focusing on certain areas, that means other areas are going to be getting less funding."

In an e-mail to *Nature*, a spokesperson for the NSF wrote, "These changes are not intended to exclude any areas of science supported by NSF," and pointed to the advances in basic science that the NSF has funded over the past seven decades. "NSF is simply signifying that these are areas of national importance and we are encouraging students to apply." The spokesperson also said that the areas of emphasis would not change the review or selection process.

Diversity at risk

Nevertheless, scientists fear that the move could make it harder for certain people to win these prestigious grants — including Black and Latinx scientists.

"Frankly, I was disappointed," says Christian Cazares, a neuroscientist at the University of California, San Diego, and a current GRFP award recipient. He views the changes as "completely antithetical" to the NSF's stated commitment to promoting diversity in science. The lack of diversity in the three new priority fields — only 18.8% of US computer-science bachelor's degrees went to Black and Latinx students and 18.7% to women in 2016 — means that the move will perpetuate already-existing disparities, he says. (According to a 2014 review of the programme, between 1994 and 2004, about 80% of GRFP awards went to white applicants.)

Research has shown funding priorities to be one of the main drivers of inequity in grants awarded to Black scientists, says Alexandra Clark, a neuropsychologist at the University of California, San Diego. In 2019, a team at the US National Institutes of Health found that topic choice had the second-largest effect on the gap in award rates between white and Black researchers among proposals selected for discussion by reviewers (T. A. Hoppe *et al. Sci. Adv.* **5**, eaaw7238; 2019). "When we know there's an opportunity gap that's at play," Clark says, "we can't really just continue on like business as usual."

"Increasing diversity and inclusiveness is a top priority for the Director and NSF," wrote a spokesperson for the NSF in an e-mail to *Nature*, adding that the agency's director has established a task force to make recommendations for addressing barriers to inclusion.

Byron is hopeful that the changes will not significantly alter the GRFP selection process. But she does worry that students from under-represented backgrounds or lower-resourced schools will be dissuaded from applying because of the programme's new emphasis. "The last thing anybody wants to see is for a really stellar young scientist to look at this new solicitation and say, 'that's not me'."

There are growing concerns about ties between China's military and its universities.

AUSTRALIA'S PLAN TO END FOREIGN INTERFERENCE IN SCIENCE: DID IT WORK?

Pioneering guidelines aren't enough to prevent overseas militaries co-opting research, say experts.

By Dyani Lewis

Almost a year after Australia introduced a pioneering system for minimizing the risk of foreign interference in research — in particular, from overseas militaries — observers are divided about whether it is working.

The guidelines, which were introduced last November and are widely assumed to be a response to concerns about the Chinese military's ties to universities, encourage institutions to perform risk assessments on potential collaborators, communicate the risk of foreign interference to staff and bolster cybersecurity. They also urge universities to ensure that they comply with laws that restrict exports of certain technologies, such as those that have military uses.

Although other countries, including the United States, the United Kingdom and Japan, are grappling with similar concerns, Australia is the first to set such a specific set of guidelines for its universities.

But some specialists warn that Australia's guidelines and export laws aren't sufficient to help universities identify collaborations in which research could lead to military applications. Although the guidelines outline 'best practice' steps that universities could take to mitigate risks, the measures are optional, says Alex Joske, a China analyst at the Australian Strategic Policy Institute, a think tank in Canberra.

Others question whether universities are up to the task of scrutinizing international partners, particularly those in China. The guidelines are "basically saying, do due diligence on your partner in an opaque authoritarian political system", says Jeffrey Wilson, a political scientist at the think tank Perth USAsia Centre in Crawley, Australia. "You're asking people to do something no one can do, except maybe a spy agency," he says.

Others say the system is working well. James Laurenceson, director of the Australia–China Relations Institute at the University of Technology Sydney, says export controls on weapons and technologies that could have military uses, such as facial-recognition or cybersecurity software, reduce the risk of research being used by international armed

forces. He says this is the right approach – focusing on the research, rather than who the collaboration is with. "Fundamental questions about the science being conducted – I think they're more important ones for us to be asking," he says.

Research partners

On paper, China is Australia's biggest research partner. In 2019, Australian researchers co-authored close to 14,000 papers with authors who had affiliations in China, according to an analysis of papers indexed in the Scopus database (go.nature.com/3adyful). That's 16.2% of Australia's research output, more than for any other international partner nation (see 'Australia's top collaborators').

Fierce competition for limited government funds in Australia is driving collaborations, particularly with China, says Wilson, adding that this exacerbates the risk of interference. "One of the challenges for Australian universities is that they have been heavily incentivized to seek foreign research income," he says.

In most cases, research collaboration benefits all parties, says Yun Jiang, a geoeconomist at the Australian National University in Canberra. Problematic research is only a small part of research collaborations, she says.

But as China increases links between its civilian universities and the armed forces – a policy known as military–civil fusion – those links are becoming more difficult to identify, says Joske. Chinese universities, he says, "are more and more integrated with military assets, especially around research and development. They're working on classified projects and a lot of their graduates are going into the military or the defence industry."

Military ties

In 2019, Joske and his colleagues developed the China Defence Universities Tracker, which places Chinese institutions on a risk scale according to how closely they are associated with the military and whether they have been accused of or engaged in espionage and intellectual-property theft.

Ninety-two institutions – including 60 run by the People's Liberation Army or security and intelligence agencies, and 20 civilian universities – are rated as very high risk. A further 23 civilian universities are graded as high risk.

Joske is concerned about collaborations with universities in China that have military ties – and about how these should be policed. In his view, the Australian government should provide universities with information about which foreign institutions deserve more scrutiny, and should establish a national research-integrity office that can enforce existing national-security and export-control laws.

Some academics think that collaborations with military institutions should be ruled out entirely. "These universities are exceptionally important to the development of China's military technology," says Clive Hamilton, a public-policy researcher at Charles Sturt University in Canberra, who has investigated Chinese influence at Australian universities. "So why take the risk?"

The tracker also lists 12 state-owned defence-industry conglomerates, 4 of which have links to overseas universities.

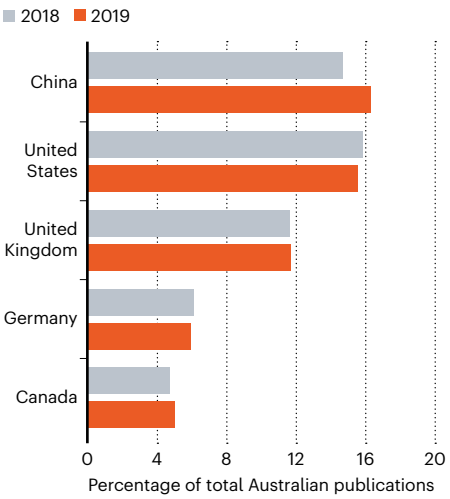
One example of the kinds of relationship that are raising alarm is outlined by Joske in a 2019 report accompanying the tracker (see go.nature.com/3gjynsf). The report noted that one of those conglomerates, the Commercial Aircraft Corporation of China (COMAC), signed a memorandum of understanding with Monash University in Melbourne in May 2017 to design 3D-printed aircraft components. The collaboration will also fund a Aus$10-million (US$7-million) Aeronautical Research Centre that will be established at the university, a spokesperson from the university said.

"We want to be transparent. But how do you deal with that when your research partner is fundamentally not?"

Joske says the collaboration is a cause for concern because, last year, the cybersecurity company CrowdStrike in Sunnyvale, California, accused COMAC of using technology stolen through cyberespionage from rival airlines to design its C919 commercial aircraft, which could be converted into a military surveillance aircraft.

AUSTRALIA'S TOP COLLABORATORS

Last year, researchers in Australia co-authored almost 14,000 papers with people at Chinese institutions — more than with any other country.



SOURCE: J. LAURENCESON & M. ZHOU *THE AUSTRALIA-CHINA SCIENCE BOOM* HTTPS://GO.NATURE.COM/3ADYFUL (2020)

KEVIN FRAYER/GETTY

COMAC did not respond to *Nature*'s questions about the allegations.

But the university defended the partnership, saying it followed the Australian Code for the Responsible Conduct of Research and the university's own policies and procedures. "The university regularly monitors advice provided by the government, intelligence agencies and the wider education sector, and acts in accordance with advice received," the spokesperson said.

Group of Eight

Several Australian institutions have made changes in response to the guidelines produced last year. *Nature* contacted the 'Group of Eight' leading research universities, and of the seven that responded, five said they had introduced new processes or were deciding whether to do so.

But some experts think that more needs to be done. The guidelines recommend that foreign affiliations and funding be recorded. Hamilton says universities should go a step further, and make these registers public. "Transparency must be priority number one," he says. "Australian universities are public institutions, and I can see no reason why the public should not be permitted to know the affiliations and financial links academics may have with other organizations, at home or abroad," he says.

And he says the universities should take a hard line with researchers who fail to disclose foreign ties, including firing them in some cases. The government should also be stricter with universities, says Hamilton: "Universities that fail to heed government rules and guidelines concerning research links that jeopardize national security should be excluded from receiving funding from the Australian Research Council."

Limits to transparency

In the United States, funding agencies have alerted institutions to grant recipients with potential undisclosed foreign ties. Investigations have led to dozens of researchers being sacked or forced to give back research funding.

But transparency has its limits, says Wilson. "We want to be transparent. But how do you deal with that when your research partner is fundamentally not?" he asks. Although information on connections to the military is openly available in some instances, he says, it could easily be hidden.

In June, the Australian government announced that it had created a new integrity unit to identify and analyse emerging threats to the quality of higher education, and to assist universities in addressing foreign-interference threats. Joske says it's a positive move, but it will take time to prove that it is working.