Public views on genetics – what have we learnt?

The G Word transcript

**Vivienne:** Hello and welcome to the G Word. My name's Vivienne Parry. I'm the Head of Engagement at Genomics England, and our subject today is one very close to my heart: science communication, and specially of course, genetics.

Now, the pandemic put words like "variant" and "whole genome sequencing" on every front page. People rapidly became familiar with well-evidenced science, but even with a wealth of high-quality information available to them, some people remained highly sceptical and negative. Why?

To talk about the findings of the recent Genetics Society Survey and a fascinating paper in PLOS, I'm delighted to welcome Dr. Adam Rutherford, geneticist, author, and broadcaster; Professor Laurence Hurst, Professor of evolutionary genetics and the Director of the Milner Centre for Evolution, who was the author of the PLOS paper; and Dr Cristina Fonseca, Head of Engagement and Communications at Genetics Society, and the lead author for the PLOS paper.

Cristina, let's start with you. Why did you conduct a survey at the Genetic Society?

**Cristina:** This came out of the back of the Genetic Society celebration for the centenary in 2019. We had a whole programme of events, and one of the things that we were interested in was something that would have a legacy and could be used by the genetics community. That's why we decided to do this survey; we wanted to have a framework that could help not just the Genetic Society, but also science communicators and policymakers to know what the state of science communication in genetics was in the UK. Obviously, this was pre-pandemic, so the idea we had for the survey changed a bit. It was quite interesting that, when the pandemic started, we had to change our focus, and we used COVID as its own natural experiment. I think it worked really wonderfully.

**Vivienne:** What was the outcome?

**Cristina:** The outcome was that, basically, for all the things we tested, and I think Laurence can also elaborate on this, we found that there were people with opposing attitudes – either very positive or very negative attitudes. They had a high level of self-confidence about their knowledge, which was quite interesting. We also found that attitudes toward genetics have increased during the pandemic, which is great news for genetics and science in general.

**Vivienne:** When you say attitudes, do you mean knowledge?

**Cristina:** Just a positive attitude toward genetics and some of the genetic technologies. In terms of knowledge, we did find an increase, but we also found that 30% of our sample, and I find this quite interesting, did not know what PCR was, and 30% also did not know that COVID was caused by a virus. Even though we had all the exposure to all of the COVID information, there was still a third of our sample who had not heard about these key points of information.

**Vivienne:** So, Laurence, take us on a bit to the PLOS paper and what you said in that.

**Laurence:** I think one needs to backtrack a little to understand a broader framing. That broader framing is science communication through the eighties and nineties ran under a thing called the Deficit Model. The presumption of this is that if you ask why some people do not accept well-accepted science, it's because they don't know the well-accepted science. In fact, in multiple survey works, you find that there is indeed a correlation between what people know about science and their general attitude towards it. So that looks sound. However, after the eighties and nineties, people then thought, "Okay, then clearly the way to go is just to tell people the science. They get it, and they will accept it”, sort of if you know science, you love science sort of thing. It became fairly rapidly clear that enterprises like that were failing, that simply telling people information did not engender any acceptance, and in fact, people discovered things called backfire effects whereby if you try to tell people information, you actually make things worse. They become more entrenched in their prior understandings than they were.

Now, over the last five years, there have been two key papers - one in 2018 and one in 2019 - that then point to a different resolution of this potential problem. The problem being why, faced with the same information, do some people who are very strongly negative and some have very strongly positive information. If you think about it psychologically, that's a great psychological quandary. How do some people, seeing the same information, end up with such different views? So these two papers, in 2018 and 2019, both came independently to the same conclusion. That is, if you look at the individuals the most negative, it is true that they don't know very much. So, if you just look at straightforward factual knowledge, it tends to be quite low, as we saw that the basis of the Deficit Model. More important, if you then ask them questions about what they think they know, how well they think they understand the science, what these papers found was that those most negative believe that they understand the science.

So, what we were wanting to do is, first, can we replicate this in the context of genetics? And yes, we can absolutely replicate that effect - four different questions, slightly overlapping, but actually turns out not as overlapping as you might have imagined. And we always get the same effect that the ones who are most negative tend not to know all that much but tend to believe they know an awful lot.

We were also more particularly interested in what you might call the natural history of those who accept science, because this is actually the domain that, for the most part, as far as we can see, has not been well studied. It turns out that those who are most accepting of science, actually, if anything, even believe even more that they do, in fact, understand the science; however, they are warranted in their beliefs. So if you then look at their textbook knowledge - we ask 12 sort of textbook questions - they typically score very highly on those.

So what we then have is a model which is different from the Deficit Model, and what it says is those that know that they don't know do not take a negative attitude. So it's not a fear of the unknown. Those should be the individuals who have a great fear of the unknown. Those who know they don't know tend to be neutral. Those who believe that they know tend to be positive if they understand the science and tend to be negative when they don't understand the science.

This being said, there's an awful lot of variation in the data. This is survey data, so we don't expect perfect correspondences all the time, but it did strike me that we now have a series of similarly designed experiments all giving actually more or less the same results - that is, that those most negative tend to have overconfidence in their understanding of the science.

**Vivienne:** Now, Adam, you are the author of at least three - to my certain knowledge - brilliant books on genetics and genomics, hugely popular, big sellers, and presumably people read them and they understand them, and yet some of them still remain highly negative, and you have a lot of trolls, I know. I mean, do you despair? I mean, is there anything that you can do?

**Adam:** Well, I mean, it's an interesting question, and I don't really know the answer to what sort of valence people have about reading popular science books. The sample sizes are very skewed, so even an exceptionally well-selling book about genetics is a tiny proportion compared to someone listening on the radio or watching on TV, or watching a mainstream film about it. And also, there's a huge selection bias. People aren't going to buy my books about genetics, about the history of genetics, who have zero interest in the subject. I think it talks more broadly about how we talk about genetics and what we think genetics is. And a thing that I think is very clear if you work in science communication, as you do as well, Viv, is the disconnect between what we think we know within the walls of the academy and what we think people outside - real-world people, sometimes I refer to them as civilians, which is probably not the best way to describe the general public.

I think that, well, here's the thing, right? I think all scientists believe that their subject is the least well represented in the media. I've been doing this a long time, and I think that when it comes down to it, genetics, which is a relatively young science and really in a sophisticated way, you know, a mere few decades old, but what is it at its absolute core? It's thinking about families, it's thinking about inheritance, and it's thinking about sex. These have been the major preoccupations of humans for thousands of years, and it's only really in the last century - really, only in the last 30 years or so - that we've had a sophisticated understanding of how these things work, if indeed we have it at all.

Jim Al-Khalili can talk about quantum physics, and it bears absolutely no relationship to one's lived life - important though, I'm sure, it is, if I understood it. Brian Cox can point at the universe and say that there's a black hole 10 billion light-years away, and it has absolutely no experiential effect.

Whereas if you start telling people how inheritance works within families and within populations, you are attempting to counter hundreds, maybe thousands of years of cultural baggage, and I think that is really the core problem. So, like I said, if all scientists think their own field is least well represented, I'm with no skin in the game and with absolute neutrality, no bias whatsoever, I'm a hundred percent convinced that genetics is the least well represented. To a certain extent, that's, you know, that's on me, right? That's on us. We're all responsible for communicating science beyond the walls of the academy, and our jobs will never be done because this is a hard game. It turns out biology is much more complex than we thought, and simple models of explanation, well, they don't necessarily tally with what we actually know.

**Vivienne:** Of course, we have to understand that there are areas - there are lots of ethical areas, for instance, in genetics - and it's perfectly okay to take a position on one side or the other. There are lots of different nuances, and we can't say to people, 'Yes, you should always do this or you should always do that’, but I guess we want them to take those views based on some knowledge. But are we going to ever get people who are so negative, Laurence, about genomics and about what they think about it? Are we ever going to get them to change their minds, or should we just move on and just concentrate on the people who know nothing at all?

**Laurence:** It's a great question, and there's quite a lot of discussion at the moment within the domains of science communication as to whether we should, in fact, be attempting to address those most negative. What we clearly see is there are some very loud, very prominent voices that are very negative. This can skew our view of the world. I think one of the things that's come out of the survey very much is that we have been ignoring what you might think of as the side of the majority. So it turns out when we ask these 2,000 individuals, 1 or 2% sit in the most negative camp, but 40 to 50% said they wanted to hear more science, another 50% or so said that they think the amount of science coverage is right, and only less than 10% said they thought there was too much science. So I think we are doing ourselves a disservice to think that we only talk to the 1 or 2%.

Now, that being said, we can then ask questions about how could you talk to the 1 or 2%? This is an experimental question, and to the best of my knowledge, except for de-radicalisation programmes, no one has found a way to talk to them. There's a large European survey going on at the moment on so-called conspiracy theorists and what their mindsets look like, and for the most part, you can't have a conversation because actually the evidence doesn't matter. One of the things that's come out of this European survey is that for this strange 1-2%, they actually enjoy the fact that their theories are not falsifiable. So, there is no evidence that you could give them that would contradict it, and they always have a get-out clause - you would say that, wouldn't you? - and blame the messenger rather than the message. So, I think, to a large extent, no, we can't have general science communication trying to talk to that 1 or 2%. Let's focus on the others.

You are absolutely right - we're not here to dictate to people what their ethical opinion should be. What we could do is say, at least could we come to a position where your ethical positions are being based on good scientific information, the best scientific information that we have, and I think that's really where science communicators can have a major role, and as I said, most of the population is actually open to this. They want to hear from us, and I think that's then the way to go. The question then is, again, it's another experimental question. If we decide we're not talking to the 1 or 2% or most negative, how do we talk to the ones who do want to listen to us? Now, we could preach to the converted, that would be relatively pointless. There's not a lot of point going to the other end of the distribution going, 'You all agree with me? Let me give you more information', because that's not going to change the world. There is, however, a lot of interest now within the science communication in the idea that what we ought to be doing is actually telling people clearly what the consensus view actually is.

So, one sees this all the time in advertising, nine out of 10 cats prefer, et cetera, et cetera. There's now a considerable body of experimental evidence suggesting if you lead off science communication by telling people that 97% of climate change scientists agree, that that actually has more of an effect than, for example, telling people what the evidence for climate change is, or at least just telling people what the evidence for climate change is. So getting over the consensus science to start with, there was a recent matter analysis of I think about 20 to 30 or so experimental investigations, it showed a clear effect of just telling people what the consensus actually is. The idea is then a gateway into opening minds.

**Vivienne:** I mean, we do have a fatal flaw as scientists, which is, we think other people ought to know what we know, and actually a lot of what we know, they don't need to know. I started off in genomics a long time ago, and I've realised that the more I talk about genomics, the less I talk about, you know, I never talk about base pairs, but yet there's a lot of geneticists who want to tell people all about base pairs. If they don't know about that, then obviously, you know, they don't know enough. Maybe the way that we are presenting our information is not actually the most conducive to the public. Cristina, you are nodding there.

**Cristina:** I think it's important to also remember that there are some people that are just not interested in science, and it does not matter what you’re going to do. There was a really interesting conversation on Twitter, on the Genetic Society that someone was saying, and I can actually see myself in that example, that she didn't like football and she was not interested in football, did not know anything about football, and it's not because of a lack of information, and I do the same thing. You're reading the newspaper and you just skip that section, and so the problem is not the information. The information is there, you are reaching those people. Those people just don't necessarily want to know about it. They don't necessarily go and engage with what you are saying. It's sad because as scientists, we just think that this is amazing and everyone should know about science and it's so interesting and there's applications for your day-to-day life, but at the same time, people might just not want to know, and I think that's very difficult to come to terms with.

**Vivienne:** It's a bit like, how your boiler works, or your pension. I mean, you don't need to know until your boiler breaks down, and that is the moment. Very often, I see parents who have a child born with a rare genetic disease, and they get very rapidly up to speed when they need to have the information.

Adam, do you think we're all guilty of trying push too much science down people's s throats when they don't actually want it? I mean, maybe when it's not the right time frame?

**Adam:** I mean, we're asking an incredibly complex question, and there are so many different factors involved, but also something that we haven't really mentioned here, that Cristina mentioned, that the original conception of this survey was pre-pandemic.

Now, still in the age of the internet, in the age of rampant conspiracy theories and huge amounts of disinformation, and due to the very nature of the providers of that information (social media polarising, amplified polarising views), we see that as a result in the paper itself, that you get further amplification or reinforcement entrenchments of polarising views, which is exactly how Twitter and Facebook and YouTube actually work by design because that's how they monetise those systems.

We also know very well, and this has been the case since the 17th century, that our politicians are largely uninterested in science, systematic lack of investment in science, education, and science funding over successive governments for a long time, but also politicians who are frequently not scientifically literate.

I think it's really crucial to remember Laurence's point, which is this idea of the silent majority. Most people trust establishment figures of science, authority, medicine, and we are generally okay to get on with our jobs, even though, in many cases, like I said at the beginning, we might be pushing against cultural tides that are generations or hundreds or thousands of years old.

But then COVID was an unprecedented event in modern history, and all of a sudden, we're thrown into a world where, as you introduced it at the beginning, all of a sudden, the science – we talked about the science as if it's one thing – is absolutely front and centre in daily briefings.

There was a moment, early during the pandemic, when everyone in the press started talking about exponential, just the word exponential, and it was hard for scientists not to be a little, possibly a little bit supercilious or a little bit sneery when things that are sort of basic science education part of maths suddenly become the subject of daily scrutiny or news media coverage.

The idea that only 30% of people in the survey didn't know what PCR was, I was amazed it wasn't higher than that. I mean, it may be a screwdriver for people like us, but why on earth would you know what PCR was if you spend absolutely no time sequencing DNA, which let's face it, the majority of humans in history have not been in that situation.

I think there's one key element as well, which is a sort of failure of a broader understanding of what science is, not necessarily genetics, but science more generally. The notion that science is continually changing, that we're constantly updating and revising our views depending on the evidence, and I think we saw that unfold in real-time during the pandemic. The whole publication system changed so we're still sort of trying to understand the long-term repercussions of that, but follow the science, whatever that was, the hopefully changing policies in response to the incoming data. Again, there's always going to be a minority, which is probably the same minority who are never going to get on board with these types of ideas, who regard the fact that science is a self-correcting ever-changing thing as a weakness when actually it is its core strength. I think we saw that in real-time and I think the results of the survey in the paper, a part of that framework of not really understanding what science is.

**Vivienne:** There's actually a lot to learn from vaccine confidence work because vaccine, it always strikes me, the vaccine confidence and confidence in genomics, there's a lot of overlap there. What was striking to me was that there were some people who were hesitant, and actually, you just had to answer their questions and be prepared to answer them, you know, twice or three times, and then, finally, when they talk to their friends, then they would be happy to go off and have a vaccine.

Maybe we should learn from some of the approaches that we used in overcoming vaccine hesitancy in genomics. Cristina, how do you think that we should be moving forward and particularly addressing the 75%?

In other words, not the people who've got genetic disease who are interested because of that. Not the people who are interested in science, but the 85% or so of the population who actually don't care or are completely disengaged or even hostile.

**Cristina:** I would love to have the answer for that question because then I would be such a great science communicator. It is very difficult. I think it is just we need to be less preachy and just engage with the audience and just try to address their concerns.

I think that sometimes scientists do a disservice to themselves. I think we spent so long trying to explain, for instance, with the vaccines, that vaccines take a long time to be developed. That it takes a long, long time to actually go from bench to actually being given to a patient and then suddenly during the pandemic, there was a vaccine within less than a year.

We are giving contradictory information to people because we did not explain what was happening, all of the security measures that were still being taken into place, but it was just like a rapid succession so that we could have a vaccine as fast as possible, but in a secure way. So I think that it's very difficult to answer that question, but at the same time, I think that we need to just engage and listen to what people want to know and how they want to know. I don't think that there's an easy answer to that, to be completely honest.

**Vivienne:** There are lots of different segments of the public. I mean, we shouldn't think of the public as a homogeneous whole. I mean, there are, you know, young white men, for instance, who have very different attitudes to, I don't know, say a group of older Caribbean ladies.

I mean, there’s a lot of different groups, and certainly Genomics England is doing work with Professor Anna Middleton at Welcome Connecting Science to our project, Being Human, to try and address that. In our last few minutes, I just wanted to ask each of you: What do you think the strategy should be for the future? We've got this hugely interesting work that's a great basis for going forward. Laurence, what do you think we should be doing?

**Laurence:** One of the things that's very clear is that in presenting information, the trustworthiness of the voice is actually very important. When you talk about the vaccine hesitance, for example, lots of good evidence suggests that getting that information from somebody who knows, who is your contemporary, who you can relate to, is important. We've got experimental evidence in schools that authority voices telling you that evolution is true matters. It's not the evidence that matters, it's the trust in the person telling you. So I think we have to work hard to generate that trust and use trusted figures. David Attenborough is one of those trusted figures, for example, that's why people listen to him.

That also means, for example, not having axes to grind, being honest when we don't know, et cetera, etc. I think for the most part, actually, the communication through COVID was actually rather good. They told you what they know, they told you what they didn't know, and they told you what they're doing to find out. When you're not approaching consensus science, I think that is the way to go. So, I think we need to think less about what exactly we're saying and much more about how we should be engendering trust in what we are saying and that we are trusted voices. As it happens, academics are trusted voices, and one of the things we did ask is who would you trust, and academics came out number one, so big tick for me.

**Vivienne:** You're top of the pops there, Laurence. Cristina what strategies would you take at the Genetics Society?

**Cristina:** I think media literacy, I think it's quite important. I think empowering people to actually gain crucial skills to learn how to analyse and critique and respond to information. There's a lot of information. As we said, there's a minority with really loud voices, and if we just empowered people to learn where the information is coming from and to actually go and check for themselves, I think it will be a huge advantage for the science communication field.

**Vivienne:** Adam, your strategies for the future, apart from writing more books.

**Adam:** This is good because I think all three of us are giving a sort of rounded picture because we're all saying slightly different things. I think that a fundamental change in how we teach science from an early age. I think there's a couple of key things in school age teaching of science which we get wrong. One is the probabilistic. We just don't teach probability at all really at school. The nature of science being conditional and that we can actually say confident things whilst recognising that they are subject to being incorrect in the future is, as I said, science’s strength. I think that if that is inculcated into culture much more, I know that sounds like almost like it's contradicting what Laurence was saying about the authority, how things are said with authority. I think those two things can sit quite comfortably next to each other. I don't need to know how the boiler works, I just need to believe that the guy who comes to fix it does.

I think recognising what science is and what probability and chance, the complexities of the real world, rather than trying to answer complex questions with simple answers, I think that needs to be bred into society from a very young age.

**Vivienne:** I think for me, one of the things that I think is that we shouldn't try to be right all the time. I think sometimes we come across as we have all the answers, and if somebody disagrees, then that's just because they're stupid. I think that's an attitude that actually really doesn't help. I've seen it quite a lot, and I think that we really need to embrace people and understand that they have fears and worries, ease those concerns without actually telling them they're wrong and stupid to have concerns in the first place. So I think that there's a huge amount to do, and I'd really like to see the whole genomics community get together to work on this rather than us all go off and do our own often quite contradictory things on a small scale, because I think we need to be thinking about big scale for these kinds of messages.

So we've got to the end of our time. It's very good of you all to have been with us today. Thank you so much to Adam Rutherford, Laurence Hurst, and Cristina Fonseca. If you want to know more about genomics or genetics, then the G word has an absolutely fantastic selection of podcasts for you to browse through, and you'll find those on your favourite podcast platform.

In the meantime, it's goodbye from me and thank you to our contributors once again. Bye for now.