and miss a good idea. And I think we all, we all have those. This kind of, that's where the art I think creeps in that, that kind of subjectivity in not just the evidence. I think one, for me, the real difference with something like proof is it's not just generating data, it's how that data interacts with the world and the decisions we make. And I think that's where things get really interesting. It's like where do we actually set the bar for

evidence and then both to convince ourselves, but then go out and convince others to.

EW: Well, professor Kucharski, thank you so much for joining me today. This was such an enlightening conversation and I really did, I loved your book proof, so I, I appreciate you coming onto the show.

AK: Thanks. It's great to talk.

EW: A big thank you again to Dr. Adam Kucharski for taking the time to chat with me. If you enjoyed today's episode and would like to learn more, check out our website. This podcast will kill you.com, where I'll post a link to where you can find proof, the art and science of certainty, as well as the link to Dr. Kucharski's website where you can also find his other book, the Rules of Contagion. Why things spread and why they stop and don't forget. You can also check out our website for all sorts of other cool things, including but not limited to transcripts, quarantining recipes, show notes and references for all of our episodes. Links to merch, our bookshop.org affiliate account, our good reads list, a firsthand account form, and music by blood mobile. Speaking of which. Thank you to Blood Mobile for providing the music for this episode and all of our episodes. Thank you to Lianna Squillache and Tom Breyfogle for our audio mixing. And thanks to you listeners for listening. I hope you liked this episode and are loving, still being part of the T-P-W-K-Y Book Club. A special thank you as always to our fantastic patrons. We appreciate your support so very much. Well, until next time, keep washing those [00:50:00] hands.