Science ethics: Young scientists speak
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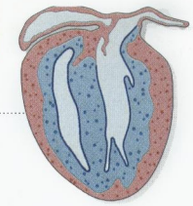


## LETTERS

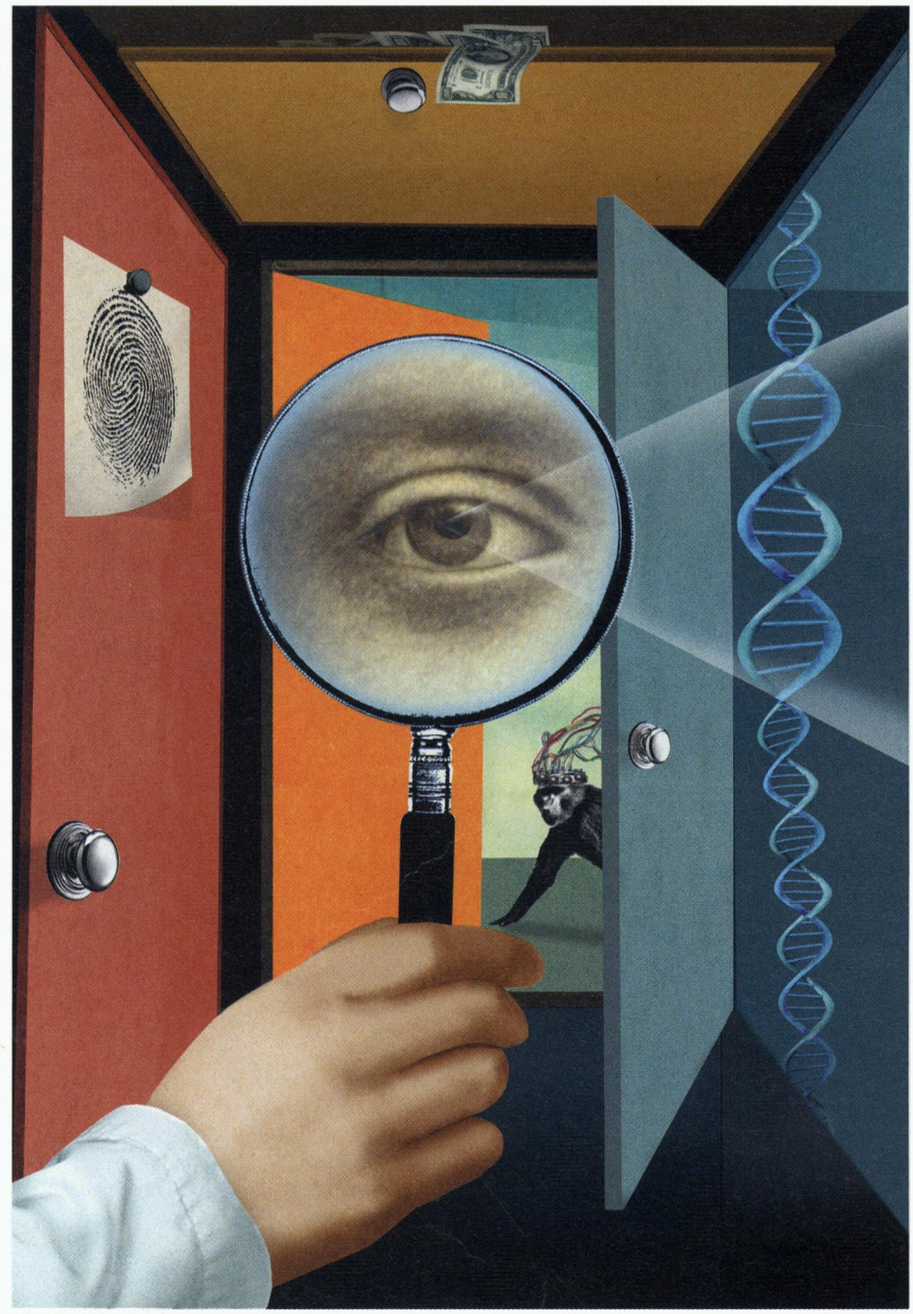
*Edited by* **Jennifer Sills**

# *Science ethics: Young scientists speak*

What is the most challenging ethical question facing young investigators in your field? How should it be addressed? In April, we asked young scientists to tell us their thoughts. A sample of their responses can be found below. To allow for as many voices as possible, in some cases we have printed excerpts of longer submissions (indicated by ellipses) and lightly copyedited original text for clarity. To read the complete versions, as well as many more, go to http://scim.ag/NextGen11Results. Follow *Science*'s NextGen VOICES survey on Twitter with the hashtag #NextGenSci.

**NEXTGEN VOICES**

MEDIA COMMUNICATION about stem cell research, nanotechnology, and other novel medical biotechnologies often fuels public expectations for imminent health applications. The pace of science, however, is often incremental and falls short of hopes. Information that promotes optimism is necessary to attain public support and mobilize science, but poorly informed hope leads to disappointment, despair, and distrust. Compounding these challenges is the impact that hype can have on policy agendas, with a premature focus on translation at the cost of basic science. A key ethical question, therefore, is: How ought we communicate about the promise of novel biotechnologies with the aim of catalyzing public support while avoiding hype? Social responsibility in science communication is the answer. Media should strive for accurate reporting, accounting for the scientific merits and caveats of research. Likewise, scientists communicating with the media about their research should highlight both roadblocks and progress.



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Educational approaches must be extended, particularly targeting scientists-in-training as future spokespersons. Clinicians could address media content in their clinical practice to help patients—the end-users of biotechnologies—develop informed hope. Whereas a body of research predominantly focuses on managing the content of science communication in the public sphere, future research should aim to characterize the influence of promotional communications on patient decision-making. Balanced science communication will encourage support for scientific progress and ground expectations in the limits of science and current clinical tools.

***Shelly Benjaminy***

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...WHEN SCIENTISTS fabricate their data, eventually they get caught. But because the timeline for detecting fraud is slow, the skewed data may in the meantime already have been used as a foundation for the latest "breakthrough." Why not catch the criminals before they commit the crime? Scientific journals do have strict review processes in place, but these processes are not rigorous enough. Data modifications, regardless of size or type, can easily be overlooked. I propose that the best journals in the world require proof of data replication by another researcher before submission for publication. The social and financial stigma against research that strictly confirms the results of others should be replaced by healthy encouragement and funding of outside validation as a way to provide checks and balances in the scientific community.

***Rosalie Doerksen***

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...THE MOST CHALLENGING ethical question facing young investigators is a lack of scientific integrity, which may damage the reputation of both young individuals involved and the whole scientific enterprise, and dampen the ability of young scientists to produce original innovations. To address this problem, promoting education in responsible conduct of research is the first important step in China, where most universities and institutes did not offer official courses concerning scientific integrity or a code of scientific conduct until recently.... Another deserving effort in promoting scientific integrity in China is to foster a healthy research environment, which includes making explicit research ethics policies, issuing a practical code of conduct, establishing a credible and authoritative national organization to supervise local units, protecting whistleblowers, building a rigorous and fair peer review system, revising the criteria for promotion and reward to emphasize research quality rather than quantity by a researcher, and achieving zero tolerance for unethical research behaviors.

***Fengbo Li***

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THE USE OF animals in scientific research is the most controversial, divisive, and ethically challenging question I face. That innocently seeking question, "...and what do you do?" has so many times led to a long and heated debate on whether animal research is ethical or necessary. The majority of our medical and scientific achievements are developed, tested, or discovered with the help of the ubiquitous lab animal. This is a nice sentiment, but it often misses the mark when defending animal research, and who is really surprised? As far as the public are concerned, our research is just inaccessible and incomprehensible jargon. The very animal scientific procedure act (UK) we work under contains a secrecy clause, published articles are hidden behind online paywalls (even those paid for by the taxpayer), and access to animal laboratories is restricted. Ultimately, shutting out the public like this is inimical and will eventually exaggerate the public's view of scientists as cryptic, egotistical, and cold. Through constant public engagement, social communication, and early education, people could have a much better understanding of why the laboratory animal is indispensable. Such projects as the recent Declaration of Openness on Animal Research Concordat, the Elsevier "cost of knowledge" boycott, and the petitions to have our secrecy clause lifted are all in favor of educating the public. It is imperative that as scientists we seek to support such causes wherever possible, if not for the benefit of the public, then for the benefit of science in the long run.

***Roddy Grieves***

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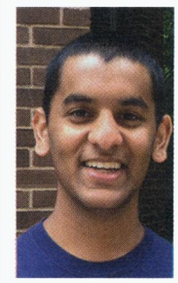

IN GENETICS RESEARCH, I am expected to work with high-throughput sequencing, which regularly collects and processes data spanning entire genomes. With so much genomic data and computational power at hand, it is increasingly likely I will encounter incidental findings of BRCA, CF, Alzheimer's, or other flagged genes. However, with samples coming from distant sources, the question arises of my ethical responsibility to contact the sample provider and make sure that the donor is informed. Having donors fill out consent forms asking if they would like to be notified in the case of relevant findings and then subsequently marking biological samples would solve the dilemma that investigators like myself face when dealing with sensitive genomic data.

***Girish Valluru***

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...MEDICINE IS INCREASingly becoming too complicated for many individuals to understand. It is beginning to surpass the ability of patients to make informed decisions, especially around new emerging biotechnologies such as stem cell interventions and genome sequencing. The burden is increasing on our new generation of young investigators to disseminate increasingly complex science to the community; however, there is no formal training offered in this endeavor. We need to educate new scientists and clinicians about these aspects of knowledge translation, as well as the public about medical tests and procedures, so that patients can truly become empowered to make informed decisions.

***Karen J. Jacob***

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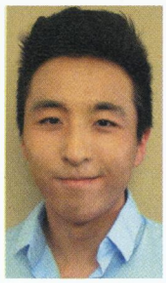

AN ETHICAL ISSUE facing young investigators in neurosciences pertains to the use of cognitive-enhancing interventions in healthy individuals. ...A notable example on university campuses is the use of ADHD drugs such as Adderall and Ritalin by healthy students to improve performance on exams and work efficiency. Some argue that we should welcome new methods of improving our cognitive function and that the use of neurocognitive enhancing drugs is essentially no different from increasing our work efficiency through the use of caffeine. On the other hand, the use of usually illegally purchased and not prescribed drugs may have detrimental effects on the user; the long-term side effects of ADHD interventions on healthy individuals have not been extensively studied. Also the ethical issue presents itself as to whether it is fair in an academic setting for those who take cognitive-enhancing drugs to be assessed against those who do not take such drugs, especially considering the increasing competitiveness for admission to graduate programs. I suggest that we approach this issue first by educating students on the possible dangers of not prescribed medications and second by investing more research to truly understand the impacts of cognitive enhancing drugs on students competing in an increasingly demanding academic environment.

***Cody Lo***

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LARGE-SCALE, MULTICENTER clinical trials are the way of the future for young investigators wishing to address complex questions related to brain development and to discover safe and effective interventions for kids living with neurodevelopmental disability. ...However, important ethical challenges must be addressed before the power of Big Data can be harnessed to its fullest potential. For instance, how do we achieve consensus among researchers, pharmaceutical industry representatives, regulatory agencies, research ethics boards, and family advocates on best ethical practices for conducting large-scale multicenter clinical trials involving children and adolescents living with neurodevelopmental disability? What mechanisms need to be in place to ensure ethics harmonization and oversight? Work is currently being done to achieve this at both national and international levels. Young investigators need to be engaged in the harmonization process, as they are on the front lines of data collection and analysis and are uniquely positioned to interface with actors on many levels: senior researchers, research staff, ethics boards, and the research participants themselves.

***Nina Di Pietro***

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ENVIRONMENTAL research requires money and logistical support, particularly if the science being conducted is cutting-edge and uses the latest technologies. Obtaining this funding can be difficult—even as government science budgets increase, the proportion of money available for research that will not produce direct financial benefits has waned. Therefore, young researchers who tackle important environmental questions may find themselves in a position of tailoring their programs to involve industry partners that can support their work. How can these young investigators accept money and in-kind support from an industry partner while ensuring that they maintain a real and perceived ability to conduct and publish unbiased science? There are tremendous positive opportunities in forming research partnerships, but there are also risks, particularly of a real or perceived conflict of interest. Researchers should be trained in how to enter into these partnerships in such a way that the integrity of their research program is not compromised. In addition, the scientific community should establish transparent best-practice guidelines that can be followed to ensure scientific impartiality, so that it can be clearly identified when research is produced through a defensible funding arrangement. Audits should then be conducted to identify whether researchers and partners are following these rules.

***Brett Favaro***

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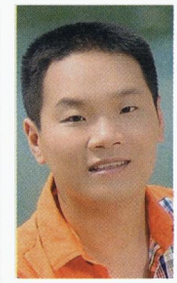

THE MOST CHALLENGING ethical question facing aerospace engineers is the protection of the space environment. Although young scientists and engineers contribute increasingly to the space exploration and development, we have not given adequate attention to the possible connections between the advanced technique and environmental consciousness. In my opinion, we ought to broaden access to environmental philosophy and realize that unbridled space activities by manned and robotic missions may pollute, degrade, and even destroy the space environment. In addition, young investigators should be encouraged to participate in the discussion of ethical code and policy for future space program. The seniors can help us develop the conception of a sustainable and environmentally aware exploration of the space environment for industry, commerce, and tourism.

***Jiang Zhao***

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ALTHOUGH THEY ARE sufficiently warned against committing outright fraud through ubiquitous ethics seminars, young investigators are still exposed to a more subtle, lurking enemy challenging their professional integrity: scientific pollution. This murky underworld of junk science includes everything from improper citations to perpetuation of invalidated ideas to gross misinterpretation of data. Young investigators are particularly prone to (often unknowingly) muddy the scientific waters because as they learn the lay of the land, they take cues from other papers, peers, and mentors. So when a graduate student reads a review paper citing other review articles instead of original work, this becomes their standard of what is acceptable; never mind that if you trace the cited fact to the original study, you may find a 1965 publication using an outdated method now known to be unreliable. A postdoc designing a new experiment may opt to use currently available methods—even if they are far from the best—for the sake of feasibility or consistency with prior work, unwilling to question their mentor's established, affordable methods. Junior investigators

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struggling for grants and promotions may be tempted to overstate their findings or publish premature findings in lower-than-low-tier journals to boost their publication numbers. Because all this nonsense makes good science more difficult for everyone, it is our collective responsibility as scientists, colleagues, communicators, advocates, and mentors to curtail it wherever possible. Research thoughtfully. Analyze critically. Publish scrupulously. Speak truthfully.

***Kelly P. Downing***

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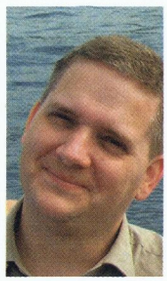

THE PRESSURE TO publish can lure young people to fake data, ignore data, or jump to conclusions from an insufficient number of data. ...The "publish or perish" game is bad for science and for the scientist. Instead of quantity, we should go for quality. I strongly support an idea of my professor in which each scientist starts with a limited number of publication slots, and he/she is only allowed to publish more if the previous publications are deemed good enough.

***Ádám Kun***

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PRIVACY AND DATA collection have become the most challenging ethical issue in telecommunication and wireless systems. Now that coherent optical technology is used to deliver 100 gigabit through fibers, and microprocessors and permanent memory are made inexpensive, how do we guard the massive amounts of personal data submitted to commercial entities when ordering online or using mobile apps? Imagine a world where unique fingerprints, facial dimensions, and palm patterns unknowingly become available to physicians, insurance companies, and research entities, but are not protected by privacy or anonymity laws, while unencrypted patient data could be lost or stolen at any minute.... Soon, cellphones and GPS will know your route everywhere, with speeding tickets coming directly from private industry, not the police. ...It's time for us to think about what kinds of information should be collected and retained. The gap between data collection and privacy protection needs to be bridged through appropriate policy discussions. And the principles of purpose limitation and data minimization need to be addressed at the soonest possible time to balance the benefits for businesses and researchers against God-given constitutionally protected individual privacy rights.

***Yi Weng***

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BUREAUCRACY AND guanxi (cultivating relationships with people who can help you) form a major challenge to science ethics in China. Most young investigators have to bear great pressure and be kept busy in the bottom of the pyramid. Only a few can do something of personal interest. Boss professors are busy participating in conferences, developing guanxi, and grabbing projects and funds, while young investigators have to practically fulfill these projects and write papers with the names of the boss professors in the author list, sometimes as the first author, even if the boss professors do not know what was written in the paper. There is a circle of guanxi, and the most successful young investigators in China are often the former students of famous professors who hold or formerly held critical positions as academic bureaucrats or referees in judging projects and talents. ...If the younger generation of Chinese investigators wants to achieve better development in China, they must comply with famous professors and develop guanxi, or obtain a Ph.D. degree and work experience abroad and then become awarded returnees.... China needs reforming mechanisms, institutions, and laws to remove interference from bureaucracy and guanxi in allocating research resources....

***Xin Miao***

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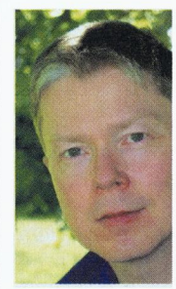

MY FIELD IS COMPUTER security. I use techniques aimed at detecting malicious attacks on computer systems, and I need to operate in the twilight zone between good and bad. Research on new intrusion detection algorithms is often at best questionable and at worst invalid, given that the results cannot be verified under realistic conditions. Testing under realistic scenarios is problematic, because the results are not repeatable. Furthermore, testing on real data requires high-security vetting and may produce confidential results that are not publishable. Security technologies may also have dual-use possibilities. Security researchers may, for example, detect new system vulnerabilities during their research, and may end up in ethical dilemmas: Shall I be good and publish these results or shall I sell them at the highest price to the gray market of government agencies and others that capitalize on vulnerabilities? And then you have privacy: These technologies can be used both for the good—protecting security of citizens—and bad—creating an Orwellian surveillance society. ■

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**SUBMIT NOW:** COLLABORATIVE SCIENCE

Add your voice to *Science*! Our new NextGen VOICES survey is now open:

**In your experience, what is the biggest challenge to global scientific collaboration? How should it be addressed?**

To submit, go to http://scim.ag/NextGen12

Thanks to Kefeng Li at the Department of Medicine, University of California, San Diego, for submitting this question.

Deadline for submissions is 15 August. A selection of the best responses will be published in the 3 October issue of *Science*. Submissions should be 250 words or less. Anonymous submissions will not be considered. Please submit only once.

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