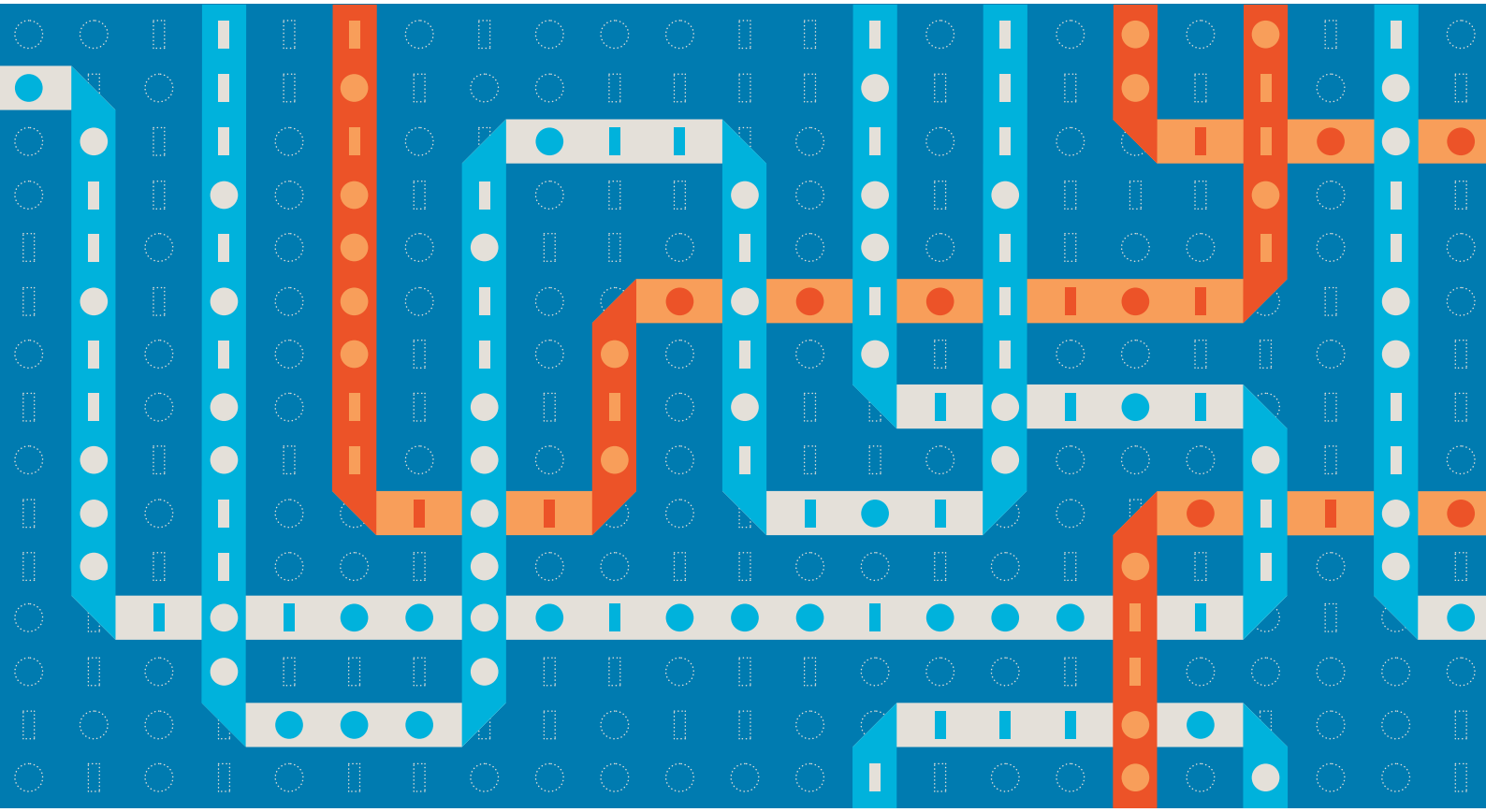
COMMENT



WES FERNANDES/*NATURE*

Global funders to focus on interdisciplinarity

Granting bodies need more data on how much they are spending on work that transcends disciplines, and to what end, explains **Rick Rylance**.

Three arguments are often made in favour of interdisciplinary research. First, complex modern problems such as climate change and resource security are not amenable to single-discipline investigation; they often require many types of expertise across the biological, physical and social disciplines. Second, discoveries are said to be more likely on the boundaries between fields, where the latest techniques, perspectives and insights can reorient or increase knowledge[1]. The influence of big-data science on many disciplines is a good example. Third, these encounters with others benefit single disciplines, extending their horizons.

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The arguments against interdisciplinary work are also familiar. Devotees of normalized citation measures often contend that interdisciplinary research is inferior. Some fear that it drains funds, time and energy from 'core' disciplines. Research funders often hear complaints that schemes targeted at interdisciplinarity distract researchers. There is a persistent argument that 'you can't have inter-disciplines without disciplines'.

According to proponents of interdisciplinarity, obstacles abound. Academic institutions' budgets, governance and promotion arrangements are usually organized around single disciplines, as are processes at many granting bodies and journals. Interdisciplinary research struggles for prestige — as measured by quantitative metrics that favour single disciplines — and it is trickier to peer review. Thus early-stage researchers are often advised that starting on an interdisciplinary trajectory is not a smart move.

One striking aspect of this debate is how poor the consolidated data are on which to base judgements. This is why the Global Research Council (GRC) has selected interdisciplinarity as one of its two annual themes for an in-depth report, debate and statement between now and mid-2016. (The other is the position of women in science and research.) The GRC is a federation of more than 50 national research funders, with representatives from countries including Brazil, China, Japan, Russia, the United Kingdom and the United States. Participants include the US National Science Foundation, Research Councils UK (RCUK), Science Europe and the Chinese Academy of Sciences. I serve on the GRC's governing board, in my capacity as chair of RCUK.

As it has done in recent years with peer review and open access, the GRC aims to establish a common position on interdisciplinarity — a topic on many people's minds worldwide, and one in which I have a personal interest.

GROUND TRUTH

So, what do we know? The 2014 Research Excellence Framework (REF) — a multi-year UK exercise that assessed universities' research strengths in 2008–13, and which thus determines funding — found that, when academics were asked to submit cases of research to REF that had significant impact outside academia, 80% were interdisciplinary. However, items submitted to discipline-based REF panels under-represented the quantity of top interdisciplinary research published by UK researchers in some fields[2]. These included health sciences, mathematics, information technology and the humanities. This is despite growth in UK interdisciplinary work overall. (The United Kingdom's share of the top 10% most interdisciplinary research grew from 7.9% to 9.1% in the four years to 2013.) In my view, this suggests that researchers perceive interdisciplinary research to be vulnerable to discipline-based assessment.

Further evidence comes from the UK government's recent triennial review of the country's seven national research councils[3]. The review heard 'evidence' — what I consider opinion — to the effect that current structures did not serve interdisciplinary research well, and that it was significantly more difficult to gain funding for this than for mainstream activity. The review recommended that RCUK — the councils' umbrella body — investigate this, which it has been doing.

It is difficult to get clear answers in response to the allegation that funding is more difficult to obtain for interdisciplinary work. Sample tests do not sustain the view that success rates for interdisciplinary grants are significantly adrift. But funding data are not easily analysed in this way. This is in part because there are different schemes under which interdisciplinary work is undertaken: for example, through 'grand challenge'-style programmes, fellowships or 'highlighted' opportunities in mainstream schemes. Awards are also made in areas in which interdisciplinarity is simply the norm, such as design. So, what should be included? More fundamental, however, is an issue of definition. What should be measured when evaluating the funding of interdisciplinary activities?

"The generic protocols of a scientific paper and those for a piece of humanities research are very different."

Arcane debates about whether research is inter-, multi-, trans-, cross- or post-disciplinary complicate data collection. People also speak of methodological, theoretical, instrumental, critical, restructuring and bridge-building interdisciplinarity[4]. I find this faintly theological hair-splitting unhelpful. But there are areas in which discrimination is important. One is the difference between 'near-neighbour' or 'distant' disciplines.

Interdisciplinary research that involves neighbour disciplines is much more common, and significantly easier to develop, than areas in which the disciplinary stretch is vast and the logistics and intellectual challenge more demanding. This seems a significant point of analysis and one featured in a study[2] by the publisher Elsevier, which used a citation-based approach to review interdisciplinarity in the United Kingdom. The measure considered the diversity of citations and the disciplinary distance between them to determine the extent of a paper's disciplinary reach. The German Research Foundation (DFG) has used similar techniques for its funding portfolio, again demonstrating significant differences between 'near' and 'far' interdisciplinarity — far research being more complex to undertake[5].

CASE STUDY

I have personal experience of the challenges of interdisciplinary working. My background is in English literature, but I have worked for many years on the history of psychology, in particular on the intersection of mind and biomedical systems. Separately, I work with neurologists on what the brain is doing when a person reads complex verbal artefacts such as poems. This is tested experimentally using functional magnetic resonance imaging.

My personal interest is in why, in brain-processing terms, might culture be good for you (if it is)? Clinicians have different — but compatible — concerns, for example in recovering advanced reading functions and well-being following head injury. Educationalists are interested in information processing and interpretation.

Of my two areas of research — one historical, the other experimental — the first is not much of a stretch, intellectually or methodologically. The second is. I had to learn new things: to work in a team, to work with complicated machinery, to observe ethical protocols and to raise money. I have had to acquire knowledge of brain anatomy and statistical analysis, and learn a different research mindset. This has been far from straightforward. It has meant, for instance, adjusting how I think about elementary issues such as 'what constitutes sufficient, appropriate evidence?'; methods of analysis; how inferential conclusions can be sustained; and how to write up results.

The generic protocols of a scientific paper and those for a piece of humanities research are very different. This is a matter both of how to express oneself and of the way the proposition is shaped in the first place. I have found that it is easy to be too 'arty' for the scientist and too 'sciencey' for the arts researcher. A humanities colleague remarked that the statistics "might as well be in Russian"; a scientist asked why the poems we used in the neurology experiments were by different people (for example, Shakespeare and Milton): couldn't we just write our own for consistency?

And then there is the question of serial investigation. The cycle of grant, paper, grant, paper and so on does not pertain in the humanities, in which articles tend to emerge from longer projects that culminate in a book. In my experience, issues about raising grants (from whom?), satisfying peer review (from which constituency?) and gaining career recognition are relevant. But paramount is confronting the groundwork challenges that come with interdisciplinary work — especially those that require 'stretch' — and doing so with integrity, honesty and a degree of disciplinary self-denial.

There is evidence that the first steps in establishing interdisciplinary projects are crucial. This was a finding of a review[6] of the European Union's efforts to stimulate interdisciplinary work under its Fifth Framework Programme for research development. Projects did not succeed as well as they might have because they did not facilitate 'enabling

conversations' from the outset and because they lacked coherent leadership. Interdisciplinary work requires particular skills, mindsets and attention to establishing common ground[6–8].

FACT FINDING

Interdisciplinarity will be a headline topic at the GRC annual meeting in Delhi in May 2016, organized by India's Science and Engineering Research Board and RCUK. A report on the state of play worldwide is being commissioned by RCUK, on behalf of the GRC (the team to undertake the research will be appointed in October).

The report will survey current policy and practice among global research funders. What forms of support do they offer to interdisciplinary research? How and where is it done? What are its outputs and impacts? The survey will begin to establish base data on how interdisciplinarity can best be stimulated and managed, and look for good practice in this most precious and complex of research endeavours.

The GRC expects to issue a policy statement following this meeting, as it has done previously on topical areas. These documents focus and clarify attitudes on key subjects. They marshal data that can be used while national policies are established and international cooperation is developed. We need much better definitions of what kind of thing we are supporting when and if we support interdisciplinary research, and better intelligence about what works. ■

Rick Rylance *is chief executive of the Arts and Humanities Research Council, chair of Research Councils UK, and a member of the governing board of the Global Research Council.*
e-mail: r.rylance@ahrc.ac.uk

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ANDREW BERTULEIT PHOTOGRAPHY/CORBIS

Equipping cities to weather our changing climate takes many disciplines working together.

How to catalyse collaboration

Turn the fraught flirtation between the social and biophysical sciences into fruitful partnerships with these five principles, urge **Rebekah R. Brown**, **Ana Deletic** and **Tony H. F. Wong**.

An urgent push to bridge the divide between the biophysical and the social sciences is crucial. It is the only way to drive global sustainable development that delivers social inclusion, environmental sustainability and economic prosperity[1]. Sustainability is the classic 'wicked' problem[2], characterized by poorly defined requirements, unclear boundaries and contested causes that no single agency or discipline is able to address[3].

It is crucial to understand, then, why so many well-meaning attempts at interdisciplinary collaboration fail to deliver tangible outcomes — and why others succeed. Here we offer an unapologetically personal answer by reflecting on how, working across multiple faculties of Monash University in Melbourne, Australia, we have built a team of disciplinary experts that delivers integrated and sustainable water management across multiple cities.

We have now grown this interdisciplinary team to incorporate other institutions nationally and internationally. At the same time, we acknowledge that substantial transaction costs come with interdisciplinary research — it takes extra time and effort to make it work.

PERSONAL JOURNEY

Our journey began in the early 2000s, with two maturing groups working on urban water research: one in the faculty of engineering, focused on sustainable stormwater technologies, and the other in the faculty of arts, focused on urban water governance (see Supplementary Information; go.nature.com/pjgbmn). The research teams had a common impact agenda, and our collaboration grew from a realization that an interdisciplinary approach would be more effective. In 2005, the two groups joined and secured funding for the establishment of a Aus$4.5-million ▶

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