

Research culture: changing expectations

Conference report



THE
ROYAL
SOCIETY

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Introduction

Scientific research produced in the UK is internationally recognised as excellent. UK researchers are at the heart of efforts to solve major problems. However, there are continuing concerns over many issues, including diversity, research integrity, researcher career structures, publishing and reward structures that raise questions over the culture of research.

The UK has a long history of shaping global research culture, from the times of the Enlightenment scientists, the foundation of the Royal Society and the frameworks of publishing and peer review, through to its recent leadership in championing science as an open enterprise¹. Through its recent research culture programme *Changing expectations*, the Society has been leading discussions across the research community about how the future could be different². The conference, *Research culture: changing expectations* was an opportunity to bring these conversations together with a range of different communities to allow discussion, highlight thought leaders and consider lessons learned from other sectors.

“It was interesting to have people at so many different career stages and from different sectors attending the conference.”

“The conference has inspired me and motivated me – it was great to see that so many other researchers share the same concerns.”

Feedback from conference attendees.



Image: Speakers at the research culture conference.

1. <https://royalsociety.org/science-events-and-lectures/2015/04/future-of-scholarly-scientific-communication-part-1/>
2. www.royalsociety.org/researchculture

The research culture programme

Changing expectations

Why was *Changing expectations* launched?

The culture of research is central to research excellence; it affects who does research, what research is done, how it is done and how it is disseminated. Whilst high quality research is produced across the community, there have been ongoing concerns around issues such as research integrity, career paths, permeability between sectors, recognition and reward, diversity, and support for collaboration and interdisciplinarity. These could ultimately affect the quality of research.

What was the Society trying to do?

Changing expectations has been an endeavour to encourage people to think differently about the issues mentioned above. Rather than looking at them as single issues, the Society has encouraged a holistic approach, considering them all as symptoms of the same problems.

“I have been putting even more emphasis on providing opportunities for ECRs and those from diverse backgrounds since attending the conference.”

“Since the conference I have started leading a new postdoctoral society in the Department and engaging in culture activism such as taking part in the Concordat (for Researchers).”

Feedback from conference attendees.

What did the Society do?

As the national academy for science, the Society has a very high profile across the research community. However, the Society cannot change research culture on its own, it requires the community to come together and act. So the Society engaged:

- Throughout 2017 the Society held a series of innovative and thought-provoking *Visions of 2035* workshops. These engaged individuals from across the research ecosystem. Participants from across academia, industry and government came together to imagine an ideal research culture of the future, and how this might be achieved, using the Museum of Extraordinary Objects and speculative scenarios³.
- Insights from over 20 of these workshops, and other conversations with the research community, were published in *Research culture: embedding inclusive excellence*⁴. This document was very influential in the development of the programme.
- *TEDxWhitehall 2018* was a celebration of cross-sector learning and fertilisation. It brought together over 180 researchers, civil servants, policy makers, and others from 47 individual institutions for a series of talks, performances and videos on the theme of *Changing expectations*⁵.

3. <https://royalsociety.org/topics-policy/projects/research-culture/changing-expectations/museum-of-extraordinary-objects/>

4. <https://royalsociety.org/topics-policy/publications/2018/research-culture-embedding-inclusive-excellence/>



Image: Conference participants.

The culture of research is a result of the system and the attitudes and behaviour of the individuals throughout that system. So the Society empowered:

- The *Where will your career take you?* case studies aimed to inspire researchers to think differently about what success looks like today and to challenge ideas about what skills and achievements should be valued⁶.
- The *Collaboration collections* are a series of historical and contemporary case studies focused on the importance of collaborations and the conditions that led to their success⁷.
- The Society's statement on research integrity outlines the roles and responsibilities of individuals and institutions in relation to this issue⁷.

Culture is context specific. Initiatives that work for one team, department or organisation may not work for another. So the Society has not been prescriptive, but instead provided tools to move conversations forward:

- To support conversations about what an ideal research culture looks like in different environments, the Society made the *Visions of 2035* workshop materials freely available on the research culture website⁸.
- *Integrity in practice* is a series of case studies featuring positive interventions that can be made to improve research culture and integrity⁹. This project was developed in collaboration with the UK Research Integrity Office (UKRIO) and launched at the World Economic Forum's Annual Meeting of the New Champions.
- The Society is considering how researchers' overall contribution to research can be assessed. Resume4Researchers is a tool for showing the full range of an individual's contributions to excellent research and will be released in 2019.

All materials from the research culture programme are available on the website royalsociety.org/researchculture

“The conference made me think a lot about how we in Gov interact with colleagues in academia and how we should seek to change our own research culture to make stronger and better collaborations. We share many of the same challenges, particularly around D&I, and there would be much to be gained by learning from each other and tackling some of these problems together.”

Feedback from conference attendee.

5. <http://www.youtube.com/playlist?list=PLg7f-TkW11iVr5nfezTEXa-4kQWfnyR2n>

6. <https://royalsociety.org/topics-policy/projects/research-culture/changing-expectations/career-case-studies/>

7. <https://royalsociety.org/-/media/policy/projects/changing-expectations/The-Collaboration-Collection.pdf?la=en-GB&hash=DF1DCC34F61D73DAC639F9CDC86B9D9B>

8. <https://royalsociety.org/topics-policy/projects/research-culture/changing-expectations/visions-of-2035/visions-of-2035-materials/>

9. <https://royalsociety.org/topics-policy/projects/research-culture/changing-expectations/integrity-in-practice/>

The conference

Research culture: changing expectations

Research culture: changing expectations was the first conference of its kind. Through bringing together a wide range of speakers from a range of sectors, by experimenting with the format of the programme and releasing new types of materials, the Society wanted to create an excitement and momentum behind change. Focussed exclusively on culture, its aims were to encourage delegates to:

- Think creatively about how the culture of research could be different.
- Share and build on best practice across the sector.
- Develop new networks with individuals from across different communities to work together to move ideas forward.

Across the two days over 200 people attended and over 30 speakers took part in discussions, presentations and speeches. People tuned in on the live feed, videos from which are still available in the research culture website (royalsociety.org/researchculture), and many carried on the conversation in the room, on Twitter and other platforms. Many ideas were discussed in the two days of the meeting. Here we have summarised together points from our speakers in eight key areas. We have also invited 10 individuals to reflect on the conference, and write pieces on what challenged them and what they will take away. These can be read in the next section.

Excitement following on from the conference has been palpable. Feedback has been universally positive. The vast majority of attendees said the conference was very good and many have committed activity to improve research culture within their own environments. Many questions were asked and ideas generated, please see Appendix A and B for a list of these. For those who weren't there, here is an overview of some of the themes from the two days:

The summary

Much is being done

Speakers talking about initiatives and programmes they are leading created real excitement within the room. Dr Jess Wade's barnstorming talk on her efforts to make the internet less sexist was one of the stand out moments of the two days. Dr Wade writes a biographical article a day on a female researcher and adds it to Wikipedia, she also has taken it upon herself to nominate those from more diverse backgrounds for prizes. Andrew Smyth put himself forward as a role model for those considering a braided career, being a part-time engineer and part-time science communicator. He posed the question to the audience, if you had a day to do something else, what would it be? Dame Julia Slingo highlighted the work that she led while Chief Scientific Adviser at the Met Office to improve the uptake of training and development and Professor Mark Walport announced two evidence based reviews that UKRI will be leading; one to study diversity both in the UK and internationally, and the other to uncover the interventions that are most effective.

“The event really brought home the idea that there needs to be both a bottom up and top down approach to culture change.”

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“I am now going to try to call out bad behaviour, not just mitigate its effects. We'll see how I get on with that.”

[Feedback from conference attendees.](#)

Collaboration versus competition

Collaboration vs competition was a theme that was returned to again and again across the two days. Dr Eugenia Cheng started the conference with a call for competition and gatekeepers (journals, funders) within the system to be removed. Dr Cheng argued that time spent grant writing could be better spent doing research. Professor Louise Heathwaite countered this suggestion by agreeing a greater reward of collaboration should be the community's aim, but that it was not clear how that would be measured, so thoughtful and deliberate change is required. Dr Margaret Heffernan got straight to fundamental assumptions about what successful researchers look like: the heroic soloist. She stated the truth was that the success of the few is based on the suppression of the success of the rest. Sir Venki Ramakrishnan offered a different viewpoint to these ideas agreeing that researchers can be altruistic and helpful, but that they are also ambitious, driven and competitive. He said that science, like art, is creative; no great work of art was designed by a committee, whilst also reflecting on the power of competition to push forward and improve research. Providing a view on competition and collaboration from another sector, Liz Nicholl, Chief Executive of UK Sport, gave attendees food for thought as to how they have improved collaboration within elite sport in the UK and the sharing of best practice across different sports to improve performance in international competitions.

“The workshop gave me more insight into biases and I hope has improved my own personal awareness of such biases.”

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“It was an opportunity to pause and reflect on the factors that contribute to a supportive research culture.”

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“Following on from the conference I talk more about research culture with colleagues and how we can nurture a more positive environment and set of behaviours.”

Feedback from conference attendees.

Inclusivity is as important as diversity

Numbers of women in senior positions in research are low and the numbers of those with BAME backgrounds is lower. Improving diversity in research will be key to enabling the UK to reach its target of 2.4% of GDP investment in research said Sir John Kingman, as more researchers will be required in this future research environment. Sir Mark Walport also discussed the importance of those in research reflecting the population at large. However, the current issues were starkly laid out by some speakers. Dr Jess Wade stated that science is currently failing women, with their representation decreasing in comparison to men at every stage of academia and Professor Andrea Brand highlighting evidence that women's papers are cited less, and CVs are rated less highly when the name is female than when the name is male. Inclusivity was also agreed to be important if the statistics were to change. Professor Leanne Hodson and her PhD student Pippa Gunn posited that creating an inclusive environment required focus on the individual and the group, strong communication and mutual respect. A point then supported by Dr Margaret Heffernan, who cited research on productive teams as requiring empathy, equal contributions from all team members, women in them and a culture of trust and helpfulness.

Research culture is not just about researchers

Recognition and respect of those who support research was a topic that was returned to multiple times. David Sweeney, said there needed to be a positive research culture for all; less discussion about the elite 1% and more about those individuals across the system contributing to the research endeavour. Robert-Jan Smits, Envoy on Open Access from the European Commission, agreed, saying that only once data scientists were leading authors and not just in the footnotes could we say that culture had really changed. Other speakers focussed on efforts to provide better recognition for all that are already underway. Fergus Brown discussed how he has championed structured career paths for technologists and academic clinicians, as well as traditional academics, in his role as Head of HR at the University of Glasgow and Dame Julia Slingo highlighted the efforts she led at the Met Office to secure data scientists parity of esteem with the wider research community.

A sea-change in reward mechanisms is required

Excellence comes in many forms. Whilst high quality research is undoubtedly important, so too is work that supports the wider community such as policy and public engagement. Professor Andrea Brand reflected on whether the research community has a preconceived view of what a successful researcher looks like and how that might affect hiring and promotion decisions, undervaluing those that do not conform. Professor Leanne Hodson and Pippa Gunn talked about developing a 'no blame' culture and the importance of recognising diversity of strengths. Professor Louise Heathwaite discussed the shapes of different researchers, currently just the 'I' (deep specialist) is rewarded whereas 'X' (breadth of discipline at the start of career and breadth in strategy) should also be encouraged. Carol Monaghan MP, Shadow SNP Spokesperson (Education) and member of the Commons Science and Technology committee, talked about research integrity and the importance of valuing no or 'wrong' results (negative results). Rewarding institutions as well as individuals was discussed, with Professor Susan Wessler highlighting that US News (a US newspaper) Best Colleges rankings now includes social mobility as a criteria. Robert-Jan Smits stated no one in the room is disagreeing with the need to change the reward structure, so why isn't it happening?



Image: Leanne Hodson and Georgina Mace.

Expectations of careers

Discussion about Early Career Researcher (ECR) careers was a topic that was returned to many times over the course of the conference. Research is a Pyramid or Ponzi scheme stated Dr Jenny Rohn, with PhD students at the bottom, with postdocs slightly higher and professors at the top. Dr Rohn said that only a tiny fraction of those at the bottom will make it to the top and there is currently little incentive to change it. Professor Richard Massey started by describing ECRs as being 'indentured' to their PIs, and he followed with a call for them to be allowed to be named on grants. Pitch winner Dr Shirley Keeton agreed with this call putting forward her Bring on the Bigger Brains proposal to support ECRs to win grants for and lead their own research whilst being mentored by more senior researchers.

“It was exciting to hear at the conference how many people already think about the problems we have in our research culture and are trying out different solutions. It convinced me that the main challenge is to connect and coordinate all these efforts better to achieve change.”

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“After attending the conference, we have run the Royal Society's Research Culture workshop (Museum of Extraordinary objects) with the Research and Innovation Services and ECR Forum, and the ECR forum has a refreshed vigour to develop a programme of activities related to culture.”

Feedback from conference attendees.



Image: Alex Freeman, 'The Pitch' winner presenting her idea 'Octopus'.

Publish and be damned

Publishing models and the way information is shared was an ongoing theme. Big data, global collaborations, request for more accountability and transparency are among the biggest drivers of change in research stated Robert-Jan Smits. Professor Marcus Munafo argued for the opening up of science. He said that this would improve quality as well as efficacy by reducing the repetition of work. The Pitch winner Alexandra Freeman won the popular vote as well as the judges endorsement for her idea Octopus; a distributed, modular, open source system. Her idea centred on moving researchers away from forcing a retrospective, linear narrative onto research. Publish or perish culture was also discussed by speakers. Professor Richard Massey wondered what would happen if researchers were restricted to publishing a limited number of papers each year. Dr Adam Rutherford followed with a call to end journal publishing completely and for the demise of the use of metrics in the evaluation of researchers. Professor Mark Walport reminded delegates that the title of a journal may not be used as a surrogate for its quality; it's what's been discovered that's important and how it's applied, not where it's been published. However, Sir Venki Ramakrishnan said that students and postdocs ignore the hypocritical pronouncements from academies and other organisations about the evils of 'impact factors' because they know when they apply for fellowships and jobs, it will matter where their work is published. Such pressure to publish in a few journals exacerbates competition.

“Following the conference, we have introduced a forum to start a conversation about how researchers from different disciplines can come together and work on projects.”

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“The conference was not afraid to raise some difficult issues and radical solutions. I think this approach will resonate for some time to come and has given a boost to thinking seriously and differently about research culture.”

Feedback from conference attendees.

The next generation

Teaching of the younger generation and ensuring underrepresented groups were in the pipeline at the start was emphasised to 'support of the best and brightest'. Dr Eugenia Cheng called for the community to teach love as well as proficiency. She said we need people who love the research they do. Picking up on similar themes Professor Susan Wessler stated that for science to flourish, the best education needs to be provided to the brightest to ensure a future diverse faculty. However, she then highlighted how traditional teaching of undergraduates by the 'sage on the stage' led to on average dropout rates of 50% of STEM majors in the US student population, and 60 – 80% of underrepresented minorities. Professor Tom McLeish reflected on paths into science. Science is a palace of many doors, but children are currently only shown one. Sir John Kingman picked up on this theme stating that while the UK Research and Innovation could fund 1000 new PhD places, the PhD is the end of the pipeline. The talent pipeline relies on students learning science and maths and wanting to pursue it at A levels before they are eligible at university. All UK primary school children should be given the opportunity to learn STEM subjects to give them the opportunity to pursue these subjects later on. They will be needed for the future of UK research.

Post-conference reflections

Research culture is about everyone within the research system. A range of individuals who attended the conference were asked to reflect on the conference and consider how it had challenged or inspired their thinking around research culture.



Transforming research culture

By Sarah Chaytor, Director of Research Strategy and Policy,
and Joint Chief of Staff Office of the UCL Vice-Provost (Research)

The Royal Society's conference examining research culture in the UK was refreshing both because it offered a dedicated focus on this vital but too often overlooked issue, and because of the plethora of speakers who were 'non-usual' suspects (as well as the great and the good). It was genuinely refreshing to see a healthy proportion of people from BME backgrounds, women, and those earlier in their careers. The fact that this struck me so strongly is in itself, probably a strong indictment of the predominantly middle-aged, white male 'visible face' of our research culture!

A particularly energetic theme was the challenge to the orthodoxy of competition; the idea that the best research emerges from a highly competitive culture. Whilst there is undoubtedly a role for competition, it seems clear the value of team work and collaboration has been far too neglected for far too long. It was highly encouraging to see more thinking about how to develop a more collaborative and inclusive research culture, and the recognition that these aspects should be inherent to how we conceive 'research excellence'. Julia Slingo's inspiring description of how she had fostered a positive and inclusive working environment, and of the key elements in this (including space for creativity, fostering collaboration, mobility and cross-disciplinary thinking, championing diversity and flexible working for those with caring responsibilities) provides a clear model for us all to emulate.

There were two particularly strong take-aways. Firstly, the need to think much more seriously and ambitiously about how to create a more porous research culture and enable more mobile and flexible research careers. In one of my breakout discussions, someone asked why we talk about the career 'pipeline' as if it's entirely linear, and why we only talk about a single pipeline. Moving towards a structure for research careers that involves multiple, intersecting, pathways, and that allows researchers to work in and develop knowledge of other sectors and practices should be a key ambition for us all.

Secondly, the need to reassess our attitude to those lone 'star' academics that work (or seem to work) in isolation. Margaret Heffernan's powerful argument for the importance and effectiveness of team-work and the need to foster collaboration, rather than isolation, suggested that we need to redefine or broaden our notion of what 'research leadership' is. Moving to a concept of inclusive and collaborative leadership, which recognises a responsibility to and reciprocity with colleagues, is a much healthier one for our research culture.

These are ideas I have been reflecting on and with my colleagues at UCL, will incorporate into our revised Research Strategy (and its implementation) in the coming months.

A final note of caution. It is easy, speaking within our research community, to start to take certain things for granted: the value of research, the importance of public investment in research, and so on.

However, in the current climate, where there is an increasingly compelling need for research to consider and contribute to public good, we must be careful to avoid any sense of entitlement. I welcomed the frequent references to the idea that researchers should engage more with the public policy sphere, but feel some of the discussions too often started from an unquestioning assumption that researchers deserved to receive funding, without thinking about how research is inherently integrated with wider society. If we are to open up these discussions of research culture beyond the walls of the Royal Society, we need to think seriously about our societal responsibilities. Whilst a room full of peers may be tolerant of an argument that could be boiled down to: 'Give us money coz we deserve it', the world beyond the Royal Society may be less understanding.



Does revolutionary thinking require a revolution?

By Dr Kate Hendry, URF and Reader in Geochemistry at the University of Bristol.

One of the speakers at the *Research Culture: changing expectations* conference at the Royal Society said that, throughout the two days, we were all essentially talking about the same things. The wider conversation within the community echoes this; we are all identifying the same issues and the same potential solutions, but yet not making progress.

However, I think I'm brave enough to disagree. I came away from the meeting agreeing with Prof Mark Miodownik, that there did seem to be a dichotomy of opinions. These views were most strongly put forward, respectively, by Dr Adam Rutherford, who made a call to arms (revolutionary thinking is needed!) and by Royal Society president Sir Venki Ramakrishnan, who took a view that we need to be cautious about idealism (revolutions fail!).

So, where does that leave us?

For want of a more eloquent soundbite, I think – in the business of thinking – revolutionary thinking doesn't need a revolution. Simple things can be done tomorrow and they can make an impact, if we embrace an attitude change rather than systems change. Improve diversity in our hiring decisions, but also shift our approach to include true inclusivity. We can talk to each other and improve communications: ask about the views of our Early Career Researchers (ECRs), our mid-career researchers, our technicians and support staff, and respect all of these people as essential components of a functioning team. Respect is key.

As highlighted so passionately by Dr Eugenia Cheng: teach love of the subject as well as proficiency. Rekindle our excitement about new ideas, but welcome what we may formally have termed 'negative results', and evidence that our methods are reproducible and robust, as motivating discoveries. At the next conferences you go to, don't present your newest paper, but present your newest idea!

But we'd be kidding ourselves that these simple changes – tweaking the edges of existing structures – will solve all of the problems. Fundamental transformations are needed and systemic change is required. But perhaps this isn't such a

monumental task as it may first appear. Perhaps, instead, one action will actually cause a snowball effect. But what is this action?

I believe that the main thing is that we need to change how we evaluate people and the reward structure in academia. A lot of the revolution will then fall into place.

Get rid of bad practice and bullying! Get rid of the existing reward structure, and this will follow.

Get rid of the aspects of academia that disadvantage women and other minority groups! Get rid of the existing reward structure, and this will follow.

Get rid of the emphasis on impact factors! Get rid of the existing reward structure, and this will follow.

And so on.

We need to change the academic CV, so that people are judged on what they have done broadly in academia, their advances in the field, their links with industry and society, and their contributions to knowledge exchange and outreach. Evidence for this isn't just in the form of papers and books, but might be datasets, online teaching resources, a television series, or a patent. This means that the CV can be shaped, naturally, for different subject areas and disciplines as well as cross-discipline research.

Then, we can move on to the wider sector-level change. Once the shift has been made in terms of what academics consider an appropriate CV, then we can apply pressure for top-down action, to align this new vision with how excellence is judged at a national level in the Research Excellence Framework and by funding bodies, most notably UK Research and Innovation.

This is no more difficult a challenge than the introduction of open access publishing, which – although shocking at the time – is now becoming an everyday part of academia and industry.

Yes, revolutionary thinking is needed, but I do believe it's in our sights.



Time for more research on research

By Steven Hill, Director of Research at Research England

There is no doubt that research culture is high on the policy agenda, with questions about diversity, misconduct, integrity, bullying and harassment all receiving lots of attention. These and the other complex issues that make up research culture are interrelated, and also can't be separated from the context within which research is conducted. There are limited resources for research, that need to be deployed strategically to meet the objectives of the funders of research, and the autonomous organisations that conduct it.

In bringing this agenda to the forefront of their policy work, the Royal Society deserves huge credit. In addition to the actual change that the work will bring about directly, the mere fact that the national academy of science is publicly expressing concern, and trying to make change on these issues sends a very powerful signal. It would be easy for an organisation made up of researchers who have succeeded within the current system to remain complacent or resigned to that system. Instead the Royal Society is seeking to lead change, both through detailed and practical work, as well as stimulating the debate through events like the conference.

There was a lot of other positives to take away from the conference, especially the inspiring examples of individuals working hard to bring about real change. But I was also struck by how far we have to go in terms of changing research culture for the better. In particular, now that the issues have been raised, what is needed is a more evidence-led approach to solutions.

It is essential that researchers themselves are engaged with the debate about research culture, but it is equally important to recognise that anyone's views will be strongly influenced by their own experiences. As well as researchers' opinions we require more evidence. Of course, this will sometimes challenge the preconceptions of researchers, but that is the point – anecdotes are unreliable. We should be as rigorous about evidence on research, as we are about evidence in research.

There is already a wealth of knowledge about how workplace cultures in general, and research cultures specifically, operate. This evidence-base seems rarely to feature in the debate. For example, competition for funding is often presented as a problem for research cultures, without reference to the evidence which suggests both negative and positive aspects of competition.

A step forward in improving the quality of debate around aspects of research culture would be the commissioning of a series of evidence syntheses or meta-analyses on key topics. As well as summarising the current evidence, these should also highlight gaps in the evidence base, and make action-oriented recommendations where the evidence allows.

A further area for improvement is the evaluation of the effect of proposed changes or new interventions. Rather than jumping to solutions, we should support experimentation and pilots, testing their effectiveness. Sometimes this could take the form of randomised control trials, although we should also take advantage of natural experiments. In all cases, our aim should be to improve our understanding of how research cultures work, as well as testing new interventions.

Finally, the learning that comes from evidence syntheses and evaluations ought to be collected together and shared to improve best practice. If we are serious in our discussion of research culture, and indeed other aspects of the effectiveness of the research system, perhaps now is the time for an independent 'What works' centre for research on research, as recently called for by James Wilsdon.

The last two year's work and the recent conference have demonstrated that the Royal Society is serious about addressing the challenge of improving research culture. To move forward from debate to effective action, the Royal Society, perhaps joining forces with the other national academies, should promote and lead a step-change in the gathering and use of evidence about research.



Don't let the system fail our future research leaders

By Catriona J. MacCallum, Director of Open Science at Hindawi

What does culture change mean for research and scholarly communication? To me, like many, changing research culture is fundamentally about changing the reward and incentive system. It is moving away from a focus on where researchers publish to what they publish and how their work and activities contribute to science, society, and the growth of knowledge more generally. This includes, for example, making articles Open Access, collecting and curating data, writing software that can be reused, as well as teaching and public engagement - what is increasingly known as 'Open Science'.

My view of Open Science broadened, however, after I was privileged to attend two thought-provoking meetings in the space of one week: a Royal Society workshop, 'Research culture: Changing Expectations' – the focus of this post – and the OpenCon conference organised by SPARC. The first was held at the Royal Society in London, home to many of the world's most famous scientists, past and present, while the other took place at the York University campus in Toronto, with some of the next generation of researchers at the outset of their careers. These meetings powerfully complemented each other; both changed my expectations of what we should expect from a 21st century research culture and who the role models for that culture change might be.

At US public universities, 50% of undergraduate students drop out (60-80% for underrepresented minorities), whilst in the US and UK only about 6% of PhD students ever make it to professor. Those that do are mostly men and mostly white. Often less than 10% of the senior faculty are women. And, as I learned at the Royal Society, despite awareness of these figures and years of policies and interventions to redress the balance, the numbers have essentially remained unchanged.

That our lecturers and labs do not reflect the gender and ethnic diversity of our society is no accident. Hypercompetition can bring out the worst in people, as indeed it does in chickens... Margaret Heffernan recounted research done by William Muir at Purdue where the hens that laid the most eggs were chosen to be part of a superflock. At the end of the experiment, rather than finding an abundance of eggs, all but three of the nine hens

in the flock were dead. While picking out the best egg layers, the researchers had also inadvertently selected the most aggressive hens. This message resonated one way or another throughout the workshop – the success of the few in science today is too often at the expense of the many, who often play an equally vital role but are not recognised and rewarded for it. Heffernan also challenged the supposed truth that competition means the best rise to the top. Where it is sink or swim, she added, people will do anything to survive: "the steeper the hierarchy, the greater the corruption".

What I found most interesting, however, was not the retelling of the negative behaviour that we increasingly hear about, but the evidence of what makes a productive, innovative, and happy team. Heffernan discussed the need for three attributes or types: lions, the leaders; owls, the thinkers; and St Bernard's, those who are also willing to support and help other team members. Individuals can be a mix of these. She told of one lab head who had recruited a team of stellar scientists, but then couldn't work out why it was so dysfunctional. When analysed, they found lots of lions and owls, but no St Bernard's. Research has also consistently shown that more productive groups are ones in which no voice dominates, score more highly for empathy, and contain more women. As she said, too often we are measuring scientists in terms of the bricks and not looking at what really counts in terms of productivity and innovation – the mortar.

We all have a responsibility to sweep away the perverse incentives in the current system. Mark Walport emphasised that the name of the journal must NOT be used as a surrogate for the quality of the work. The hypercompetitive research culture of the West, with its focus on a very limited set of 'bricks' combined with the cult of the superstar scientist – or the 'sage on the stage', as Susan Wessler put it – has also meant the loss of a huge amount of diversity, alongside the skills and talent it engenders. The UK needs 50% more researchers to fill the growing R&D gap. John Kingman, Chair of UKRI and Legal and General PLC, concluded that closing the gender gap in science might be the single biggest thing the country could do to redress this. A systems problem requires disruption across many levels of the system, from funders, institutions, and publishers, as

well as researchers. Plan S, with its focus not just on Open Access but on a commitment to fundamentally change the way researchers are evaluated, with the Declaration on Research Assessment (DORA) as a starting point, is one way that the European Commission and UKRI intends to do this. Wellcome and the Gates foundation have also recently joined this coalition. Researchers rebelling against the plan cite restriction on their academic freedom, without realising they do not have any real choice in the current system, as Jos Baeten *et al.* of the Fair Open Access Alliance have pointed out. Such academic sentiment is evidence of how entrenched the current culture has become. It is also one that actively discriminates against early career researchers, women, ethnic minorities, as well as most of the Global South, whether it is via paywalls or peer review. The rich get richer and yet we continue to fool ourselves that it is a meritocracy.

I was not the only one there struck by the fact that the conference was hosted by scientists who have reached the pinnacle of their career. As David Sweeney, Exec. Chair of Research England, noted, 99% of scholars are not Nobel Prize winners or Fellows of the Royal Society, and indeed may never have set foot there. That they have succeeded in the current system is tantamount not just to their incredible talent, but also to their skills at navigating a system over the past 30+ years where the key currency was very often (at least in the life sciences) that elusive paper in a high-ranking/high-Impact Factor journal. They are also there because they have been able to run successful and productive teams – they do care about the mortar. Those at the workshop are also acutely aware of the deep-seated problems in the current system and are actively trying to remedy it. Scholarly societies such as the Royal Society have a hugely important role in helping to understand, lead, and navigate the economic and cultural changes required for a research environment fit for the 21st century.

No-one can dispute that the discoveries made in the past 50 years or so in science are remarkable, as are the individuals who have contributed to them. The Royal Society in the UK and National Academy of Sciences in the US are justifiable halls of fame. But what we don't know is what we don't have – those discoveries and insights and innovations that might have been possible had the research culture been more open, more collaborative, more empathic, and more inclusive. There is room for healthy competition, but only if we can change our expectations about the nature of the prize.

By the end of the workshop, I was left wondering who it is now that can actively embody the change that had been identified – and are they being rewarded? I found the answer in Canada. It is the next generation of researchers - ironically those who are among the most penalised by the current system - where the role models we need can also be found. The OpenCon conference in Toronto was dedicated to them and run by them. I was amazed by the bravery and determination of the speakers and participants who are putting in place projects and support for Open Access, open data and open education. Their aim, and that of OpenCon, is to promote a set of common values around openness that is sensitive to the relevant cultural context alongside a scientific work ethic that aims to be safe and inclusive for the many different skills and voices research requires. Some of them work in the face of extreme gender bias and sexual harassment. Some of them are working in war zones or areas of deep poverty and little education. And still others are trying to change the system in the West from within. I found it truly inspirational. My overriding concern, however, is that the reward system we currently have cannot keep these talented individuals within science itself.

I would like to put Early Career Researchers on centre stage. I would like to see more of them invited to venues such as the Royal Society, where they can interact with some of the world's leading scientists who also recognise the need for change. Let them work together to help decide the future – a 'research culture that embraces all', as David Sweeney argued for. We need to accept and encourage different definitions of success and then let prestigious and influential bodies like scholarly societies and funders find a way to reward them so that they become the next leaders of science. I feel a great urgency in this. We need to act now before they too decide to leave or because they fail – because the current system failed them.



A shopping list of 'to-dos'

By Professor Dame Georgina Mace FRS, Professor of Biodiversity and Ecosystems, and Head of the Centre for Biodiversity and Environment Research at UCL

Overall research culture has not evolved as research practice has changed. So there is now a set of structures and traditions in place that are just not fit for purpose and starting to stifle success.

1. The early career researcher (ECR) stage is particularly problematic and a serious deterrent to good people staying in research. The uncertainty, lack of freedoms and over-dependence on securing a position in a 'good' lab are the key problems. The solution is to make ECR posts more independent, not fixed-term and coming with their own research money. There seem to be few disadvantages to this. More ECR positions need not be a bad thing either if leaving science to take the skills learned into other sectors and careers is appropriately supported and rewarded.
2. The tradition of the strong lab leader and 'his' lab is no longer a good model for doing science or the basis for measuring success. Teams and groups are the way to go. HEIs should be growing strong groups which can be very varied in size, structure and function according to what is appropriate to the topic. Assessment is better geared towards assessing the success of groups (in Research Excellence Framework etc).
3. A lot of progress has been made with diversity but there is no reason to think that it is solved. In particular, there is poor inclusion of ethnic and social groups and this is damaging research culture.
4. The scientific publication system is broken and a mess that needs to be sorted out. There are many different aspects but I think that a move away from journal-based metrics of researcher performance, along with a consistent and realistic strategy by research funders to support open access publishing across disciplines are necessary first steps.



The ideal research culture?

By Professor Richard Massey, Royal Society Research Fellow in the Department of Physics, Durham University

From evaporating black holes to DNA and the world-wide web, British research has enjoyed success far beyond our size. But 250 scientists, funders, university executives and publishers gathered in London, and a thousand more streamed online, because we all recognise flaws in British research culture. If we improve the environment in which we do research, imagine how many more discoveries we could make, medicines we could invent, and problems we could solve.

How to counter a culture

The meeting culminated in a plea to executives attending from UKRI, Research England, the Wellcome Trust, European Commission and the Royal Society, to impose rules that would increase the perceived value of research and of all those doing research. My favourite suggestions were:

1. Rearrange funding mechanisms to supply 100% of the cost of a research project, honestly. The current conspiracy of 80%+overheads skews effort between fields – and, set against uncapped student numbers, demotes all research activity to no more than a loss-leader.
2. Require contracts for early career researchers to work at most 80% of their time on someone else's project. The 100% expectations usual in some fields inhibit career development of the next generation, and the short-term contracts encourage low-risk, incremental research.
3. Set and enforce rules about funding laboratory technicians, computer support, admin, public engagement, and travel expenses as part of a grant. These are economic multipliers that make research more efficient.

If this means better funding to fewer projects, so be it. By establishing the most attractive research culture, the UK could attract enough outstanding teachers and scientists to enable the government's proposed increase in R&D spending from 1.7% to 2.4% (or 3%) of GDP. This will eventually fund more, better projects.

Top-down change is needed because of the perverse incentives of academia's pyramid scheme that deter people from doing the right thing. For example, unless budgets for support staff/travel/CPD are required, they tend to be trimmed by grant review panels (or, shockingly, by funding agencies themselves). Even principal investigators who had good intentions when writing a proposal have incentives at odds with those of junior researchers when it comes to meeting deadlines. To be effective, campaigns must also be coordinated across funding agencies. For example, although for decades the Research Excellence Framework has (commendably) judged the quality of a few papers, other systems still reward the quantity of papers, so the deluge has continued.

What went wrong?

Frustratingly, most of the problems in our research culture are our own fault, stemming from the narrow criteria we set up to recognise and reward research. We insufficiently value the cadre of software engineers, data analysts, secretaries, technicians, computer managers, etc. who make research possible. Without support, scientists who are hired for their creative ability are then compelled to spend almost all their time doing administration, writing proposals for grants with <10% success rate, or worse... managing. When nerds can't manage people, and aren't told how, it turns out that some resort to bullying. In the worst laboratories, 'disposable' students and postdocs are indentured to a project with no opportunity for free inquiry.

The hyper-competitive environment to meet narrow criteria is off putting, and segregating. We built a wall around academia that makes those inside feel clever, but reduces our influence with the rest of society. Perhaps it could be made more transparent by allowing outsiders to influence research agendas? We have also built walls between academics, discouraging collaboration. The 'superstar' culture of giving prizes to individuals ignores the reality that modern research is done in teams. Yet teams no longer discuss their preliminary results at conferences, for fear it will undermine a press release or publication in *Nature*.

What would be right?

To set an optimistic goal for the future, our panel was asked to imagine the ideal research culture. There is not a single answer, because fields are different. But, inspired by conversations at the Royal Society, here is an imagined day in the life of a science postdoc 20 years from now. After all, research is a creative art.

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I arrive at work and drop my kids at daycare on campus. I'm here early because the weekly journal club is on an awkward time zone. But holding it in a virtual environment lets me talk to people from all over the world – and all researchers now have a guaranteed minimum travel grant, for occasional face-to-face meetings. The discussion weaves broadly, now it has become easier to keep up with a wide range of literature since a cap was placed on the number of papers people could publish. Individual papers are now more thoughtful.

One paper today suggested a better question than the one I asked in my thesis. My contract reserves Mondays for my own research, so I spend the morning doing a few calculations, and think it will work. Anyone at the university is allowed to ask for time to apply for grants, and I may draft a proposal to hire a student. I'll run the idea past my mentor.

After lunch, I write a reference for my boss. She is applying for promotion, and 360-degree referencing ensures that everyone is treated fairly.

In the afternoon, I visit the archaeology department. I did a 6-month rotation there last year, fulfilling a dream that was closed when I chose sciences at school. It turns out that the work we did was well received at a recent conference. I stay longer than I had planned, enjoying discussions over their communal coffee meeting. For my next placement, I am considering working at a local engineering firm, or a school. Research council funding for my main project only covered 3 years, but the University's block funding glues together fragmented funding, and let me move to the city for a longer time if I chose.

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We need to talk about intersectoral research

By Wendy Middleton, Head of the Insights Unit in the Office for Product Safety and Standards and Government Science and Engineering Champion, Department for Business, Energy and Industrial Strategy

We all love science and we all have a stake in it. The remarks of Mark Miodownik during his welcome speech struck a chord with me, as I'm sure they did the majority of the audience.

I was also struck by the definition of research in Dame Julia Slingo's opening plenary, "creative and systematic work undertaken in order to increase the stock of knowledge – including knowledge of humankind, culture and society – and to devise new applications of available knowledge."

'Wicked problems' – climate change, waste, cancer, AIDS/ HIV, biodiversity, hunger, obesity – with complex interdependencies and whose solutions require huge societal shifts in behaviour, need everything science has got to increase our knowledge of them and to devise applications of available knowledge in the form of innovative and practical interventions.

Not only would a more diverse scientific community catalyse innovation to support these goals, but it would also better reflect society and so help science remain competitive; reduce replacement costs; better meet the expectations of the next generation and so draw in talent; and promote the development of all of those working in it.

We heard over the two days of the conference of a number of innovative and exciting efforts of both individuals and institutions to improve diversity and inclusion in research. We spoke less about diversity in terms of how we recognise and embrace the research efforts of those outside of academia. Those scientists working in industry, government, NGOs and as private citizens, who might not be conducting experiments or publishing research papers, but whose research efforts are providing insights – increasing the stock of knowledge – crucial to their own sectors. We also spoke less about collaboration between sectors in general, how science can pull with those working in areas critical to devising and implementing solutions to problems that concern us all.

Intersectoral collaboration or research describes both the cooperation between researchers in, and amalgamation of research generated by different sectors.

As a scientist working in government, I've seen first-hand the benefits of bringing together expertise from different sectors. In all of the areas I have worked in (animal welfare, animal disease, climate science, product safety) without the knowledge and insights provided by my colleagues working in different sectors, we cannot develop relevant good policy.

If 'wicked problems' – cross-sectoral problems – require everything science has got to solve them, the prize of combining the efforts of scientists working in different sectors – intersectoral research – could be huge. The challenge is that it requires us to understand and attempt to merge often incompatible systems, and to overcome our respective hierarchies and issues with diversity and inclusion.

We all love science and we all have a stake in it. As one speaker said, outcomes happen if you look after process. If we all take responsibility for challenging and changing the culture of our own sectors and all make a commitment to recognise other scientists across sectors and collaborate more – whatever the barriers – perhaps we can learn a little from each other about how to achieve change, and start to break down some of those wicked problems in the process.



Can we make competition a positive force for science?

By Liz Simmonds, Postdoc Careers Adviser, University of Cambridge

As someone whose list of passions in life is topped by science and sport, I was delighted to see Liz Nicholl, Chief Executive of UK Sport, on the bill at a conference on the culture of scientific research. And she wasn't alone in drawing on the sporting world for inspiration. Prof Leanne Hodson and her PhD student Pippa Gunn gave an inspirational talk comparing the running of a lab with a rowing eight. All this got me thinking about the parallels between these two worlds, science and sport, especially around the themes of competition and teams. What could we learn from sport to make positive changes in research culture?

Competition was a big theme throughout the conference, and among the majority it seemed clear that for science it's considered a Bad Thing. A culture which prizes the individual glory of a very few was seen to be a major contributor to high stress levels, bad behaviour, and many young researchers feeling undervalued in their work. But sport, professional sport at least, is unashamedly competitive. We play to win. We also celebrate individuals: the top goal scorer, the gold medallist, the yellow jersey. What makes this more acceptable in sport than in science?

My sense is that it comes down to how we value the team. In team sports, this is clear. An individual might deliver a brilliant performance, but we recognise that he or she did that with the support of their team. And the whole team, including the supporters, share in the result and the glory. 'Man of the match' is something for the individual to aspire to, but probably means much less to them than winning the cup or league with their team. Even those competing in individual sports effectively do so as part of a team (team GB for instance). And these teams are recognised, valued and celebrated, as much as the individual, in some cases more. If we think back to our success in the last two Olympic Games, we might remember a few brilliant individuals, but what we really celebrate is the total medal haul of the team.

How does this compare with science? We talk of teams of researchers, striving for shared goals, but in fact a research group is much more a collection of individuals, all working to their own objectives, mainly because they will always be judged as individuals. In navigating the career ladder, it's all about presenting independent, personal work, and ultimately any big prizes go to an individual or individuals, not a team. When a scientist achieves a major breakthrough, we know there are likely to be many others who have contributed to that work in many different ways. They might be lucky to get acknowledgement from a prize winner, or share in the excitement of having been part of something big, but ultimately reflected glory doesn't carry much weight on the job market, which is where it needs to count. Like the domestiques of science, postdocs may well end up toiling away for the glory of their lead rider.

So does it make sense to get rid of competition in science? We know that many a major advance in science has been accelerated when multiple research groups have been focused on the same question. But would this aspect of research culture be more palatable if the success could be shared more across the team, as it is in sport? Let's start giving prizes in science to teams – something that wouldn't be too difficult to introduce. A bigger culture change, but one we should aim for, is to establish ways to make sure we give credit to everyone who makes a contribution to an outstanding piece of work. This was an idea we heard again and again at *Changing expectations*, but if we could really make it happen, the research team finally becomes a real team. If we can do this, we needn't fear competition, and then like any sports team, we can all play to win.



POST-CONFERENCE REFLECTIONS

Research integrity – at the heart of a strong research culture

By Catherine Winchester, Senior Research Adviser,
Cancer Research UK Beatson Institute

What a fantastic opportunity to effect change! We all know the challenges of creating a healthy and productive research culture and recurring issues certainly emerged over the course of this conference; narrow career structure, gender imbalance, research assessment metrics and publishing models, to name a few. Having agreed that the culture of a research environment has a huge impact on all aspects of science and on the lives of individual researchers, rather than dwelling on the negatives the conference was a buzz of ideas and positive, and sometimes provocative, discussion. My particular interest is in research integrity and the drivers that lead to bad practices and ultimately to poor and unreliable science. So I was delighted to hear Sir John Skehel, Vice President of the Royal Society, mention in his welcoming address that research integrity is at the heart of research culture. In my own institute we are striving to generate a positive research culture by openly discussing research integrity, revising policies and implementing mechanisms to support researchers in the generation of robust and reproducible data and by providing formal training. But as this conference highlighted there is so much more we can all do to foster best research practices and improve research culture.

Several talks at the conference made me think in a much more expansive way about research culture in the context of the research environment. Starting with researchers' local environments, which directly impact on how researchers feel and behave. Any positive changes to improve the wellbeing and career development of researchers can only benefit science. Happy and motivated researchers are more likely to work honestly and productively. We could all learn a lot from the way

Leanne Hodson, Professor of Metabolic Physiology at the University of Oxford, runs her group, with mutual respect, trust and honesty and with everyone's contribution being valued. Several other speakers echoed the themes of teamwork, collaboration and inclusivity, and in particular the inspirational talk by Margaret Heffernan, TED speaker and entrepreneur, left me with food for thought about the autonomy of a research group. If the research culture within individual research groups is so dependent on principal investigators and their personalities should these research leaders be trained in social skills such as empathy, helpfulness and social harmony? This seems like something that could be easy to implement and not too costly a means of revolutionising research culture.

Thinking further afield, all stakeholders from government bodies to funders, publishers and policy makers all have a part to play in changing the research culture for the better. It's hard not to consider the negative influences that some of the measures of research success have on a researcher's wellbeing and behaviour to succeed, that can sometimes lead to bad science. Not only do funders have the opportunity to influence change in areas such as the use of publication metrics to evaluate the worth of science, they have the power to introduce funding sanctions for bad and inappropriate behaviour, including bullying or harassment as well as research misconduct.

However, we all have a part to play in maintaining scientific integrity and improving the future research culture. I think we can all implement small changes in our own research environments, such as valuing every researcher's contribution and promoting openness, honesty and transparency.



If we want to change research culture, we have to change the system

By Dr Anna Zecharia, Director, Policy and Public Affairs,
British Pharmacological Society and co-Director, ScienceGrrl

What is research culture? What would we like it to be? Why should we care? If culture is ‘the way we do things around here’ then you could argue it doesn’t really matter as long as things get done. As long as the UK is still regarded as a research leader, and has the capacity to increase its research intensity for the benefit of the UK economy. However, our values and our approach define who we are, individually and collectively. They also have the potential to shape the nature and quality of research. Done badly, research culture can be overly competitive, self-serving and it can exclude those who don’t fit the mould. I believe we should be aiming for a research culture that is consistently collaborative, supportive and science-driven. Taking a fair and long-term approach will help us get there.

Cultural change will, in part, emerge from systems change. I had a moment of realisation at the recent #sciculture conference: we are so enmeshed in the realities of the system as we know it that we mistake this reality for an immovable truth. If moving to a different research culture means we need to ‘start to do things differently around here’, we need to dismantle a deeply held belief that we can do this whilst keeping the current system largely intact. I was encouraged that so much of the conversation honed in on the peculiarities of this system: the (quite frankly) perverse incentives and rewards in academia. The short version of this is that first/last author papers in journals with high impact factors lead to security and prestige. Little else is consistently valued. This has led to the implicit sanctioning of behaviour that puts individual success first. Left unchecked, problematic research culture emerges.

The mood for change has been building. There has been a sector-wide focus on improving diversity, removing unconscious bias and the introduction of charter marks such as the Athena SWAN. There has been growing action to support the mental wellbeing of early career researchers and #teamsience has crystallised as a concept. The desire for change is also expressing itself in policy terms. For example, the Research Excellence Framework rewards research ‘environment’ and ‘impact’ rather than solely outputs, the introduction of UKRI is intended to promote cohesion and collaboration. The move to open access publishing is about sharing knowledge whilst the growing support for cross-sector collaborations recognises the value of working together in pursuit of a shared mission. These many threads of discussion and action are inexorably interlinked when considering how to shape an ideal research culture, but they seem to remain in stubbornly separate silos.

These advances also have one thing in common. They are all driven by a focus on the end result: producing more impactful research and innovation. Fairness and equality rightly drive a number of them too. Together these drivers make a ‘business’ and a ‘moral’ case for change. Two senior Fellows of the Royal Society warned against too much change because we ‘might break the system’. In my view, this is the entire point. David Sweeney challenged the elite echelons of academia for acting with too much self-interest and forgetting about the purpose of research as well as those who are doing the bulk of the work – those ‘not in the 1%’. Which leads me to ask – where does the power to affect change lie? In my mind it’s quite simple. The power is where the money is. It’s with the employers, the institutions and the funders.

If we try to improve culture without changing the system, we are doomed to failure. If, however, we are prepared to admit that if we were designing the system from scratch today it would look very different, then we might be onto something. Because how we do things around here does matter. Those who have succeeded in the current system will tell you that it needs to be this way; that we need to pit people against each other and work all hours in the name of 'excellence'. Attempts to redefine the system will be actively dismissed under the cover of the 'pursuit of excellence' and 'academic freedom' by some. But this is smoke and mirrors. Just because one way of doing things has worked for some people and some challenges, it doesn't hold that it is the best or the only way. For example, the pharmaceutical industry is demonstrating that redefining competitive space (eg via the Innovative Medicines Initiative) can yield dividends for research and development. And if we really believe that diverse, collaborative teams are more creative, innovative and productive then what is stopping us from rebuilding our system in the image of the contribution we want to make?

I understand that this is a big challenge, but science is good at big challenges. I also can't help but suspect that whilst it's not easy, it's also not that complicated. Plenty of other sectors have figured out how to assess employees on their skills and competencies, and they don't take a reductionist approach to results. For example, I work at the British Pharmacological Society where we have introduced a broad competency framework that outlines the behaviours expected of employees, and this is tied to a transparent remuneration and benefits system. Good companies work hard to keep good people, and they know what they are looking for. I don't believe academic research needs to take a fundamentally different approach.

If we keep feeding the system by overvaluing short-term outputs at the expense of everything else then we will keep seeing problems – not least with research integrity, efficiency and reproducibility. If, however, we could get explicit about the wide range of skills we need in research (not just research skills) for the long-term, and commit to rewarding and developing those people and structures best placed to deliver them, we would probably end up with a system and culture that looks very different.

Change is uncomfortable and it is difficult, even when it is worth it. I keep coming back to my moment of realisation. Nothing is set in stone. The plethora of activity and discussion suggests that the community is close to defining what it wants and values from research and researchers. It would be helpful to collate this thinking and start to describe a shared vision for the future. Then, we need to get clear about the barriers and develop strategies to dismantle them. Employers, institutions and funders hold much of the power, but we all have a right and responsibility to do this. We are working towards a 2.4% of GDP investment in research and innovation. It matters how we get there.

Research culture – what next?

The research culture programme has highlighted the importance the Society places on strong culture and underlining its importance to research excellence. By bringing together new networks of people and providing tools to support discussions, the Society has created space for new conversations about culture to start and new initiatives to be developed. The findings of the research culture programme will continue to influence the work of the Society going forward. Now the Society and research community at large need to think about next steps and how research culture in the UK and globally can continue to be developed to enable researchers to successfully tackle the big problems of our time.

Appendix A

Questions from the audience

Throughout the two days' delegates posted questions on Sli.do, an online audience engagement tool. They were then encouraged to vote for those that they wanted the panellists to answer. Below are a selection of the most popular.

Should we abolish short-term post-doc contracts and move towards permanent post-doc positions in universities?

36 votes

How can the changes in research culture discussed in this panel and the whole event actually be achieved?

29 votes

Do we need to recruit more researchers or just be better at retaining the ones we already have trained who leave?

28 votes

The real elephant in the room: every academic job component is growing: teaching, research, policy etc and it's a lie that it's possible to do more of everything

27 votes

What solution do you see for supporting PhD graduates in alternative careers outside of academia?

27 votes

What suggestions do the panel have for identifying / rewarding scientists who are working collaboratively?

26 votes

Do we need to celebrate escaping the academic pyramid scheme more? eg. celebrate the achievement of PhDs who left to go into commercial/social applications?

25 votes

How to we get buy-in from senior leaders to support CPD in a research environment?

24 votes

Can we talk more about research culture pipeline? How do we get children from every background to feel it's an inclusive and exciting career?

20 votes

Do we need to rethink how we define 'research leadership' to value those leaders who champion teamwork, collaboration and supporting others?

19 votes

How important is it to train research scientists on team working and leadership techniques?

19 votes

Should the Royal Society stop giving FRS's and thus stop promoting the idea of superstar scientists?

19 votes

Why do you think that creativity is so under-discussed in science although it is, as you say, so vital?

18 votes

Is REF a cause or a solution to the problem? Or both?

16 votes

How do we create research environments where bullying and "being mean" cannot thrive? How can we mitigate risk for those who speak out?

16 votes

Should the RS introduce a new prize scheme that rewards collaboration and collegiality? And / or team prizes?

16 votes

If research culture issues arise as systems problem, who has agency to change the system?

16 votes

Yes, need to break the link between doing a PhD and expecting a career in academia. So we need to promote the broad value of a PhD. Thoughts on how to do this?

15 votes

How do we better value 'administration'? All very well 'disliking' it but risk devaluing the people whose role it primarily is.

15 votes

Solving big world problems requires cross-society collaboration... Shall we talk about intersectoral research in addition to interdisciplinary research?

15 votes

How can lower ranked staff prosecute lemon leaders who bully and harass when the HR system processes fail and institute executives seem to turn a blind eye?

15 votes

How can we overcome the damaging assumption that only 'scientists' ought to/can talk about science? (Imposter syndrome in teachers, admins, writers, ...)?

14 votes

Will industry scientists embrace open access for their outputs? Will their companies encourage, or even mandate open access?

12 votes

How do we reduce admin with such a complex funding system, and in a political culture of accountability?

12 votes

Appendix B

Conference ideas

Across the two days many ideas were generated by attendees; within the working groups, on Twitter and Sli.do and during the audience discussion. Some of these ideas have been captured below to help keep the discussion about how a strong research culture is created and maintained going.

Career development

- Contracts could include a set amount of time for career development.
- A mixture of IMDB, LinkedIn and ORCID could be used to attribute credit/contributions/skills.
- Compulsory supervisory training for all new principal investigators that comes with a financial implication for those who refuse to take it. This should include training on career coaching.
- Greater support for mid-career researchers should be provided, giving them the opportunity to supervise students and get funding to go on courses.
- Postdocs could be allocated 20% of their time to pursue their own research. This could be written into grants and fellowships.
- Time should be taken early on in researchers' careers to build foundational skills in supervision.
- Principal investigator and supervision training should be a central part of Doctoral Training programmes, giving them the skills to manage teams and run appraisals. A professional qualification in supervision could be created that can then be used to badge individuals as they move around different organisations.
- There should be more supervision awards (with no self-nomination).
- Better sign-post the variety of careers available to those with PhDs to supervisors and academics. They need to change their perception of life outside of academia. Perhaps encouraging PhDs who have gone into other sectors to come back and discuss their experience or have work experience placements as standard. Other mechanisms to create and promote positive role models (be who you can see!) and non-academic career trajectories could also be thought about.

- Put on drop-in career sessions in PhD offices to help them begin to recognise their own transferable skills.
- Each new group joiner should only have their funding released upon submission of a credible and co-signed career development plan. This plan should also emphasise reproducibility and integrity.
- Send Professors out into other sectors to experience other work environments.
- Ensure PhDs have a personal mentor/supervisor as well as their academic supervisor to support other activity (eg policy development, industry engagement or public engagement).
- Put early-career researchers on boards (initially as observers).

Recruitment and employment

- Leaving academia should no longer be seen as a failure. Principal investigators and supervisors should celebrate and be open about all the destinations of their researchers by listing them on their webpages.
- Have anonymised CVs as part of all recruitment processes.
- Postdoc applicants should meet the prospective research team as well as the principal investigators as part of the interview process
- Institutions must make sure that all new PhD and postdocs receive employment policies as would any new starter in any other organisations.
- Change how language is used to describe 'non-academic' staff so that they feel valued.
- Follow the industry model for large engineering projects – create a pool of people who could be flexed between projects as needed. Longer term posts within the pool allow time for specialist knowledge to be developed by the individual and retained by the organisation. It also means junior staff are not tied to certain projects, feeling unable to leave if there are issues.

- Have clear career paths for people with different skills (as in the civil service) instead of trying to get everyone to do everything.
- Accept that not all projects will work out. Allow for failure and redeploy people onto other projects as happens in industry research.
- Look at new forms of CVs that give a more rounded view of the individual. This would start to move away from the practice of extensive references being sought from previous teams, which gives previous bosses too much power to ruin careers.
- Remove the administrative burden that many academics feel under, but also recognise the contribution of those who take it on.
- All universities should sign up to the San Francisco Declaration on Researcher Assessment (DORA). Publicly committing them to not use journal-based metrics as a surrogate measure of the quality of individual research articles, to assess an individual scientist's contributions.
- Organisations should have 360-degree feedback on supervisors.
- REF should be focused on the institution and not the individual. Individuals should not be discussed as 'REF-able'.
- Make job-sharing an option for all research staff in academia (as already happens at some organisations, for example UCL).

Open science and publishing

- Openly available research data. A national mapping exercise on all of the data there already is held by UK teams could support ongoing work and bring new teams together.
- Let's rethink the journal. Online repositories and platforms can be used to disseminate the work instead of traditional journals.
- All publishers should use ORCID to validate peer reviewers.
- Universities, publishers and funders should enforce authorship rules. Publishers should experiment with different ways of listing authors. Reviewers and authors could ask publishers what listing system is being used by publishers on a particular journal and what the reasoning behind choosing that was.
- The head of a group should be seen as an enabler or research rather than the lead author on every publication.

Culture

- Hierarchy in research groups can be a major problem in terms of research culture. Can the size of groups be limited? Another suggestion was that large research groups were broken into 'subunits' run by postdocs.
- Principal investigators should properly credit the research efforts of all members of their teams.
- Inclusion should be promoted by bringing in individuals who are not PhD students and not doing research as part of their role.
- Discussion groups could be set up in departments for PhDs, PIs and PDRAs on cultural issues. They could run facilitated discussions and also pair with other schools (not necessarily a science one!) to bring in diverse viewpoints.
- Organisations should support bottom-up approaches to improve research culture, as well as also being willing to reflect on practice at the top. This should be part of a long-term approach to improvement.
- Regular away days that focus on team building not business should be encouraged. Time for creativity should be encouraged in shared spaces, informal discussions and team building activities.
- Breaks with cakes (and fruit) should be encouraged to improve relationships between those in teams.
- The creation of research groups 'contracts' that all individuals in the help create and sign. This would include details on mission, research priorities, lab hygiene, relationships and respect, culture, career development and expectations.
- 'Whistle-blowing' mechanisms should exist for concerns about bullying, harassment and research integrity. Independent dispute resolution services could also be created to tackle bullying, such as at the UC San Diego (<https://ombuds.ucsd.edu/>).
- Teaching and research in the humanities and social sciences tends to be seen as a package. How can this be encouraged in the sciences, allowing teaching to feed into research and vice versa.
- The STEM community needs to be much more engaged with other disciplines. New links could potentially help improve research culture.

Funding

- The national funding framework could explicitly consider wellbeing of staff and whether negative results are ever published.
- Institutions should be assessed/monitored on the exit information of past students.
- More lab technicians should be employed to provide better lab continuity and knowledge retention. Funders should take into account the importance of technicians when designing grants.
- People and organisational policy adapt to funding demands. If there is going to be more money in the system why not permanently employ more people eg technicians.
- REF gaming by institutions should be replaced by long-term research strategies. Moving institutions towards this should be a key aim of the team developing REF 2025.
- Funders should enforce data sharing policies with financial penalties for those that do not comply.
- Funders should tie funding to the Athena Swan Award and not fund organisations that haven't reached a certain level.
- Anonymised grant application forms could be considered.
- Create funding schemes that would support a range of projects (rather than just one). This would allow people with different skills to be moved across different projects and also for resource to be moved around as it was needed.
- Funders to withdraw funding if allegations of harassment against the named holder are proven.
- The link between postdocs and project grants should be broken.
- All project funding should go to the university not the individual. Giving it to the individual mean some see themselves as autonomous and above organisation rules and procedure.

Research integrity

- Research integrity should be an embedded part of discussions about work. It should be discussed alongside project plans and the latest results.
- Peer review of hypothesis before the experiment starts would help encourage better design and implementation of research.

- A version of the Hippocratic Oath for researchers could be developed, touching on research integrity and reproducibility.

Diversity and inclusivity

- Group leaders should create an environment based on respect, trust and integrity. A culture of inclusivity would recognise administrative staff, postdocs, technicians, contract staff and those with expertise in other disciplines.
- A public engagement campaign on 'what science is' should be run, using competitions and other engagement techniques to create interest and awareness of research in the public at large.
- Positively discriminate to better encourage a larger number under-represented groups into more senior academic positions.
- More avenues for part-time research should be created. For example by promoting job shares and braided careers.
- Safe spaces for PhD students to talk openly about issues with their supervisors should be created.
- Brave Chancellors should encourage HR teams to progress all complaints transparently
- PhD students could create self-help groups to discuss issues they are facing.
- Micro-aggressions amongst researchers is a topic that should be more openly discussed.
- All researchers at all levels should be aware of language 'outside' academia, 'making it' in academia, 'alternative' careers.
- Case studies should include diverse groups of people and discuss the 'mortar' not just the 'bricks' that are required for successful research projects.
- When inviting questions, take one from a woman first. It always encourages more questions from women.
- Maternity and paternity rights equal should be equal, and men taking up their full paternity entitlement should be celebrated.
- The data on sexual harassment are overwhelming. It needs to be made much easier and much safer to fix. when people are afraid they go quiet.

Acknowledgements

Research culture conference attendees

Conference attendees spent two days working together to develop many of the ideas you are reading about here. Many thanks to the 20 working groups, some of which are named are below (they didn't all give themselves a group name).

A really good group name	Grasp the nettle	The team
Alpha	Room 4 radicals	Untitled
Average chickens	Secure	Voices
Cracking research culture	The no name team	
Culture vultures	The odd ones	

Research culture conference 'The Pitch' finalists

Many thanks to all of the teams and individuals who entered their ideas into the Pitch. Below are the finalists and winners.

Winners

Dr Alexandra Freeman,

Winton Centre for Risk and Evidence Communication.

Dr Shirley Keeton, University of Reading.

Professor Mark Reed, Dr Tanja Collavo and Mr Richard Young, Team Impact, Fast Track Impact and Newcastle University.

Finalists

Dr Shraddha Singh and Mr Talha J Pirzada, Reworks, University of Oxford.

Dr Gemma Archer and Dr Owen Nicholas, The Research Integration Group, King's College London.

Rory Miles, Alexander Finn and Diane Hatzioanou, Three Microbiologists.

Research culture conference speakers and panellists

Many thanks to all the chairs, panellists and speakers for giving up their time to come and take part in the conference.

Speakers and panellists	
Professor Jim Al-Khalili FRS	Professor of Theoretical Physics, University of Surrey, and President of the British Science Association
Professor Ian L Boyd	Chief Scientific Advisor, Department of Environment, Food and Rural Affairs
Professor Andrea Brand FMedSci FRS	Herchel Smith Professor of Molecular Biology, University of Cambridge
Fergus Brown	Head of Human Resources, College of Medical, Veterinary and Life Sciences, University of Glasgow
Professor Richard Catlow FRS	Professor of Chemistry, UCL and Foreign Secretary and Vice-President of the Royal Society
Dr Eugenia Cheng	Scientist in Residence, School of the Art Institute of Chicago
Rebecca Endean	Director of Strategy, UK Research and Innovation
Pippa Gunn	Student, University of Oxford
Professor Dame Wendy Hall FREng FRS	Regius Professor of Computer Science in Electronics, Director of the Web Science Institute, University of Southampton
Professor Louise Heathwaite	Professor of Land and Water Science, Lancaster University

Speakers and panellists (continued)

Dr Margaret Heffernan	International Businesswoman, Author, Interviewer and TED Speaker, School of Management of the University of Bath
Dr Steven Hill	Director of Research, Research England
Professor Leanne Hodson	Professor of Metabolic Physiology / BHF Senior Research Fellow, University of Oxford
Sir John Kingman	Chair, UK Research and Innovation
Professor Georgina Mace FRS	Professor of Biodiversity and Ecosystems, University College London
Professor Richard Massey	Royal Society University Research Fellow, Durham University
Professor Tom McLeish FRS	Professor of Natural Philosophy, University of York
Professor Mark Miodownik FEng	Materials Scientist, Engineer, Broadcaster and Writer, University College London
Carol Monaghan MP	Shadow Scottish National Party Spokesperson (Education) and Member of the House of Commons Science and Technology Committee
Dr Danuta Mossakowska	Senior Director, Discovery Partnerships with Academia Lead, GlaxoSmithKline (GSK)
Professor Marcus Munafò	Professor of Biological Psychology, University of Bristol
Liz Nicholl CBE	Chief Executive, UK Sport
Sir Venki Ramakrishnan PRS	President of the Royal Society
Dr Jennifer Rohn	Cell Biologist, Novelist and Science Communicator, University College London
Dr Adam Rutherford	Writer and Broadcaster
Sir John Skehel FMedSci FRS	Emeritus Scientist, The Francis Crick Institute and Biological Secretary and Vice-President, the Royal Society
Dr Magdalena Skipper	Editor in Chief, Nature
Dame Julia Mary Slingo FRS	Former Chief Scientist, Met Office
Robert-Jan Smits	Open Access Envoy of the European Commission, European Political Strategy Centre
Andrew Smyth	Engineer at Rolls-Royce, TV Presenter and previous contestant on The Great British Bake Off
David Sweeney	Executive Chair, Research England
Dr Jessica Wade	Physicist, Early Career Researcher, Imperial College London
Sir Mark Walport FMedSci FRS	Chief Executive, UK Research and Innovation
Professor Paul Walton	Professor in Bioinorganic Chemistry, University of York
Professor Susan Wessler ForMemRS	Professor of Genetics, University of California Riverside, Home Secretary of the National Academy of Sciences



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