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## **#347: Disciples of the interdisciplinary: Researchers crossing boundaries to unleash creativity**

VOICEOVER

This is Up Close, the research talk show from the University of Melbourne, Australia.

ANDI HORVATH

I'm Dr Andi Horvath. Thanks for joining us. Today, we bring you Up Close to where science and art collide, where unexpected new innovations can arise. I'm talking about the interdisciplinary space where the traditional research disciplines cross-fertilise to be a source of synergy, creativity and new knowledge.

Walk across the campus of any older university and you'll see the names of traditional academic domains on the buildings such as natural philosophy, an old term for physics. But if you check the campus websites, you'll see entirely new disciplines.

Perhaps the traditional academic departments and disciplines were useful ways of dividing up views of nature and culture at the time when they were established, yet the disciplines also seem quite arbitrary demarcations, as there isn't a professor today that doesn't encounter or draw on interdisciplinary approaches to their research. While specific domain expertise still confers legitimacy and authority, it's pretty much impossible not to be interdisciplinary.

Joining us to explore the issues around the rise of interdisciplinary scientific research and the insights that can leverage creativity and innovation is Dr Daniel Glaser. He's a neuroscientist, director of the Science Gallery at London's King's College and a disciple of the interdisciplinary. He's in Melbourne as a guest of the Carlton Connect Initiative.

Daniel, let's explore the very notion of a discipline. What is the history of disciplines and in some ways can you describe the anatomy of a discipline? Tell us something

about their defining features.

DANIEL GLASER

Over time, disciplines have shifted. In fact if you look at the history of science, the structure of science, the names have changed, the designations have changed. If you look, for example, at the time of Copernicus, the fifteenth, sixteenth century in Europe, there were arguments ostensibly about whether the sun goes around the earth or whether the earth goes around the sun. But actually what those arguments were about was who was allowed to say whether the earth goes around the sun or the sun goes around the earth.

For mathematicians, people who compiled tide tables and helped you to navigate across the seas to have a model that had the sun at the centre and the earth going around was fine if the numbers came out better, as long as the natural philosophers or physicists who defined what reality was, could continue to assert that the earth was at the centre of the universe. There was no contradiction as long as the different disciplines were kept apart.

ANDI HORVATH

What did the ancient Greeks say about the universe? How long was that held for, their knowledge that they contributed to society?

DANIEL GLASER

Look, clearly there were as many different ancient Greek opinions as there are ancient Greeks or were ancient Greeks, but the great authorities as one might say Aristotle and Plato, held sway for many centuries in the Western tradition certainly. In fact, if you look at the word probable, which now means likely in some mathematical probabilistic sense, probable in the fifteenth, sixteenth century just meant some dead Greek said so.

So in a sense, the rise of modern thought, the way we got beyond this kind of Renaissance-accretive additional margin notes around the edges of the set texts of the Greek masters, the way we got around that was allowing the notion that experiment and observation could lead us to truth rather than just translating ancient thought.

ANDI HORVATH

Daniel, you talk about the boundaries of disciplines, can you explain what you call

your fractal theory of disciplinary boundaries?

DANIEL GLASER

Well, a fractal is a mathematical form and it has the following property. It's wiggly all the way down. So if you take the coastline of Australia, we're sitting in Melbourne right now, and you look at it at the scale of 1000 kilometres it will be wiggly, at a scale of 100 kilometres it's wiggly, at a scale of 10 kilometres it's wiggly, one kilometre is wiggly, a metre is wiggly, a centimetre is wiggly, a millimetre is wiggly, it's wiggly all the way down.

The same is true of interdisciplinary boundaries. So you might start with the boundary between art and science, but if you zoom in within science to let's say biology versus chemistry, within biology to neurobiology and other sorts, within neurobiology to systems neurobiology and molecular, within systems neurobiology you could do visual system neurobiology versus others. I was working on a particular bit of the visual system and we would have arguments in the pub as to whether what I was doing was the same or different to the person working in the lab next door.

Now, the mechanisms which define those boundaries are the same at all the scales. What are they? They're jargon. So you use specialist language to explain. You use terms that other people don't understand. You have exclusive conferences to which you only invite people who think like you. You publish in journals where you and your mates can make sure that people from other disciplines don't get to speak. The social mechanisms by which we control discourse, by which we control information, are the mechanisms that ensure the disciplinary boundaries at every scale.

ANDI HORVATH

So Daniel, does that mean there are no more Renaissance men or Renaissance women like the da Vincis and Bacons of our history?

DANIEL GLASER

Well, there is a sort of pointless question which you could ask, which is when was the last man alive who knew everything, right? So what does that mean? When was it that there was someone on the planet who could tell you absolutely everything about all human knowledge as it was commonly understood at that time? There probably were people in even the early part of the eighteenth century who understood that.

The professionalisation of disciplines, I mean you probably know this, and I'm sure your listeners do as well, but the word scientist was first used in the 1830s, the

1830s was the time the word scientist was invented. It was invented by William Whewell. I'm at the moment staying in Trinity College, Melbourne, on my visit here. I've studied at Trinity College, Cambridge, where William Whewell was master, and as part of the British Science Association or the British Association as it was known, he coined the term scientist to represent that professional domain.

By then, there were disciplines which people who were not experts could not be expected to know about, but in those days knowledge was circumscribed in such a way that an educated rounded individual could know everything.

ANDI HORVATH

So there is this evolving fragmentation of the disciplines, but yet there's this unwritten hierarchy of the disciplines that seem to pervade schools and university, that famous phrase by Ernest Rutherford about the supremacy of physics, saying that physics is the only real science and the rest is just stamp collecting. How true is that?

DANIEL GLASER

I must confess, Andi, to a degree of ambivalence about this whole question. So I've made it my stock-in-trade to allow non-experts to speak on every subject, to develop formats and situations where anyone's opinion is valid, and yet I do think there is a kind of hierarchy.

Let me give you an example of where I think this operates. I was at a drinks party and two parents came to chat with me. They were asking for advice on behalf of their 17 year old daughter who wasn't present, as parents do, and she was trying to decide what to do for her first degree. They said to me, Dan, she's thinking about doing maths or, and I said, stop, stop right there. If maths is one of the things she is considering, she should definitely do it, because nobody ever changes from psychology to maths or from English literature to maths or from even physics to maths. It's a one-way street.

So I started my first degree in maths and after two years got bored, didn't enjoy the socialising as much as I was hoping and switched to English. There's no way I could have done that in reverse. So I do think that the progression as it were from maths through theoretical physics, applied physics, into perhaps the harder bits of biology, I use that term advisedly, into psychology through to the philosophy of mind and out at the other end in media studies, is a reasonable approximation to at least the order in which you can assimilate stuff. I suppose what that really speaks to is the degree is to which the particular discipline is built in terms of knowledge in a sequential way.

With maths, unless you've done the foundations of algebra, you absolutely cannot make progress with higher algebra. You don't need to know all of literature to write or read a poem.

Can I tell a joke?

ANDI HORVATH

Yeah, sure.

DANIEL GLASER

I don't know if it's relevant, you could edit it if you want to. There's a joke that's told about the hierarchy of disciplines in fact that somebody is complaining about how expensive it is to make large applied physics experiments like the Large Hadron Collider and that it costs trillions of dollars to build these things. Someone says, well you should do mathematics, that's much cheaper. All you need is a pencil, a paper and a wastepaper basket. Someone says, well actually you could do theoretical physics, that's even cheaper. All you need is a pencil and paper.

ANDI HORVATH

[Laughs] Okay, so Dan, how does authority of a discipline reach a tipping point where their way of seeing the world changes school curriculum or establishes a journal? What is critical for that to tip over?

DANIEL GLASER

I think the way that authority changes over time is really interesting. If you've read your history of science, Thomas Kuhn, K-U-H-N, or Paul Feyerabend, and I'm not going to try and spell that, we understand that science doesn't proceed in the way that scientists think it does. Mostly the evidence is against the new theories and that they are believed to be right. They gain authority before the supplying evidence, the secondary evidence is available. There is a tendency for school curriculums to lag behind.

This may be a slight side note, but in the UK, among other places, we've been working very hard to think about continuing professional development for science teachers as being a thing which is important. If you take for example genomics, for most science teachers, the field had not really been invented by the time they were trained. So it's necessary if we're going to retain the relevance of science education that the teachers need to keep up with the latest findings. How do we decide what makes it into the curriculum? For me that's a question for educationalists. You need a convincing narrative. You need an explanatory line, but the question of what's ruled in and what's ruled out from formal education is a professional question.

Again, my older side, when I was studying maths at Cambridge, we had a course

called Algebra 1. At the beginning of Algebra 1, the teacher asked the class, this is undergraduates in mathematics at Cambridge, if any of us had done any algebra before. Of course we all said, yes. He said, well look, at the beginning of this course you just have to throw away everything you've heard about algebra up to now. We're going to start from scratch, build it from the ground up, it all starts here. Fine.

The next semester we had a course called Algebra 2. At the beginning of the course the teacher said, right, who here studied Algebra 1 last term? It was a required course for Algebra 2, so the answer was everybody. He said, well look, everything we told you in Algebra 1 about mathematics is completely wrong. You just need to let go of that completely. We're going to start again, and the same was true for the course called Algebra 3.

So I do think for the design of curriculums, we need to have a clear and consistent set of knowledge which we are prepared to throw away later.

ANDI HORVATH

The disciplines have boundaries and they have distinctions, but they're also dependent on each other. How much do they need each other to articulate their ideas? You have some wonderful case studies from history to share with us.

DANIEL GLASER

Well, I do, although again, I'm going to tell a joke which you may or may not think is relevant. It is relevant, and this of the Jewish Robinson Crusoe. I'm from a Jewish background. Robinson Crusoe is marooned on an island that when he's rescued after 30 years, they find these two massive structures that he's built on either end of the island. They say to him, Robinson, what are these structures? He said, well, these are the synagogues. They said, well Robinson, I can see you're an observant Jew, you would need a synagogue, but why have you built two? He says, well this is the one I pray in and I wouldn't even set foot in that one.

ANDI HORVATH

You're naughty. [Laughs]

DANIEL GLASER

So people define disciplines in opposition to each other, right? Funnily enough, as one might say of the fractal nature of disciplines, the social investment in explaining why what you do is different from another person becomes more and more important the closer they are to you. So people who work in professional fields of academia

spend most of their time explaining why what they're doing is different from the people in the next door lab.

So these questions of difference are really important, but they are also of really practical importance. If you're going to get your paper published, you have to explain why it says something different from the last paper in that topic and if you're going to get a grant from what is generally a competitive process, the critical thing is to explain why what you're doing is better than the person next to you.

Now, this professionalisation is not always useful, because it means that people lose sight of the big questions, because nobody gets funded to ask the big questions, they just get funded to answer the small question better than the person in the lab next door. We need I think, within the way that we do science, and I do think that the public have a role to play in this, we do need to keep the scientists focused, at times at least, on the big questions. These may be intellectually big questions or they may be societally big questions or they may be commercial questions, but it's useful to ventilate the structure of science with considerations outside the discipline itself.

ANDI HORVATH

I'm Andi Horvath, and our guest today on UP Close is neurobiologist, Daniel Glaser. We're talking about insights into the dynamics of interdisciplinary activities.

Daniel, tell us about the story of the anatomical structure called the Circle of Willis and how it was drawn by architect, Christopher Wren? Now, this is a story about how architectural thinking helps articulate science.

DANIEL GLASER

The story is an interesting one. About seven o'clock in the evening on one Sunday, I got a call from the BBC, if I could come on Breakfast television the next morning to talk about a pair of conjoined twins who had been operated on and successfully detached, one from the other. Their brains were joined, but the brain tissue, the nerve cells were separated largely in the way that they had been born, but the blood supply was connected up.

I think the reason they called me, given that I'm not a neurosurgeon and know nothing about twins, is because it was Sunday evening and all of the other scientists were down the pub, but I nevertheless agreed to go on and it was a very early start.

About two in the morning, I had a sudden brain flash. I'd gone to the loo and on the way back to bed, I thought, aah, and I went to the computer and I looked up this image that I had in my head of a thing called the Circle of Willis. Now, the Circle of Willis is an anatomical structure within the brain. It's a circle of major blood vessels in the brain and what it means in practice is that the blood supply that comes up one

side of your neck goes into one side of your brain, but through this circle can supply blood to the other side of your brain. So if one side of your neck gets blocked, if you put your finger on it, the blood supply can compensate.

The anatomist, Willis, discovered this in the seventeenth century and there was a drawing I had in mind to illustrate that and then there was a jangle in my head about it. Indeed, when I looked it up on the internet, the drawing was done by Christopher Wren, who was the notable architect in the UK at that time, who rebuilt a lot of London after the Great Fire, in particular best known perhaps for being the architect of St Paul's Cathedral.

When I went onto Breakfast television just before we went live, the presenter leaned across to me and said, I understand you've got an image to show as part of your answer to the question. I said, yes, it's uploaded already. I said, it's by Sir Christopher Wren, and they went aah, the architect? I went, yes, the architect. They went, okay. I said, it illustrates the blood supply, and they said, okay. Dr Glaser, you are a neuroscientist, aren't you? I said, yes, I am a neuroscientist.

But the reason why Sir Christopher Wren was the person to illustrate it is because it is an architectural structure. His understanding of the way that big structures work, the way that things are supported, the way that circles and lines can support a three-dimensional structure, enabled him to illustrate this anatomical bit of the brain better than the scientist herself would have been able to.

ANDI HORVATH

Daniel, let's now explore interdisciplinary research in the sciences. Let's think about the mechanics and the psychology of collaborations. Can we actually induce innovation and creativity?

DANIEL GLASER

In my experience, not. There's nothing more creatively constipating in my experience than being told to have a new idea. In the office context where you all sit around and brainstorm to come up with a new approach to something, it's generally a catastrophic and boring experience for everybody. So I think that force-feeding innovation into a situation is generally a hiding to nothing.

Most of my ideas, the best ones, come either in the shower or in the pub and I think that's because you have, either in the form of the water dropping on your back or the alcohol and the background noise, the ability to let go of what you think is important and come up with stuff that's outside.

I think the other thing that happens to me generally in the run up to a new idea, is understanding that somebody else sees the problems that I'm wrestling with from a



completely different perspective. So my own theory about interdisciplinary collaboration is born of this. It's what I call the convergent, divergent model, Andi, of interdisciplinary collaboration.

It goes like this, what you want is people from different places, and we've spoken a bit about disciplines already. You get to be a scientist by doing a job that has the word science in its title. So I for example was the world's first scientist-in-residence at an arts institution. How do I know that that's the case? Because at the time I was the imaging neuroscientist at the Institute of Cognitive Neuroscience in London and that's the designation that's got the word science twice in its title, right? I was the scientist in residence at the Institute of Contemporary Arts which has got the word art in its title. So it was an interdisciplinary collaboration in the sense of the origins of the participants.

So you need people coming from two different places and then you need to make a space where it's all okay. So that's what I call the Dionysian frenzy, the Greek God, Dionysus. This is a place of debauchery in fact. It's also called the orgy theory of interdisciplinary collaboration because you lose sense of who's doing what to whom. All kinds of criticism and interaction are allowed, and in that space, new ideas can happen because everybody is allowed to speak about everybody else's discipline.

So if you're a physicist, you can talk about psychology, the psychologists can talk about dance, the linguists can talk about physics and so it goes around, but I think it's really important having had this frenzied interaction to re-describe what you've come up with back in your home disciplines. So I'm a big fan of peer reviewed publications in professional journals in a given discipline, or an artistic performance that goes on in an art space and is reviewed by the art critic of the newspaper. I think this convergence and then divergence and then repeated convergence is at the heart of things, rather than trying to form a new discipline.

ANDI HORVATH

Tell us more about the time you worked with the dance choreographer on one of these projects that you did as a scientist in residence?

DANIEL GLASER

Well, I suppose being at the Institute of Contemporary Arts enabled me to access a lot of culture and at that time a number of notable dancers and choreographers came to see me at the bar of the ICA, and I do want to emphasise most of my time at the Institute of Contemporary Arts was spent in the bar because that's where the best kind of thinking happened.

At that time, I was still working in neuroscience and we were interested in how prejudice and expectation shape the way you see the world. This is work that I did in

collaboration with Patrick Haggard, Julie Grzes, Beatriz Calvo-Merino and Dick Passingham at UCL at that time, the University College London. We wanted to investigate how your own ability to move changes the way you see other people moving.

Now, fast forward to the high profile publications we got for this. We were criticised by our peer reviewers in one case for having done it in an imaginative way and what they said we should have done, was to come up with a movement sequence of our own in the lab and train people to use it and measured them in the scanner. That really wouldn't have worked because we were interested in expertise, and as well as being ineffectual, it would have been hilarious, the idea of neuroscientists trying to get people to come up with a new movement form. One can only imagine in a nightmare what that would have looked like.

So what we decided to do was to work with professional dancers. We used ballet and Capoeira. We took some Capoeira moves, Capoeira is a Brazilian martial art form. It has codified movements rather like classical ballet. We videoed the moves in Capoeira. We got a ballet choreographer from the Royal Ballet to write down some words in French that when read out by a ballet dancer gave rise to movements, which looked in some ways the same as the Capoeira movements. It was the same body parts moving at the same sorts of speeds.

Using those stimuli we investigated the brains of Capoeira dancers and ballet dancers to see what their responses to the stimuli were. We can talk more about the results later if we want to, but the critical point is that couldn't have done those experiments were it not for the intervention of the choreographer and the choreographer was paid as a consultant. This wasn't in fact a symmetrical relationship. We paid his time, his name was Tom Sapsford. He wasn't an author on the paper because it was a neuroscience paper and it may have influenced his practice for all I know, but that wasn't the point. We needed his expertise as a dancer in order to understand how the brain sees dance.

ANDI HORVATH

So what were the results of these functional MRIs?

DANIEL GLASER

I think often in science, if you set the question up right, then the answer is pretty simple which is yes. But I'll tell you what the story was. There are bits of the brain, unsurprisingly perhaps, whose principal responsibility it is to control movement. We know that that what's they're for, because if they're damaged in an accident or in a stroke, you lose the ability to move that part of the body.

If we looked at the brains of the dancers when they're lying motionless in the scanner, and they have to lie motionless because if you jiggle around it spoils the

image of your brain, you need a still image. When they're lying still and watching dance, we found that the bits of their brain that ordinarily control motion were more active when they were seeing the thing they can do than when they were seeing the thing they can't do.

So even though they're not moving, they're using their movement control cortex, their movement control brain to help them see. The reason they're doing that is because it enables them to simulate the movement that they're seeing and to predict what's going to happen next and it's a very useful thing to do when you're trying to interpret motion. You would use your own body's ability to move to help you do that and therefore experts do it using their movement control brain more.

ANDI HORVATH

Now, your science also influenced these dance choreographers. What happened?

DANIEL GLASER

Well, firstly, I'm not a critic or an historian of dance and to me the question of what the influence on artistic practice as scientific practice is marginal, and what do I mean by that? When Tom produces a work and there is a program that they sell in the theatre that you can read while you're waiting or in the interval or on the way home, that might give you some stuff about what happened to Tom in the run up to producing the piece. It might tell you who he was sleeping with, it might tell you where he was living, it might tell you where he got his money from, it might tell you that he was successful or an unknown at that time. All of this is a richness that adds to the texture of your viewing of the dance. But it is biographical and marginal.

But Tom was not commissioned to produce work as a result of our interaction, but at the time he was very interested in the brain. He produced a piece of work called Hypnos which he had developed by recording people sleeping, speeding up their movement patterns in sleep and using that as the movement vocabulary for his own work. So clearly he was interested in brain states. We had lots of discussions in the pub, but it definitely wasn't a symmetrical relation where the outcome was the brain research paper and the piece of dance. In this case, I have this principle, Andi, called abandoned symmetry. I don't think we need to constrain these relations so that there's always something from both sides.

ANDI HORVATH

I'm Andi Horvath, and you're listening to Up Close. We're talking about the disciplines and their evolving boundaries with neurobiologist and science communicator, Daniel Glaser.

Tell us more about the Science-Art movement. We spoke earlier about how art can leverage inaccessible science by having an architect draw the pictures. Is there a perception that art is just a way to articulate science, sort of like a handmaiden to science? Is there anything that science can provide for art?

DANIEL GLASER

I think the relation between the two is an interesting one. I have a statement that goes like this, is it a problem to find art useful? What that question asks is a question about what's called instrumentality or the instrumentalisation of the arts.

For example, in the UK, a previous Labour Government decided that they would talk about the arts agenda in terms of national wealth and national productivity. So they were looking at the pounds to the national economy that the creative industries would raise and likewise you might say, well if you're interested in public engagement with scientists, you should get some smart artists along to draw you some pretty pictures so that the public understand science better.

What this says is that art is useful. I don't have a problem with that in itself, just as long as you recognise that art has intrinsic value as well. So you need to have to assert the intrinsic value of art and you need to measure it using professional measures like professional arts reviewers. You need conservatoires on training for arts which are funded in their own right and you're doing that because that's an essential part of civilised practice and of a civilised society. Society will be sick if it doesn't have a strong arts practice and a strong cultural sector. It needs it for its own terms.

Now, it feels to me that in arts science interactions the power can go both ways. So while it is true that artists can illustrate science, it's also true that scientists can learn from that process. I can give you a specific example, and the example I would give is pseudocolor, what is pseudocolor? Most scientific images that you see on the internet or in scientific papers or in the newspapers are pseudocolored which is to say, if you gave me a map of ocean temperatures, you would label the hot temperatures as red and the cold temperatures as blue, and that's fine, that's not the colour of the sea in question, it's a way of representing the information in colour.

Now, the choice of the colour map, are hotter temperatures redder or bluer, is an arbitrary choice. You could make them purple or white or any colour you liked. What scientists tend to do is to just play around with the colour map until the picture looks right. Now, they do that because they're not visually literate and they think they're just making a small adjustment like you might choose the font in which you print out your document. That's not true. Visual information has rhetorical power and artists are not critics or experts in understanding what making something red says.

Now, scientists, if left to their own devices, will be blind to that kind of thinking and will lead themselves and others into error because of their naivety about what colour

does. So actually while you might say that an artist is simply making pretty pictures for the scientists, actually what she can do is to help the scientist to be smarter about explaining and also to stop the scientist from fooling herself by producing images that simply confirm her prejudices.

ANDI HORVATH

Now, are there areas in the interdisciplinary research fields that there should be more interdisciplinary research? Are there pockets of culture and nature that seem to resist cross-pollination? Can you see any way forward from that?

DANIEL GLASER

I will speak to my own domain. I am still fascinated by thinking and by the brain. Originally, I wanted to do artificial intelligence which is making machines that think. I became convinced along the way that we should understand the natural kind first. When it comes to understanding the important bits about thinking, it seems pretty clear to me that a study that restricts itself entirely to neurobiological methods is doomed to failure.

Let me give you an example from a domain which is slightly removed from my own - visual neuroscience, that's the study of the control of motion, of movement. We live in a friction-full world and a world which has gravity. So if you are pushing a heavy wardrobe across your bedroom floor, you have to anticipate the possibility that at a certain point it's going to start sliding. If you have not anticipated that possibility in your body, then when the wardrobe starts to slide, you'll fall over. You generally don't do that because you've pre-tensed your muscles ready for the inevitable slip of the wardrobe and that allows you to push it successfully.

Now, to understand the brain circuits which underlie that prediction, you have to understand gravity and friction. What I'm saying is that you cannot understand the brain simply by looking at the brain. Without an understanding of the world, you can't understand the brain circuits. That factor applies even more to the appreciation of culture through let's say aesthetics and interpersonal relations, as we might say love, humour, motivation and the basic structures of thought.

So for a neuroscientist to believe, as some still do, that a purely scientific enquiry into these matters can succeed, is itself naïve and ignorant. We need to work with cultural operators, with practitioners and professionals across the range of human experience and practice, in order to understand the brain.

ANDI HORVATH

It makes me think of a quote from Einstein, didn't he say something like we cannot

solve our problems with the same thinking that we use to create them?

DANIEL GLASER

I think it's a lovely statement and Einstein clearly had a way with these pithy epigrams. I think it's true that our thinking needs to broaden out and that one kind of way of seeing the world will never give us a picture in the round.

ANDI HORVATH

The future is innovation and problem solving and what you're kind of saying is that there are power tussles within disciplines or even disciplines that are very close to each other. So what could help that breakthrough?

DANIEL GLASER

I think disruption is the key here, and one of my favourite phrases is disruptive innovation. I think it may be a phrase that's overused sometimes. Actually for me, Andi, the way forward is to find ways for people who are not experts in a domain to have some say.

So for example, there's an increasing amount of evidence to show that having scientists engage with non-experts is an important part of their own science. Explaining what you do to a bright nine year old every couple of years is helpful whether you're working on childhood immunisation or theoretical physics. Having a perspective from outside your domain is an essential part of making progress and yet that's often actively resisted within scientific domains and research domains more generally where there is great professional value to be had from being obscure.

We need to undermine that retreat into private language and obscurity, and I don't say enforce, but certainly encourage and support and facilitate situations where anybody can have a go at answering the question.

ANDI HORVATH

Moving outside the sciences to include disciplines of law and business et cetera, what sort of fruitful collaboration are we benefitting from?

DANIEL GLASER

May I betray my own prejudices? I think that working in one scientific domain without ventilation from outside is probably pretty boring, but I can only imagine how much

more boring it is to be trapped in law or business or a domain like that.

The necessity of ventilation, the need to see things from other perspectives, the need to abandon one's addiction to jargon, to explain oneself in plain language and to allow others to speak to what one does, is all the more pressing in other professional domains. One of the things that I'm quite interested in is how those of us who have used engagement with science as a way to interact with young people and to bring other audiences in, can speak to people in different professional domains, to use these, what are in the end facilitation tricks, to help ventilate and expand other domains as well.

ANDI HORVATH

There are scientists working in a highly empirical area and they're quantitative measurements are within the field and they're on top of their game in that discipline. They don't really have the time or energy to ventilate with other disciplines.

DANIEL GLASER

I think there's a couple answers to that. Firstly, if you're working in a human domain where consent is important, let's say you're looking at organ transplantation, you cannot possibly succeed overall without understanding people's resistances to organ transplants and allowing family members' organs to be harvested and all this kind of stuff. So you do need to engage and that isn't true for theoretical physics. But I think there are a number of reasons why it's important for theoretical physicists even, and I don't want to pick on them, to think about this.

The first is we have increasing evidence that your research will be better if you speak to people who aren't like you. I think the reasons for that when you stop to think about it are obvious. For me, engagement begins at the door of the lab, right? So finding ways of explaining things and engaging with people outside is important.

If I may just give you a dirty little secret about science communication, for professional scientists, science communication training is usually motivated in terms of speaking to the press or speaking to children, but the principle benefits of training scientists in communication is how they communicate with their peers.

If you have ever been to a scientific conference and they have these things called poster sessions and there are thousands of these A0 pieces of paper in rows on the walls and you walk up and down and each paper is full of information about the research of that group. In the great majority of cases, it is impossible to deduce anything from looking at these pieces of paper. They are hopeless efforts in communication, even for the scientist's peers. So the ability to communicate is essential for scientific practice and is very underrated.

There is a final thing. Most research these days is paid for with public money and there is a democratic deficit here. If we're using taxpayers' money to pay for research, there is an obligation upon the scientist to report back on what she's doing and to allow it to be scrutinised. So even if you don't buy any of the other arguments, I'm afraid it's kind of tough. You do need to engage as a condition of having public money to follow your whimsical fantasy and you'll find your work is better for it anyway.

ANDI HORVATH

Daniel Glaser, thanks for being our guest on Up Close. You've challenged our mental faculties, pun intended.

DANIEL GLASER

I've enjoyed myself enormously and the challenge has been mutual. Like all conversations, I think you've led me to new places as well. It's been a delight to be here.

ANDI HORVATH

We've been speaking with neurobiologist and director of the science gallery at Kings College, London, Dr Daniel Glaser. You'll find a full transcript and more information on this and all of our episodes on the Up Close website.

Up Close is a production of the University of Melbourne Australia. This episode was recorded on 30 June 2015. The producer was Eric van Bommel, audio engineering by Gavin Nebauer. Up Close was created by Eric van Bommel and Kelvin Param.

I'm Dr Andi Horvath. Cheers.

VOICEOVER

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