

web pages, using natural-language processing to glean detailed information about the publications or research projects of potential referees. The system will use semantic analysis of the text to compare the grant application with this information and identify the best matches, says agency head Li Jinghai, who is based in Beijing.

An early version of the tool selected at least one member of each of nearly 44,000 panels that approved projects last year, says Yang Wei, the agency's former head, who presented data on the pilot at a meeting on scholarly communication in Hangzhou last month. Panels are composed of between three and seven people. The system is already cutting the time administrative staff have to spend looking for referees, says Yang. A similar approach will be used this year to select reviewers, he says.

The NSFC has become a world leader in reforming grant-review processes, says Patrick Nédellec, director of the international-cooperation department of the French CNRS, Europe's largest basic-research agency. The NSFC is being forced to innovate as the number of grant applications keeps growing, says Nédellec, who attended a meeting last September at which Li discussed the agency's reform plans. "Because the pressure is so high, China has no choice but to find the best way," he says.

In the past five years, the number of applications the NSFC receives has increased by roughly 10% a year. In 2018, the organization evaluated 225,000 grant applications — almost 6 times the number received by the US National

Science Foundation. The NSFC is struggling to process applications and find appropriate reviewers, says Li. "The challenge is not having enough people," he says. "AI will solve that."

Li also wants the tool to reduce bias in reviewer selection. In China, scientists try to lobby for their projects, he says. "AI can't be corrupted."

Bias can also be an issue in countries where applicants are asked to suggest experts who could review their proposals. The Swiss National Science Foundation has found that reviewers who were recommended by the applicants were more likely to endorse a project than were referees chosen by the foundation.

The NSFC's pilot AI system works on websites written in Chinese characters, but Li wants it to be able to crawl English-language sites in the future.

"NSFC's reform plan is ambitious, forward-looking and comprehensive," says Manfred Horvat, a science-policy adviser at the Vienna University of Technology, who also heard Li's talk last September.

Other countries are following China's lead. Last month, the Research Council of Norway started using natural-language processing to cluster about 3,000 proposals into groups and match them to the best reviewer panels, says

Thomas Hansteen, an adviser to the council.

But not everyone is convinced that AI should be used in the review process. Susan Guthrie, a science-policy specialist at research organization RAND Europe in Cambridge, UK, notes that the Canadian Institutes of Health Research has run into challenges with an algorithm used for reviewer selection.

The Canadian agency hired RAND Europe in 2016 to carry out a meta-analysis of studies on grant peer review. Partly on the basis of that report, the agency concluded that the algorithm sometimes selected reviewers who had conflicts of interest or were otherwise not qualified to evaluate the proposal. "While algorithm-based matching sounded attractive, there is a limit at this stage of artificial intelligence to what it can possibly achieve," an independent expert panel concluded.

Elizabeth Pier, a policy researcher at Education Analytics in Madison, Wisconsin, thinks AI will not remove selection bias. She fears that AI systems end up replicating the biases ingrained in human judgements, rather than avoiding them.

Li says that the NSFC also plans to introduce a credit system that will reward researchers for good, fair and timely reviews — although he wouldn't comment on the nature of the rewards.

But statistician John Ioannidis of Stanford University in California says it will be difficult to evaluate whether reviewers have made good decisions because it can take decades for an idea to be considered "great or a waste". ■

"Because the pressure is so high, China had no choice but to find the best way."

POLITICS

Extremism concerns Indian scientists ahead of election

Researchers are also troubled by a flat budget and a rise in pseudoscience.

BY T. V. PADMA

Rising intolerance towards intellectuals and minority groups in India has prompted scientists there to speak out ahead of the country's mammoth general election. More than 200 scientists have signed an open letter appealing to citizens to reject the discrimination and violence being promoted by some extremist groups.

The election is a contest between the ruling Hindu nationalist Bharatiya Janata Party (BJP), led by Prime Minister Narendra Modi, and the main opposition, the secular Indian National Congress — the Congress party. Nearly 900 million people are eligible to vote in this election, which began on 11 April and is

being held in several phases, ending on 19 May.

The letter, posted online last month, is an unusual move for India's research community, which rarely comments on political or social issues. It calls on voters to "reject those who lynch or assault people, those who discriminate against people because of religion, caste, gender, language or region".

The letter does not mention any political party. But since the BJP formed a government in 2014, there has been a rise in attacks by Hindu right-wing groups in India against Muslims and other minority groups that eat beef — Hindus consider cows sacred. Extreme right-wing groups were also blamed for the deaths of three intellectuals, between 2013 and 2015, who campaigned for scientific reasoning.

Against this backdrop of intolerance, some scientists say they also face flat investment in science and a rise in politicians and public figures making unscientific claims. The BJP includes new technology in its manifesto, but some worry that it prioritizes technology ahead of basic science. The Congress party has promised to boost spending on science, but there are doubts over whether it can deliver on this.

The BJP's election manifesto states that it will launch major programmes in artificial intelligence, robotics, supercomputers and genomics for human health, but the manifesto does not mention how much it will spend on these endeavours. Last year, Modi also announced a mission to send humans to space by 2022. ▶



Indian Prime Minister Narendra Modi at an election rally.

► The proposal could improve technological capabilities and advance the country, says cell biologist Satyajit Mayor, director of the National Centre for Biological Sciences, Bangalore. But he fears that if these missions are pursued in lieu of promoting basic and fundamental science, that could weaken the country's scientific base.

The Congress party, meanwhile, has promised to raise science spending to 2% of the country's gross domestic product, up from between 0.7% and 0.8% over the past decade, a pledge that has been welcomed by some scientists, including Mayor.

But others are sceptical that the plan will pan out because the party has not explained where the money to fund it will come from. "BJP's plan seems to do better in trying to boost the

economy through encouraging technology," says geneticist Tapasya Srivastava at Delhi University.

Irrespective of party promises, Amitabh Joshi, an evolutionary biologist at the Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, would like to see a greater balance between investment in basic and applied research. In the biological sciences, for example, molecular and cell biology get vastly more money than ecology or evolution, he says. The imbalance runs through into the education system; there are no postgraduate courses in evolutionary biology offered at Indian universities, says Joshi.

As a consequence, scientists working on emerging infections such as dengue fever and Nipah virus, and on antimicrobial resistance,

have limited training in evolution at the university level, which is important to understand how host-pathogen relationships evolve and pathogens develop drug resistance, says Joshi.

Neither the Congress party nor the BJP has addressed another concern for scientists in India: public figures promoting 'unscientific' ideas. The most recent case occurred at the 2019 Indian Science Congress in Jalandhar in January. Gollapalli Nageswara Rao, vice-chancellor of Andhra University in Visakhapatnam, cited an ancient Indian text as proof that knowledge of *in vitro* fertilization and stem cells existed in India thousands of years ago. Another speaker contested Einstein's theories of relativity.

Last year, a higher-education minister also questioned Charles Darwin's theory of evolution while talking to reporters. Indian scientists posted an online petition condemning the minister's statement.

"Those who care about science are certainly very distressed by the gratuitous claims of our politicians about pseudoscience without regard to any evidence," says Mayor.

All parties are guilty of talking pseudoscience, says physicist Gautam Menon at the Institute of Mathematical Sciences, Chennai. But he says the party in power carries special responsibility because its words and actions will determine policy. He cites the government's push in 2016 for research on the health and other benefits of a combination of cow products called *panchgavya*, which have not been scientifically validated. As a result, individual research institutes started projects on cow products, and science minister Harsh Vardhan set up a panel to carry out research to validate the products' benefits. "This spending is only for ideological reasons," says Menon. ■

BIOMEDICAL RESEARCH

Brazil's science faces reproducibility test

More than 60 labs will assess the replicability of work by the country's researchers.

BY RODRIGO DE OLIVEIRA ANDRADE

An ambitious project to test the reproducibility of biomedical experiments by Brazilian scientists is about to get under way.

The Brazilian Reproducibility Initiative was launched last year by researchers at the Federal University of Rio de Janeiro (UFRJ). Now, the first wave of reproducibility testing is set

to begin in August, with help from more than 60 laboratories scattered between 43 Brazilian research centres.

The project is one of the first to test the reproducibility of scientific research from a particular country, instead of a particular field.

Participants will attempt to replicate up to 100 biomedical experiments — with each experiment tested by 3 labs (O. B. Amaral *et al.* *eLife* 8, e41602; 2019). The team decided

to take that approach, rather than trying to reproduce full studies, to broaden its coverage of the published literature and to make it easier for volunteers to participate, says project coordinator Olavo Bohrer Amaral, a physician at the UFRJ Institute of Medical Biochemistry.

"We intend to systematically assess the reproducibility of biomedical research, covering different areas of life-science research in Brazil in an open, unbiased and transparent way," he says.

To determine which experiments to test, the project's leaders examined 30,000 biomedical articles published over the past two decades. They narrowed this list down by identifying 5,000 papers in which most authors were at a Brazilian institution.

From this set of studies, the team drew up a list of ten analytical methods commonly used in Brazil — including the MTT assay to assess cells' metabolic activity, RT-PCR to amplify and detect specific genetic sequences, and the elevated plus maze to test rodent behaviour. The researchers then randomly chose