

Healthcare Triage Reproducibility in Science Podcast Episode 8: Solutions Pt. 2

Aaron Carroll:

Welcome back to the Healthcare Triage podcast. This is the eighth and final episode in our series on science, culture and reproducibility. And it's part two of a two-part segment on how we might address many of the issues we brought up in the series. In the last episode, we focused on issues related to publishing, funding and mentorship. In this episode, we'll focus on the system of Academia itself and all the problematic incentives within it. So what were some of the major themes when we started asking people, what do we need to do within universities, within Academia to fix what clearly is a broken system of incentives?

Sanjay Srivastava:

Whether you get a job, whether you get tenure, whether you get professional awards, whether you get a raise, all these other things, we need to tie them to doing things in the right way. I think we need to tie them more to asking the right questions and using the right means to answer them as opposed to getting an exciting and flashy result.

Ed Yong:

It's got to be a set of structural changes that reward people more for accurate and true work than for attention grabbing publishable work. I think we, as a community of journalists, of scientists and of science enthusiasts need to think hard about how we're apportioning respect and fame.

Mike Dougherty:

And so I think the first step of course, is acknowledging the problem and understanding the source of the problem. The second step is setting up the system so that they're incentivized to not engage in those problems. And the third thing is to recognize that we have this overarching goal to understand the world and improve the world. And if we can bring those things together, then I think we can start to make some progress in this whole enterprise.

Ivan Oransky:

The current generation if you will, or the generation that's coming up, maybe the grad students now, maybe the postdocs junior faculty, they're actually hearing about all this stuff in a way in public, in a way that best I can tell nobody used to talk about. Now, it's not that it's not still going on. It's not that all of a sudden we solved all these problems, but the fact that there's even a discussion.

Josh Nicholson:

So I think this is error corrections and really kind of the socio dynamics of science is what holds back a lot of this. Most of the problems we have are not technical. It's like these structures that have existed for decades and Academia is a very tradition bound ecosystem that's hard to change.

Kelli Barr:

Tinkering with these institutional practices is not as sort of dire as a lot of you might think.

Tiffany Doherty:

Before we dig into changing major institution values, let's take a pit stop at the level of individual practices of researchers within these institutions. Particularly related to data analysis, our stats experts were clear on this, we need to cultivate a better understanding of statistics and more specifically an attitude of embracing uncertainty. Here's Dr. Gelman.

Andrew Gelman:

I think we should accept uncertainty. I've been involved in studies where when they came in on day one, I said, "I'm only going to be involved if you accept that statistical significance is not your goal." So we do a lot of studies where we gather data and it's like, "Well, maybe we'll get lucky and find something statistical significant, or we accept that." And then when it doesn't happen, then people start back peddling and figuring out what to do next.

Aaron Carroll:

Dr. Gelman emphasized how we must get beyond the push a button attitude with our statistics. He's also a proponent of division of labor. Some people are really good at designing studies and collecting data while others are good at analyzing data appropriately, constructing a good research team to really hit each area with the best talent results in better studies. Here's a little more on stats from Dr. Goodman.

Steve Goodman:

I will say that I proposed and I think other people have on the pages of nature about a year ago, that scientists should put at the end of papers the degree of confidence they have in their claim. Just say it, we're 75% confident, 90%. The fact is there's not a single statistic that we calculate that is that number, and yet we think that we are producing that number with some of our statistics. And what's interesting is often that number will deviate strongly with sensible scientists from any P value they have generated. What we do is we encode our confidence in language like this is suggestive or more studies need to be done, or an RCT needs to confirm, or we have all this sort of sociological conventions about how we express uncertainty, but we don't often recognize that's what we're doing. The biggest problem with P values and the whole system of statistics is that they've robbed us of our ability to talk about uncertainty in any quantitative way.

Aaron Carroll:

Would you change to more of a Bayesian outlook or is that just like too long of a conversation?

Steve Goodman:

I think we need to unfold the onion layer by layer. The first step is focusing more on the confidence intervals, but really be honest about that. That's actually hard. It's super hard. So if we were totally honest about just confidence intervals, which by the way are no magic potion, they reflect many of the problems with P values, but at least they represent uncertainty, we would not be able to look at a significant result and say, "Oh, we have high confidence. This makes a difference." So just the proper and honest use of uncertainty in showing that many of our experiments, neither the significant experiments don't rule out trivial effects and the so-called negative experiments don't rule out dramatic or important effects. So that's the first layer of the onion.

Steve Goodman:

Then there are many more layers which could get us very quickly into Bayesianism, which gets to how confident are you about the truth? None of our current statistics, unless you go to Bayes, get close to that. And then second of all, what do we do with that uncertainty? What claims do we want to make now that we acknowledge how uncertain we are? So I don't see the problem as just frequencies versus Bayes, in many cases as you know very well, the results are not so different. A Baye is credible. What we call a credible interval is the same thing as a confidence interval. So what's going on there? Why should we care? It's that we don't know how to deal with uncertainty in any meaningful way. And that is the fundamental problem.

Tiffany Doherty:

So we've got to find a way to address this, but if we want to see that done along with the other changes we've discussed, we need to cultivate an environment that incentivizes it. It's a lot to ask researchers to change their behaviors if the environment they're in won't reward that change, especially when the rewarding question is literally their job security. So here's the big question of episode. What can we do and or what are we doing at the level of the university to facilitate a better scientific culture as we've defined it in this series? Let's kick things off by returning to Aaron's conversation with Dr. Nosek.

Aaron Carroll:

It's interesting, because I've often found too. It's like I find that what I wind up doing, and I think some junior faculty do, but it's almost you see it as a game. There's what I have to do to achieve promotion and tenure. And then there's what I actually do that makes a difference in the world. And if you're lucky, those Venn diagrams overlap a lot, but they often do not. The stuff that I know matters is not the stuff that the university loves. And trying to bring those together would be great, but it is slow going.

Brian Nosek:

Yeah. It is slow going. I think everybody is aligned on the ideal and it's really about implementation. And so what I hope that all these debates about reproducibility and concerns about the credibility of our discipline and recognition of the dysfunctional culture incentives, what it will inspire is a lot of experimentation. We can't presume to have all the way the exact right ways to do this from the outset, but what we need are progressive institutions that are willing to try stuff.

Aaron Carroll:

Here's Dr. Vazire.

Simine Vazire:

I don't even know how to get a foothold in changing what universities value. I've agitated a bit for things like signing the DORA declaration on research assessment.

Tiffany Doherty:

Just jumping in here to explain DORA, this is a declaration developed in 2012, that aims to advance practical and robust approaches to research assessment. You can read more about it@sfdora.org.

Simine Vazire:

In the end, every faculty meeting, search committee I'm on, there's some point where the discussion turns to metrics that are pretty meaningless and where we're just rewarding the wrong things. And my

feeling there is, if we can get the journals to value the right things and or people to value the journals who value the right things. So if we change which journals have the most prestige from citation and back to something like the ones that have the highest quality standards or something like that, that would be crazy. But then maybe even if search committees and faculty groups and whatever, keep doing the same thing and using these stupid heuristics, at least if we can make the heuristics slightly less bad, then we don't really need to change that as much. But it could just be my lack of expertise and experience with how administration works.

Simine Vazire:

I just don't know. I feel hopeless about getting them to value the right things. I don't even know what that would look like to be honest, because you can't expect people to read every paper. And even if I tried to read a paper by my colleagues in a different subfield, it would be hard for me to evaluate it. So there's some sense in which I have to rely on some heuristics. There are better and worse heuristics, but it is, I think in many of those situations where outsourcing our evaluation to the journals or to the funding agencies. So if we can get the journals or the funding agencies to either do better or to have their reputation track better how good or bad of a job they're doing, then those kind of university based problems might resolve themselves or at least be a little better.

Tiffany Doherty:

And circling back to the conversation with Dr. Nosek here, where he and Aaron hit on this exact point, doing the work with funders and publishers to make change happen. But what can we do if anything, within Academia?

Aaron Carroll:

So it seems like a lot of your focus has been on journals and some on funders, but how do we change the academic environment? How do we make it so that people can get credit, promotion, tenure, all the things that matter to academics for doing this careful collaborative, transparent work?

Brian Nosek:

Yeah. And it is the ultimate problem, because if you don't change the incentives there, doesn't really matter what happens elsewhere in the system. If I need lots of publications and in the most prestigious outlets to get the job and to get tenure, then that's what I'm going to do. The other part that makes this a particularly difficult problem is that it is so decentralized. All of science is decentralized, right. The individual funders make their own decisions, individual journals make their own decisions, individual institutions also make their own decisions. And changing the culture within an institution is super hard because the ultimate anchor that we need to shift there is the hiring committee and the promotion committee. Hiring committees and promotion committees, particularly in the US tend to be ad hoc. They're created a new each time there someone to hire or someone to promote.

Brian Nosek:

So having policies that are effectively implemented requires a policy landscape where it actually influences each ad hoc committee as it's created. It's a lot easier to deal with a standing committee and all of those things for implementing good policy, right. So that already is a problem. The second problem is that each of those committees is within a department, a single discipline that has its own norms and standards. And the university has a super structure that tries to span across all of these different disciplinary communities with all of their own different challenges. And are they a book based discipline?

Are they a journal based discipline? Do they embrace qualitative research versus quantitative research? There's just so many different factors for institution to think about how do we set up the right norms and incentives for a reward system?

Aaron Carroll:

As it turns out our experts had a lot of suggestions. And a recurring pain point centered on bibliometrics. As we've discussed, our reliance on bibliometrics is a major issue in promoting poor scientific practices. And the idea of actually reading people's papers for hiring and promotion was strongly supported among our experts, though, Dr. Vazire has a point that we can't read all of them, but perhaps we can device system where the scientist is required to submit their best paper or maybe their three best papers. And that's it. Here's Dr. Paula Stephan for more on all of this.

Paula Stephan:

I think universities, if they really want to change have really got to downplay the role bibliometrics plays in promotion and in selecting Canada. And I think that really requires a commitment to different selection processes. And I think that's only going to come from the top and really come from a strong provost or a strong president saying, "I don't want to hear about the citation counts." Of course, my biggest concern is that people don't read articles, that they just look at where they're published. And I think that's very true of search committees. So I've been a big advocate all along that people shouldn't be able to list all of their papers, but only list their top papers and that, that changes the incentives.

Tiffany Doherty:

Encouragingly, some universities are instituting practices like this. Here's what we learned from Dr. Goodman.

Steve Goodman:

One of the things that Stanford does is in the letter that supports promotion, you are not actually supposed to cite any bibliometric facts. You're not supposed to say how many first authors, which journals, nothing. In fact, I know about this because I wrote one of those. It's so automatic that how else do you evaluate somebody? And they turned it back. And what they want is an in-depth exploration of one paper.

Tiffany Doherty:

Dr. Nosek brought up this exact example of Dr. Goodman's experience.

Brian Nosek:

He said that he got a tenure letter that he needed to write. And he wrote, they sent him a paper and they said in the instructions, "Please read this paper and comment on it." And he did a little bit of that, but he also put the standard stuff, right. Here's the H index and stuff, because that's what it's expected. And the committee sent it back to him and said, "Get that stuff out of there. We can read his CV. What we want you to do is really write it up this paper." That's awesome, right. It's so great that they're doing that and-

Aaron Carroll:

That'd be so good. Yeah. That is not what my experience has been when I write these letter.

Brian Nosek:

Exactly, nor mine. And I often will put a PS complaining about what they put in their ask is misaligned with what I think they should be asking. A very simple intervention that would've totally changed my mindset of what it means to succeed at university of Virginia would've been, when I walk in the door, they say, "You're going to go out for promotion a few years and what's going to happen is you're going to submit three papers. You can even email them, but you're going to submit three papers for the committee to read and review and to understand the quality, the approach that you take to doing your work." And if I had that in mind, I would've said, "Wow, I need three bang up papers." And of course I would've done more work because who knows which ones are going to work out, which aren't, but I would've been focused on quality, not on volume.

Aaron Carroll:

Dr. Heathers mentioned that this kind of practice might be creeping into grant applications as well.

James Heathers:

There's some grant conditions now that say, "You are only allowed to in your bio sketch site, maybe three or five of your individual papers that directly relate to this topic." So you can't dump your entire CV on us. Captain fancy's enormous CV with pages one through 37. You can't do that. You're allowed to say, "Here are the relevant references." And that's all that you're going to be judged on in the immediate sense. And if they were all from the mid '90s or something, they probably go, "Well, you really haven't done anything contemporary in this area for a while. So maybe we'll go with the younger researcher who just did all the relevant work."

Aaron Carroll:

We also discussed some potential changes at Harvard when we spoke to Dr. Flier as well as further recommendations he made in the nature article published a few years ago.

Jeff Flier:

My point of that article was that we should take as institutions more responsibility for assessing reproducibility and how to do that. Well, I made several recommendations one of which has partly been taken up by my successor, I think. And that is, we had a form letter that I used to be, have my signature put on the bottom of all these, when we requested people to comment. And it would say, has the person done important work? Has it changed the field? How highly are they regarded in all of this? But it never explicitly said, "Are there controversies about the work? Which doesn't apply that the work is bad or wrong, but we want to know if you think there are controversies. Because I have heard so many times people will come over to me, the water cooler or so to speak and say, "So and so got promoted and, but no one believes their work." But it's rare that you see that in a letter because people are afraid that the letter will get out and whatever.

Jeff Flier:

So I think now we have a line that's been put in there and the key thing will be, does it lead to any change in behavior specifically requesting that people comment on controversy? Okay. The second thing that I proposed and this one I view is even more important. So we have a form of a CV that a faculty puts together when they're up for promotion at any level. So it has the usual things. However, I would like to

add another section and that says, "I would like you here to display your critical analysis of the field in which you work, including your own observations, what are the potential weaknesses of the things that you have done? How have you learned about these through your own intuition and further thinking through things you've heard and read of other people working in the area and how do you think that might influence it's your further work?" To me, this is the essence of critical thinking.

Jeff Flier:

To question your own work and not just sell it. And the idea would be that your department chair won't move it on unless they see that you're doing that. Now you could still fake that if you want to, but I think you would be bringing this to the minds of the faculty that they really care in our administration how we think about these things. It's not just a sales job. So that's very much related to the culture of the academy and how it relates to research. I think one other way that is not likely to happen in the near future is for a greater fraction of the people who are hired as faculty in medical schools, let's say to not make them so subject right from the beginning to get your grant or you're done. But to give them a little bit of a substantial runway, not however to be judging it by, will you get three grants in a lab of 20 people? I think those days they're not gone, but that's the model we have to do away with.

Aaron Carroll:

So it looks like universities are willing to try new things, but just like we mentioned in our last episode, when talking about changes funders could make, evidence will be crucial to lasting change. That means we need to evaluate the changes being made and then widely share the outcomes good or bad to promote evidence based progress within the academy. One of our experts, Dr. Mike Doherty also brought up something happening on a larger scale.

Mike Dougherty:

Let me just give you one example of this. The Massachusetts Institute for Technology, MIT, recently underwent a process in which they started evaluating or making recommendations for instituting an open access policy campus wide. They formed a working group that ultimately led to a set of recommendations that they want then departments to start formulating policies around to ensure maximal access to all the work that MIT researchers produced. That particular initiative is actually what led to this initiative at the national academies on aligning incentives with open science practices.

Tiffany Doherty:

This is officially called the round table on aligning incentives for open science. It is composed of six working groups focused on understanding what actions can be taken by agencies, funders, and higher ed institutions to realign reward structures in order to promote open science. It is a three year process being done in collaboration with the open research funders group, its first convening was in February of 2019.

Aaron Carroll:

And here we'd like to introduce a unique suggestion from Dr. Goodman about changing what we base institutional reputations on.

Steve Goodman:

Imagine if an institutional reputation for research was not based on its best research. Now this is flipping it around, but the quality of its weakest research. And what is the weakest research? By definition, it's the research that never gets published. If you have a certain percentage of your research that ends up never published, which is equivalent to taking data and throwing it in the garbage can, that should be a serious mark against the institution. Because when somebody says this is a Stanford study, this is a Columbia study, this is an Indiana study, you want that to mean something. You want people to trust that if they are in a study from this major institution, that, that is a contribution to the body of knowledge.

Tiffany Doherty:

And here are some other steps suggested by our experts.

Paula Stephan:

If I could redesign research, of course, I'd probably get rid of soft money positions. I think soft money positions have been terribly detrimental to the system.

Aaron Carroll:

You're right, because I've been at a soft money position my whole life and my... Hesitate to say this. My job is to get grants. My job is not to do good science.

Paula Stephan:

Well, Stephen [Greco's 00:22:20] great quote, it's funding or famine if you're on a soft money position.

Aaron Carroll:

Changing salaries in their conditions could be helpful across the board. Here's Dr. Yewdell.

Jon Yewdell:

One of the problems is the incentives for deans and deans are people like the rest of us and many of them were good scientists, but their incentives then are to make things bigger basically. So all that could be changed, not immediately, but over a couple of decades, for sure. The Dean salaries are completely out of whack and as are the president salaries. And again, the universities are microcosms of society, right. And the rich have gotten richer in every hierarchy basically. And that can change. And that's going to have to be a generational thing where the younger generation just insists on this.

Tiffany Doherty:

So here, we're going to start pulling on this thread of generational change because it came up in a lot of our interviews.

Steve Goodman:

It occurs slowly because it takes almost generational transfers. You need these young scientists who are trained in this way. And I will say that the people who are most excited to about this kind of work are the young scientists. As these younger generation rise to the top, you will see these values rise to the top. Right now, it's not that many people at the top, but many more than there was 10 years ago.

Tiffany Doherty:

We've talked about this, how it's the early career researchers most likely to be pushing for change, but it isn't easy for them. They're still working their way into the system and fewer at a point just yet where they're in a position to make changes. And those above them are reluctant to do it because they've succeeded in this system, as it is. Our experts had a lot to say about this. Here's Christie Aschwanden.

Christie Aschwanden:

Well, it's hard, right. Because the people who are in power now, the people who've succeeded under this broken system, they think things are working fine, right. And they have no incentive to change things. And you have circumstances where people have used questionable research practices to build a whole career's worth of research that may not hold up. Yeah, that person doesn't want to say, "Okay, let's go back and change things. And oh, no, maybe this stuff that I built my career on isn't quite what I thought it was."

Christie Aschwanden:

So I don't want to say people have to die, but it is interesting to see that the movements that have been most robust and sort of effective in trying to create change tend to be led by younger and earlier career researchers who sort of take a survey of the field and say, "I don't like this. We need to change this system." It's harder once you're really entrenched and have reached a point in your career where you've succeeded through this system. I think there's just so much disincentive to change. And I think here, it's probably helpful to look at sort of other cultural changes. This really is a culture change we're talking about.

Tiffany Doherty:

And here's Aaron speaking with Ed Yong again.

Ed Yong:

Let me ask you a question as someone who's talked to a lot of people about this. Do you think it's a generational thing? Because I think it's a generational thing.

Aaron Carroll:

I do. And I think that's what if you ask me what gives me optimism is I feel that younger people are much more accepting of this than the older generation.

Ed Yong:

Yeah, me too. What is that plank quote, "Science progresses one funeral at a time."

Aaron Carroll:

Right. Absolutely. Yes.

Tiffany Doherty:

As you can see, several of our experts felt this way. Dr. Nicholson brought up that exact quote about funerals.

Josh Nicholson:

Yeah. And I think there's that famous saying, right, "Science advances one funeral at a time." And that's because the people that control the funding are the people that control science, right. And they're also the editors and staff as well. And so, it's really hard to say something I would say different in science and to go against kind of the prevailing wisdom. And I think that's reflective upon what we see in cite.

Tiffany Doherty:

Just a quick reminder here that cite is a platform for evaluating citations in scientific literature.

Josh Nicholson:

Contradicting cites are very rare. There's less than 1% of citations. And why is that? Because you don't necessarily want to openly you contradict this person's paper. Because maybe you're going to be asking, not asking for them directly, but maybe they're going to be a reviewer on your paper, a reviewer for your grants. And so what is your incentive to contradict this work beyond the fact that you're a scientist and you think this is wrong and you need to show this wrong?

Tiffany Doherty:

And while the funeral stuff might be a bit morbid, the point is that early career researchers are trying to make change and that's encouraging. Here's more on that from Dr. Maggio.

Lauren Maggio:

My hope is it's getting better. And part of the reason why I say that has to do with some of the work that I've done with Bullied Into Bad Science, which is working with early career researchers that have become very aware of some of these issues and they're really fighting for transparency.

Aaron Carroll:

Can you talk a bit more about Bullied Into Bad Science ?

Lauren Maggio:

Bullied Into Bad Science is a campaign that was started in 2016. It was started in the UK at Cambridge, by Karina Logan and Loran Gato. It was in response to a deal that Cambridge had made with a very large publisher that really kind of ticked off the postdoc community. They really felt it wasn't a fair deal that wasn't transparent and it wasn't ethical. So they set up kind of a letter writing campaign and they pulled together a through their network a large group of early career researchers to sign this letter and make a pledge to act in a more transparent way. They also reached out to faculty members across the world to bring in folks that would be willing to support early career researchers in this type of transparency and movement towards open access.

Tiffany Doherty:

We had originally planned to interview the founders of this campaign, but then the pandemic happened and international interviews were off the table for us. However, we encourage you to check out their work @bulliedintobadscience.org. And now we want to take a turn in the conversation and examine how some research operates outside of Academia and how different goals and incentives relate to research outcomes to get an idea of this and how it compares to Academia. We talk to Dr. Paul Decker, president and CEO of Mathematica.

Aaron Carroll:

Can you tell us a little bit about Mathematica?

Paul Decker:

Mathematica is an organization that's focused on research and analytics primarily in the public policy world. And we really became known for staying close to that origin, which was conducting rigorous policy research that was reliable in terms of standing up to criticism because it was using rigorous methods and relatively straightforward methods that most anybody could understand. That's the mission of Mathematica, is really to enhance public wellbeing through the application of our analytical expertise.

Aaron Carroll:

How do you feel like you differ from academics that are doing similar types of research?

Paul Decker:

In the academic world there's probably a better chance of establishing a reputation as an individual researcher early in your career. That is you can get visibility specifically for you as an individual researcher.

Tiffany Doherty:

So there's much less of a personal fame component if you will, than is often seen in Academia. And that can certainly function as an incentive that isn't aligned with the best research practices.

Aaron Carroll:

Do you think that the way that you do work leads to better work? What are the differences?

Paul Decker:

I think it can lead to better work. I think that the nature of our work, that there's a client on the other side that wants to see the findings is important because they're constantly prodding to make sure they have findings that are reliable before they go off to Congress and say, "Here's what we know about this policy question." So we're very conscious of that in doing our work and are making sure mistakes don't creep into the work because of that. The other thing is we're often working on policy issues that are getting a lot of attention.

Paul Decker:

So we're conscious that folks are going to want to reexamine our findings down the road after they've been released. And we're generally producing public use data sets to help other people replicate those findings once the studies is complete. So again, we're very conscious of gee. If somebody comes along later with the same data set and finds out we've made a mistake, that's a disaster for us. That's a disaster for Mathematica and it's a disaster for our clients too, because they've been out there telling Congress or program managers, here's what the finding tell us and they were wrong basically.

Tiffany Doherty:

So there are clear and serious repercussions for sloppy work, which is a clear incentive for conducting rigorous work. And we don't necessarily see those kind of repercussions in the academic world.

Paul Decker:

I think in the academic world as you know, things are changing with the replicability crisis, etc. So there's more attention to replicability and people being more conscious that if I make a mistake in a publication, somebody will reveal it down the road. And so the accomplishment of a publication maybe short lived if it's found that somebody's made a mistake to generate that publication. But it's a different set of pressures. And different set of pressure is particularly with tenure decisions and the focus on tenure decisions that has a clock ticking in the background.

Aaron Carroll:

What do you think that the incentives are on the academic world that aren't as much in play at Mathematica?

Paul Decker:

Well, first we don't have a publishing or parish atmosphere. We want to bring people into the organization, mentor them, get them skilled up to conduct policy research as quickly in a way that's as supported as possible as opposed to kind of the pre-tenure period for an Academia seems almost like an apprenticeship in the sense that somebody gets down to the end and the decision goes against them they have to go find another place to stay employed. We don't have that here. And so there's an investment that's going on from day one for the mentoring that we provide. So that helps people get kind of fit up to do the work as effectively as possible. I think that in relation to wanting to influence the policy world and influence our clients as well, there's also a focus on transparent methods.

Paul Decker:

In the academic world at least when I was more involved in it, there was a more of a premium on complex methods. And when I got to Mathematica and when lots of folks get to Mathematica, they would look at some of our random assignment designs, straightforward study designs and say, "Gee, why so simple?" And the reason was because it met the needs for rigor, but it was also easier to defend in terms of being able to justify the findings at the back end of the study. Another thing that has been important for us as an organization is our total focus on objectivity. Everything in our projects, when we organize around projects is organized around the idea that we're generating an objective answer to the question that's been posed by our clients. So in addition to respond, needing to respond to the needs of our clients, we need to respond in a way that's objective so that it can be defended down the road.

Aaron Carroll:

Do you think there a difference in how people view no results at Mathematic versus Academia?

Paul Decker:

I think there probably is. And I think there are a couple of reasons for that. One is, we have to be responsive to our clients in a given contract. And so our clients have already kind of determined the framing. In some sense, they need an answer to a question, whether the answer to the question is a null result or some other kind of result. And so, it's not the case that they're less interested in a null result. In fact, they're interested in the truth. And so since a null result's part of the truth, they're intensely

interested in it. We have to deliver it as part of the obligations of our contract. So that's a relatively straightforward, mechanical reason why it might be different. It doesn't have to pass a publication test. So there's no issue about, well, a set of referees might not be interested in an a null result.

Tiffany Doherty:

So in this model of research, without the ultimate goal of publishing in an environment where null results aren't publishable, finding the answer itself becomes important, which is the overarching goal of good science, right?

Aaron Carroll:

So if you could change things in Academia that would make it more likely that we'd have consistent, reliable, reproducible research, what would you focus on?

Paul Decker:

I would focus on the quality of the analysis. I think people do focus on the quality of analysis now, but I know oftentimes there's a focus on is this finding interesting enough or important enough to be published in whatever the journal of question is? And I know people have proposed ways in which this could be done that are based on, "Hey, let's focus on whether research design passes muster before we see the results. And then if we get a null result, we're obligated based on our approval of the preliminary design to publish it". I think that's an interesting idea. And to some extent, we use that in our work. So I like the appeal of it. I don't know how doable that is in an academic publication setting, but I can say in our world, most any project where there's controversy or expected controversy around the results, we've got a technical work group.

Paul Decker:

And a technical work group represents different stakeholders, different part of the political spectrum, and they sign off on the original design. So the idea is they're being asked to pass judgment on the original design before they ever see the results. And so when it comes down to the end and the results come out, they've kind of already committed themselves because they've accepted the design in the first place. And they've been able to see the results over time and understand how they formulate to the findings. But it's hard to do in a world where referees are volunteers and there's no mentoring of referees or largely no mentoring of referees. And there's no handbook to tell you how to do it. They're the principles.

Aaron Carroll:

So in essence, this is like the practice of registered reports, which seems to be working quite well on in this context. And a quick side note here on how our referees are volunteers. This is a big issue that has inspired lots of academic conversation over the years. Dr. Heathers has recently started a movement over journals paying reviewers for the skilled labor they provide. You can check it out on Twitter under the handle 450Movement, where you can see the conversations on pros and cons of a payment system for reviewers.

Tiffany Doherty:

Okay, we've covered the problems and we've covered some suggestions for how to help fix them. Now we want to address the idea that it will be hard because it is, and it will continue to be, but we can do it.

And we want to stress the idea that we've already come a long way. Persistence and rational thinking two qualities that scientists very often possess have brought us to where we are now, to conversations like this and will undoubtedly get us to better places. Let's move back to our conversation with Dr. Vazire for more on this.

Simine Vazire:

There were completely independent little pods of people making a big fuss about this and non of us were particularly high status or had a lot of power, but we were like a dog with a bone. There were like, I don't know, maybe a dozen or something pods of people who didn't know each other before, who were each independently in their own departments and in their own corners of social media shouting that this is a really big deal and were not going away. And if it had been even just half as many people, and I think there had been periods in the past, in history when people were shouting exactly the same things and got ignored.

Simine Vazire:

So somehow we had a critical mass and we were relentless enough and we had social media. And I think all of those factors helped. And the specific people that were shouting these things also, if you look at like Brian Nosek's personality, or even some of the people that get a bad reputation for being jerks or bullies or whatever, actually are very reasonable column people if you look at what they actually write and say. Not all of them, but the vast majority of them. And I think it took people with a certain kind of personality and I would say that as a personality psychologist.

Tiffany Doherty:

And if you're still feeling pessimistic, you're not alone.

Aaron Carroll:

Do you feel optimistic, things are getting better?

Simine Vazire:

No, not particularly.

Aaron Carroll:

Okay. Well then, we're on the same page.

Simine Vazire:

Yeah. I think that it's not going to get better until there's a much more incentive to do the reviewing and criticizing and so on. We needed somebody with money to come in and say, "This is so important that this person should be just as rewarded and paid and everything else as the authors who this person is criticizing and correcting." It seems like universities would be the perfect place to do that. It's not like a for-profit company where they need everyone to be working on product development or what, I don't know if that's how for-profit company. Uber had me come and talk to them. One of the questions they asked me is what would you do if you had the resources that Uber has?

Simine Vazire:

And I was like, "I would hire a lot of red team people. I would just have half of as many researchers as they are developing new things. I would have researchers trying to poke holes in that." And then I thought, why don't universities? Why isn't there for every department, the counter department that is the critics of the department. But I think science would actually progress faster that way. It seems like a waste of resources. And I've argued with people who think that any money that NSF spends on replication or verification is a waste of money, because it's not spent on discovery.

Simine Vazire:

And I'm like, "But the pace of discovery will be faster, don't you understand?" That is the fundamental assumption of people who are against reform is that it's more the vast majority of the discoveries are true, or if they're not, they'll get filtered out very quickly in the existing system without the need for funding or replications or anything like that. I don't know how magically, and I think a lot of this human ego. I think even if there weren't money at SIG, there would be at least egos and rivalries and the drive to be first. And I think the more power you have, the more you're faced with this responsibility to do the right thing. But I do think it's sad, but true that I think it's hard to do the right thing. But I think a lot of the time we know what the right thing would be.

Tiffany Doherty:

It is very hard to do the right thing, especially when there's a lot at stake, but not everyone feels pessimistic. Here's a bit of a pep talk from Dr. Goodman.

Steve Goodman:

We do make progress slowly over time as a research community. And if you look at the way journal articles were written 20 years ago and 40 years ago, they are indeed different than they are today. So I think we're seeing that same sort of generational shift finally happening now and manifest in structures. And we're just at the beginning of building those structures at the institutional level. I think there's been lots of awareness among leaders about what this problem might be and what the sources are. But they've also begun to realize that this is not solved at the top down level. This has to be something that is solved simultaneously within the small communities of science. And by changing the big picture incentives, they both have to change it once. The metaphor I sometimes use is that all the players are connected by rubber bands.

Steve Goodman:

The latitude of each community and each person is greatly restricted by the promotion incentives, by funding, by journal standards. It's connected to each one of those. And you can only go so far, but as each one of those move, then everybody else has a little bit more latitude to move. So that's, what's happening now. Mixing my metaphors. It's a very large boat that is turning. Now, when you actually talk to scientists, there's not a single one who doesn't say it's important. They don't always know exactly what needs to be done, but they recognize that it's important in their field and they want to solve it. And as long as it's collectively done, it can be done.

Tiffany Doherty:

And we must realize that one person or one small group of people can't take on the burden for all of us.

Steve Goodman:

This is the other problem. It's a tragedy of the commons. If one person takes on the burden, then sometimes they're put at a disadvantage. But if everybody is following these practices, then all boats rise on the water of better practices. But better practices are often, they come with a little bit of overhead. And if the guy in the next lab doesn't have to incur that overhead, you're in competition with them. You might not do it.

Aaron Carroll:

We came across another optimist in Dr. Rowhani-Farid, who offered us a great pep talk as well. How do we fix this?

Anisa Rowhani-Farid:

How do we fix this?

Aaron Carroll:

I'm asking you, because you're the closest to an idealist I've come to yet. So how do we fix this? What are we going to do?

Anisa Rowhani-Farid:

Well, continue step by step. I think small steps taken for a long distance, small steps taken consistently end up in a long distance traveled. I think just slow movement, just more evidence based policy, more trials that can kind of test incentives that might motivate researchers to share more editorials, more podcasts, more conversations, more consciousness raising. Why is it that I am working so hard to prove that data sharing rates alone actually, because it's going to contribute to some type of a change. Every step is important. We believe that there is a better way out there. I can see that data sharing rates slowly increasing. I can see that now more and more journals are thinking about open data, are updating their policies. It's going to be a slow, gradual change.

Anisa Rowhani-Farid:

I don't think it's going to happen overnight. There's this beautiful cartoon in nature. I think it was in 2015 where they kind of depicted the scientific enterprise and they had all these pillars. And each pillar was like funders, university, institutions, government. And all of these pillars were crumbling and then the foundation of that entire enterprise was absolutely shattered. And it was data. The foundation of health and medical research and research and science is data. And if that's crumbling, then how are we going to reestablish our scientific enterprise? It's all of these pillars are important. It's not just me as an individual researcher thinking if I share my data, then it's going to change. It's not going to happen that way. Universities need to come on board and change their policies and train researchers and young scientists who are passionate about open data and who believe in it.

Anisa Rowhani-Farid:

Funders need to change their mandates and actually fund data that is shareable, right. So even funders need to change their policies. Academics need to change their cultural environment. Journals need to change their system of operation. And I can see glimpses of many movements, the open science framework movements. So Brian Nosek's team, the guidelines that they're promoting, the TOP guidelines, numerous policies, even at the level of now drug companies at GlaxoSmithKline have their own platform for clinical trial data sharing. That wasn't there so many years ago, right. So if we actually

have a historical perspective, we can see that we've come very far as a worldwide community, but if we just press on and contribute to this movement, we will begin to see more and more change in our society.

Tiffany Doherty:

And for good measure, here's more optimism from a handful of our other interviews.

Christie Aschwanden:

Yeah, I do think it's solvable. It will take a lot of will, but I think that we are seeing some steps in the right direction. For instance, now we have an environment where clinical trials are all pre registered, right. And that's a change that's happened and it's changed sort of the kinds of results that people are getting. There are now journals that we'll do that will publish registered reports. And there are funders now that are asking some hard questions who are making requirements of things like, okay, if we fund you have to make your data open. You need to pre-register your studies, things like that. So it is possible, but you're right, it takes a lot of collective will and collective action.

Mike Dougherty:

There's been a lot of progress I made I think in the last eight to 10 years, just to recognize, to bring this issue to the forefront.

Ed Yong:

From the perspective of someone who's been covering this since I think 2011, I do see changes. More journals are embracing the preregistration idea. More journalists are writing about reproducibility and are writing about cases of misconduct, are taking it as part of their jobs to write about studies that contradict previously established work, even big name journals. I've now seen several papers in nature of all places that contradict previously published nature papers. I don't think that would've happened 10 years ago, and yet it's starting to happen.

Ed Yong:

There is work going on at major agencies like the NIH, looking into publication ethics and reproducibility issues. My somewhat naive hope is that if enough people do enough things, then collectively we'll reach a tipping point where the norms start to shift. And I think it's got to come from both top down and bottom up directions. We've talked a lot about incentives, right. So the whole structures need to change to allow people to do the best work. We also need people to just make a start, anyway. The very fact that you are running an entire series on reproducibility, it says something about this sort of changing zeitgeist.

Mike Dougherty:

Maybe this is the optimistic side of me that's shining through here, that I really think the time is different now than it was before. And there are a number of reasons for this. I think we now recognize that people who are positions like mine, people who have gone through this process and are now reflecting on how they got here and looking at their colleagues, right, and they're thinking, I don't want them to have the same experience that I had. But at the same time, I think there's this growing recognition that this is a problem. I don't think people saw this as such an issue 10 years ago. I think there is some change. And there's also been this greater push for open science. And I think that, and the people who have been

leading that charge have really brought all these issues into focus in a way that they weren't in focus five or six years ago.

Tiffany Doherty:

We'll need to approach this as a community, supporting those people leaving the charge. And as Dr. Maggio suggests, we'll need to implement education about it in our training programs.

Lauren Maggio:

We came up this from a perspective of education. So all of us run graduate programs in health professions education. So we've started to think about how do we begin to bake this into our graduate programs? How do we start having conversations with our learners? I think education is one step. We've also started to have conversations at large with the community. I don't think this is necessarily going to come from one place, I think we have to embrace it as a community. We have also started talking to our journals to see if there's, what is the role with a journal in this space? I think it's really multifactorial. It's not going to change necessarily quickly, but we've tried to come at it in many different ways and utilize the different levers that we have, whether it's our roles on editorial boards, it's our roles in running graduate programs, it's our roles on promotion and tenure committees to try to exact some change.

Aaron Carroll:

Is this just that we're going to nibble at this, but it's going to be a problem for decades to come, or do you think we're at a turning point or really making a difference? Are we making science better or is this a lost cause?

Lauren Maggio:

I haven't been in science as long as you have, but it feels like it has starting to get better. I feel like there are pockets of people, there are conferences, there are funders that are starting to pay attention to this. I still think we have a really long way to go. And I don't know that we know exactly what we want it to look like. If we were to get to the blue sky future, I don't know we have that vision yet. And I think a lot of really talented, brilliant creative people are working on that. I think we got a ways to go.

Tiffany Doherty:

And we have to do it. As scientist, [inaudible 00:50:36] J. Burke, put it back in 1954, experimental scientists must have for their data a permanent respect that transcends their passing interest and the stories they make up about their data. It matters a lot that scientists do this right. If I may quote from the book, *The Misinformation Age* by Cailin O'Connor and James Owen Weatherall, which we mentioned in a previous episode, the views of scientists on views of public interest, from questions concerning the environment to the safety and efficacy of drugs and other pharmaceuticals, do the risks associated with new technology have a special status, not because of the authority of the people who hold them, but because the views themselves are informed by the best evidence we have? So yes, it's a long road with a lot of problems to solve, but let's end on this note from Dr. Lazebnik. We are scientists, we solve problems for a living.

Yuri Lazebnik:

I'm not that kind of pessimistic. I think you don't need to burn universities to save them. You can change the culture. It's the question is to find out how, but this is what scientists are good at.

Aaron Carroll:

So that's it for a series on science, culture and reproducibility. We want to thank the National Institutes of Health for funding this podcast, which we hope will be a major step in bringing us forward on this path to improving the culture of science and the work that we produce as scientists. And we want to thank our many guests who spent countless hours talking to us. We really appreciate them contributing their time and expertise. And thank you listeners for tuning in. We hope it's helped you learn something about the culture of science and how that might impact reproducibility.

Aaron Carroll:

We also hope it's inspired you to help enact change, or maybe inspired you to keep going if you are already trying to push back against some of the current norms. And if it has, we hope you'll share this podcast widely. Thanks for listening to this special episode of the Healthcare Triage podcast, part of an eight episode series on science, culture and reproducibility edited and produced by Stan Muller and Mark Olson. We would like to thank the National Institutes of Health for funding this series, and a special thanks to our guests for lending their time and expertise. If you're interested in incorporating this series into your undergraduate or graduate courses, please visit www.healthcetriage.info/reproducibility-podcast, where you'll find free lesson guides to accompany each episode.