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RESEARCH INTEGRITY IN CHINA: PROBLEMS AND PROSPECTS

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Abstract

In little more than 30 years, China has recovered from the intellectual stagnation brought about by the Cultural Revolution to become a global leader in science and technology. Like other leading countries in science and technology, China has encountered some ethical problems related to the conduct of research. China's leaders have taken some steps to respond to these problems, such as developing ethics policies and establishing oversight committees. To keep moving forward, China needs to continue to take effective action to promote research integrity. Some of the challenges China faces include additional policy development, promoting education in responsible conduct of research, protecting whistle-blowers, and cultivating an ethical research environment.

Keywords

Research integrity; China; ethics; misconduct; fraud; plagiarism; policies; education

INTRODUCTION

Integrity in scientific research is increasingly an international concern.¹ From the 1980s to the early 1990s, most of the scholarly and media attention focused on research integrity in government-funded research in the United States (U.S.). Misconduct scandals and conflicts of interest drew the attention of journalists and independent investigators, and Congress held hearings on integrity in research. As a result of this scrutiny and public debate, the federal government enacted misconduct and conflict of interest rules, formed organizations to oversee scientific research and promote research integrity, and required training in research ethics for graduate students on government grants.² By the mid-1990s, the spotlight shifted more toward research outside the U.S., as other countries faced scandals and problems and developed their own organizations and policies.³ The need for international collaboration on research integrity issues reached a critical juncture in December 2005, when *Science*, the world's leading science journal with a readership of over 700,000, received an anonymous tip concerning data fabrication in a paper on human embryonic stem cells authored by Woo-Suk Hwang and his colleagues at Seoul University in South Korea. Following an investigation by Seoul University, Hwang and several other researchers were charged with fraud, embezzlement, and breach of bioethics laws. Hwang's research team included University of Pittsburgh cell biologist Gerald Schatten. Though Schatten was not charged with fraud or misconduct, a university committee found that he received excessively large consulting fees for his work and did not diligently fulfill his authorship duties.⁴ In the wake of this scandal, commentators called for more international collaboration on research integrity issues.⁵

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In this essay, we will examine research integrity problems and issues in China. We have decided to focus on China for two reasons. First, like many other countries, China has had some scandals related to scientific misconduct in recent years. Second, though China is becoming one of the world's leading nations in science and technology, very little has been written about research integrity in China in English language journals.

HISTORICAL BACKGROUND

China is one of the world's oldest civilizations, with a long and distinguished scientific and technological tradition. The Chinese invented paper, printmaking, gunpowder, kites, the abacus, the compass, the umbrella, steel, the chain-pump, and the wheelbarrow. Chinese scientists and scholars have made important contributions to astronomy, mathematics, chemistry, medicine, botany, engineering, geology, magnetism, navigation, architecture, and metallurgy.⁶ During Europe's Dark Ages, scholarship and research continued to move forward in China and in the Islamic world. After a period of stagnation that began in the 1500s and lasted for several hundred years, Chinese science and technology began advancing again in the 20th century, but then suffered a significant setback during a period known as the Cultural Revolution (1966-1976). Universities were shut down and professors and students were ordered to leave academia to work in the countryside or in factories in an attempt to purge China of bourgeoisie influences and Confucianism. The educational system crumbled and scientific research ground to a halt, except in areas, such as national defence, that served national purposes.⁷

When the Cultural Revolution ended, Chinese science began to slowly recover from its slumber, and then made rapid progress once again under the national policy of 'reform and opening up' designed by Chinese leader Deng Xiaoping. The Science Citation Index listed only one paper from Chinese scientists in 1973. By 1979, the Index listed 932 papers.⁸ Since the 1980s, science and technology have played a key role in China's rapid modernization and economic development, as the country continues its transformation from an agrarian economy toward a manufacturing and knowledge-based economy.⁹ The Chinese government has made substantial commitments to science and technology funding. China is now the third leading nation in terms of research spending, just behind the U.S. and Japan.¹⁰ These research investments have paid off handsomely: today, China is second only to the U.S. with respect to scientific publications and citations, and leads the world in some key areas, such as nanotechnology.¹¹ China's percentage of articles appearing in peer-reviewed scientific journals has risen from less than 1% in 1983 to more than 8% today.¹² China has also achieved manned spaceflight and is planning a trip to the moon.

China's astonishing progress in science and technology has generated a number of different social and ethical issues. In the early 1980s, Chinese scholars began to address controversial bioethics issues, such as euthanasia, assisted reproduction, human experimentation, medical decision-making and organ transplantation. Ren-zong Qiu, Fang-fu Ruan, and others made important contributions to the field of bioethics. By the late 1980s, the Chinese Society of Medical Ethics was established, and the Journal of Chinese Medical Ethics had begun publishing articles on bioethics. By the 1990s, China had established an extensive system for bioethics oversight, research, and education, including medical ethics committees at hospitals and committees to review research with human subjects. China has also hosted national and international conferences on bioethics issues.¹³

MISCONDUCT IN SCIENTIFIC RESEARCH

Progress in science and technology has not come without growing pains, however. Like the U.S. and many other countries, China has had its share of research misconduct scandals. In

the early 1990s, some scholars began to express concerns about deviations from academic norms in Chinese universities.¹⁴ By the late 1990s, Chinese scientific journals became alarmed about ethical problems with published research, especially plagiarism. In 1996, several cases of copying large portions of published papers drew the attention of scientists and the national media.¹⁵ In 1997, two cases of wholesale plagiarism republishing someone else's article under a different name—prompted the Chinese Association for Science and Technology (CAST) to develop a code of conduct to combat plagiarism and other types of misconduct. The code also included some rules to protect the rights of authors.¹⁶

Scientists and the media continued to express concerns about the integrity of Chinese science. Frustrated by the lack of government or university oversight mechanisms for dealing with misconduct, Shimin Fang, a Chinese biochemist living in San Diego, CA, began his own investigations of misconduct. He posted his findings on a Chinese-language website known as New Threads and published a book on academic corruption in China.¹⁷ He also allowed other scientists to post anonymous allegations on the website. The website featured accusations against many top scientists, including Xiaoqing Qiu, a professor of biomedicine at Sichuan University, Yuquan Wei, vice-president of Sichuan University and a member of the Chinese Academy of Sciences, and Jin Chen, microchip researcher at Shanghai Jiaotong University.¹⁸ An investigation of Chen by his university concluded that he faked the research on a state-funded Hanxin computer chip. He had acquired more than US\$100 million in grant funding. He was removed from his positions as Dean and Professor and the funding agencies reclaimed their money. Some researchers criticized the handling of this case, arguing that Chen's punishment was too lenient and that the financial audit was not made available to the public.¹⁹

Although official judgments have been reached in some of the cases reported on the New Threads website, many of them are still disputed. The New Threads website has generated a great deal of controversy in China. While the website has helped to expose misconduct and corruption in science, it may have ruined the reputations of scientists who were falsely accused of wrongdoing. Critics argued that, by allowing anonymous accusations to be posted, the website may have had a negative impact on research integrity because it did not provide for due process and adequate protections for people who are accused of misconduct.²⁰ Some even compared the misconduct accusations on New Threads to the persecutions that occurred during the Cultural Revolution.²¹ In 2006, 120 researchers signed a letter written by Xin-Yuan Fu, an immunologist at Indiana University in Indianapolis, urging the government to take action against research misconduct and to ensure that misconduct investigations embody due process and protect the rights of the accused.²²

During the period when the New Threads website and another website 'Academic Criticism' established by Yusheng Yang which also exposed and criticized academic misconducts were operating, the Chinese government had begun its own investigations of misconduct in research. From 1998-2005, China's leading basic research agency, the National Natural Science Foundation of China (NSFC), a non-profit institution directly under the State Council of China, established an oversight committee to investigate allegations of misconduct arising from research sponsored by the NSFC. The NSFC investigated 542 allegations of misconduct, most of which were based on anonymous tips, and published its findings on a website. These allegations resulted in misconduct findings against 60 government-funded scientists. Data falsification (40%) was the most common finding, followed by plagiarism (34%), and data fabrication or theft (7%). Other types of misconduct accounted for 19% of the total.²³

THE GOVERNMENT AND UNIVERSITIES RESPOND

As a result of these misconduct scandals, many Chinese researchers became concerned that ethical problems were undermining progress and innovation, and eroding the public's confidence in science. They continued to pressure Communist Party leaders and government officials to take some steps to reform scientific research.²⁴ Soon, many different government and non-government organizations, including the Ministry of Science and Technology (MOST), and the Ministry of Education (MOE), the NSFC, the Chinese Academy of Engineering (CAE), the Chinese Academy of Sciences (CAS), and CAST issued reports on scientific integrity, developed oversight committees, and conducted investigations into ethical problems in science.²⁵ The above-mentioned organizations are working together to establish a joint committee on scientific integrity.²⁶ From 2002-2006, the MOE published a series of documents on ethics in higher education, which recommended that institutions establish organizations to promote academic ethics and establish oversight mechanisms.²⁷

In November 2006, MOST adopted misconduct rules for government-funded research. The rules, which became effective in January 2007, include policies and procedure for investigating and adjudicating misconduct as well as a definition of misconduct. The misconduct definition is broader than the U.S. government's definition of misconduct as fabrication, falsification or plagiarism (FFP). MOST's definition includes FFP and also submitting false resumes and violating rules pertaining to research with human or animal subjects.²⁸ In January 2007, MOST established an office to deal with research ethics problems called the Office of Scientific Research Integrity Construction. Misconduct allegations will be investigated by committees composed of experts in science, law and ethics. Committee members also must have no conflicts of interest related to the investigation. MOST also created a committee to advise the government on preventing misconduct. Punishment for misconduct ranges from a warning letter to employment termination and permanent loss of research funding.²⁹ In June 2006, MOST announced some reforms to discourage misconduct. Many of these changes were related to the system for reviewing and awarding research grants. The goal of these reforms was to promote fairness and transparency in grant review and avoid conflicts of interest.³⁰

In 2007, the State Council of China enacted regulations pertaining to the NSFC, which covered five aspects of research, including strengthening self-discipline, reviewing and auditing, enhancing social supervision, establishing the integrity of research records, and strengthening punishment.³¹ In 2007, CAST published a document addressing seven kinds of unethical behaviour: deliberately giving false statements (i.e. fabrication, falsification, etc); plagiarism and other violations of intellectual property; submitting research results to more than one journal; unethically interfering with other people's research; conspiring with other people's misconduct or retaliating against whistle-blowers and giving unfair review due to a conflict of interest.³²

Chinese universities and institutions have also taken some steps to deal with misconduct. In 2001, China's most prestigious research institution, Peking University, announced policies for investigating and adjudicating misconduct.³³ The policies define misconduct as FFP as well as fabricating academic experience, exaggerating the value of research, improper authorship, releasing research results to the media without proper peer review, and other activities that violate commonly accepted international scientific academic norms. The policies, which were implemented in 2002 and revised in 2007, also include rules pertaining to authorship, publication, collaboration, and peer review.³⁴ Other universities have adopted policies similar to Peking University's policies. According to a survey conducted by MOE, 70% of the 75 colleges and universities under its jurisdiction have taken steps to strengthen

academic ethics, such as adopting rules for academic conduct, establishing committees to investigate misconduct, and reforming the evaluation system to reduce the pressure to publish.³⁵ In 2007, CAS, China's most prestigious scientific organization, developed rules for dealing with research misconduct and established a high-level committee to investigate allegations. CAS also ordered its 100 institutes to develop misconduct rules and to educate scientists about the ethical conduct of research.³⁶

Chinese scientists and scholars have also begun to conduct research on research integrity. Several influential books on research ethics have been translated from English into Chinese, including *Betrayers of Truth*,³⁷ *On Being A Scientist*,³⁸ *The Ethics of Science*,³⁹ *Integrity in Scientific Research*,⁴⁰ and *ORI Introduction to the Responsible Conduct of Research*.⁴¹ Two Chinese scholars, Professors Ren-zong Qiu and Nanyan Cao, attended the first International Scientific Integrity Meeting held in Portugal in 2007. They published a summary of the meeting to let more Chinese people know what other countries are doing to promote research integrity.⁴² Professor Cao has also published articles on research ethics in Chinese journals and has a grant to conduct research on scientific ethics.⁴³ Professor Mengqiu Xu published a theory of scientific norms in a prestigious Chinese journal of philosophy of science.⁴⁴ Scholars from CAS wrote a long report titled, 'The Basic Analysis and Suggestion on Problems of Chinese Scientific Ethics and Academic Environment' in 2004 after two years of investigations, which was then sent to the State Council for reference.⁴⁵

FUTURE DIRECTIONS

Though China has made considerable progress in promoting ethical research in the last five years, like many other countries, including the U.S., it still faces some challenges. One of these is policy development. Most of the policies developed by Chinese research organizations have focused on defining and investigating misconduct. While misconduct is by far the most important issue that needs to be addressed to promote research integrity, other issues also merit attention, such as conflicts of interest, data sharing, authorship, and mentoring of students, to name a few.⁴⁶ To promote accountability and transparency, policy development should occur at the national level and at the university level.⁴⁷ Though developing clear and effective policies on research integrity might seem to be a simple and straightforward task, often it is not. For example, it took the U.S. government more than ten years to finalize a uniform policy on research misconduct, and there is considerable variation in the conflict of interest policies adopted by U.S. universities.⁴⁸ In Europe, there has been a great deal of debate about policies on genetically modified plants and animals and the commercialization of human tissues.⁴⁹

Responsible conduct of research education

Education in responsible conduct of research (RCR) is another important challenge. It is not known how many universities in China offer education in RCR or how many require science students to receive RCR education. As noted earlier, CAS has made some important steps to promote RCR education. Though China's educational policies should reflect the needs of Chinese researchers and students, China could learn some lessons from the difficulties the U.S. has had in promoting RCR education. While the U.S. government has required some types of education in RCR for graduate students since 1989, it is not clear whether this policy has had a significant impact on ethical conduct in science.⁵⁰ Assessing the effectiveness of RCR education has proven to be a difficult task, as researchers have had disagreements about deciding on how to define educational programs and educational outcomes. Studies concerning the effectiveness of RCR education in preventing misconduct have yielded mixed results.⁵¹ Additionally, some educational mandates have met with stiff resistance. In 2000, the Office of Research Integrity (ORI), which is responsible for

promoting integrity in research funded by the Public Health Service (PHS), which includes the National Institutes of Health (NIH), proposed a policy requiring that institutions provide RCR education for researchers, staff, trainees and students supported by PHS funds. After universities and professional organizations objected to the requirement and its projected costs, and several Congressmen questioned the process ORI used to develop the proposal, ORI dropped it. In the U.S., only students or trainees supported by PHS or National Science Foundation (NSF) funds are required by law to receive some form of RCR education. However, the NIH requires investigators who received NIH funding for research involving human subjects to have education on protecting human research subjects.⁵²

The U.S.'s experiences illustrate several difficulties with promoting RCR education that China may be able to learn from. First, the reason for requiring instruction in RCR needs to be well articulated and supported. The evidence from published studies does not clearly indicate that RCR instruction reduces the incidence of misconduct. Although common sense indicates that education should have an effect on behaviour, more research is needed on the relationship between RCR education and research integrity. One does not need to prove that RCR education reduces the rate of misconduct to show that RCR education is important. Education may promote research integrity in other ways, such as increasing the awareness of ethical issues, informing people about how to respond to problems, and helping to promote an ethical research environment.⁵³ Second, since RCR education involves additions to the curriculum and uses valuable resources, universities and research institutions should be consulted about decisions concerning RCR education, including the content of the curriculum and logistics. Mandates from above without any input from below may not be well received or implemented. Supporting research on RCR is another challenge to meet. Twenty years ago, there were few published studies on research integrity in the U.S. The lack of empirical and conceptual research on RCR was a barrier to developing effective policies and promoting an ethical research environment. As a result of public interest in research integrity and government hearings, researchers began to become more interested in studying RCR, but they often had trouble obtaining funding. In 2000, ORI helped to jumpstart the RCR research program in the U.S. by funding research on RCR and holding biannual conferences on RCR research. The ORI has sponsored empirical and conceptual research on misconduct, conflicts of interest, financial relationships in research, university ethics policies, RCR education, mentoring, the research environment, authorship, and data sharing.⁵⁴ European countries now also fund RCR research.⁵⁵

China confronts challenges similar to those the U.S. faced twenty years ago. Though Chinese scholars and scientists have begun to publish articles and translate books on research ethics, there are not many peer reviewed articles or books on research ethics in China. Most of the articles on research ethics in China in the PubMed database, for example, focus on research with human subjects and do not address broader issues of research integrity, such as misconduct, authorship, and so on. To promote the development of effective policies and an ethical research environment, it may be useful for research agencies in China to sponsor studies on research integrity. Of special interest would be a survey to gather some baseline data on the attitudes and behaviours of Chinese researchers pertaining to ethics. The survey could help to estimate the prevalence of data fabrication, data falsification, plagiarism, and other ethical problems. Other studies could examine factors in the research environment that contribute to ethical problems in China, or education on RCR in China.

Pressure to publish

Perhaps the most difficult challenge any nation faces concerning research integrity is cultivating a research environment that encourages ethical behaviour. The research environment includes attitudes, traditions, and norms that influence the practice of science.

56 The pressure to produce results has played a significant role in misconduct problems in the U.S., South Korea, Europe, and in China. In the U.S. and Europe, scientists must produce results and publish in order to obtain (or maintain) research funding. The phrase 'publish or perish' describes the life a typical academic researcher in the U.S. or Europe.⁵⁷ In China, performance in research (or lack thereof) can impact many areas of a scientist's life, including salary, promotion, and social benefits.⁵⁸ Researchers in some universities can earn a US\$7,000 reward for publishing articles in top journals, such as *Science* or *Nature*.⁵⁹ Even graduate students face the pressure to publish, since most universities require that students publish articles as a condition of receiving a PhD.⁶⁰ China has taken some steps to reduce the pressure to achieve results.⁶¹ Some universities now emphasize the quality of published research rather than the quantity of research in their evaluations of faculty.⁶² This reform, though helpful, can be difficult to achieve because there is a strong tendency to measure scientific performance in terms of the quantity of publications or citation score.⁶³

Conflicts of interest

It is also important to address conflicts of interest pertaining to funding and publication and other important decisions to promote an ethical research environment. U.S. granting agencies have adopted rules to prevent personal relationships between applicants and reviewers from biasing the review process.⁶⁴ In China, personal relationships have affected government decisions, such as the review of scientific grants, for many years.⁶⁵ Confucianism, which still has a strong influence on Chinese thought and behaviour, emphasizes the importance of relationships in business transactions and governance.⁶⁶ While relationships are important in society, placing too much emphasis on who you know instead of procedural fairness and the rule of law can encourage corruption. For example, Chinese scientists have used their relationships with reviewers to obtain funding for grants, and in some cases they have given gifts to reviewers in exchange for a favourable decision.⁶⁷ China has made some headway on this problem by taking steps to promote fairness and transparency in hiring decisions and peer review, but more work may need to be done.⁶⁸

Protecting whistle-blowers

Protecting whistle-blowers from retaliation is another important challenge facing China and many other countries, including the U.S. Countries with laws protecting whistle-blowers, such as the U.S., the U.K., Canada, the Netherlands and Germany, still have problems with encouraging people to report misconduct and other transgressions in research, because people fear that they will face career-threatening consequences of blowing the whistle, such as being blackballed or developing a reputation as a troublemaker.⁶⁹ Many U.S. researchers avoid reporting illegal or unethical activity because they simply want to avoid the hassle of testifying in a misconduct inquiry or investigation. Additionally, some universities have institutional norms that encourage people to cover-up or ignore problems to avoid embarrassing the institution. As a result, a large percentage of misconduct that occurs in U.S. research may not be reported.⁷⁰ Like the U.S. and other countries, China has also had some difficulties with encouraging whistle-blowers to report violations of ethical or legal rules.⁷¹ Lack of legal protections for whistle-blowers is one reason why many misconduct investigations in China have been based on anonymous tips.⁷² Several Chinese cultural traditions discourage whistle-blowing, including loyalty in personal relationships (mentioned previously), the emphasis on avoiding damage to reputations or 'saving face', the tendency to tolerate rather than confront misbehaviour, and the deference to authority.⁷³ University leaders may be able to counteract these traditions and tendencies by emphasizing the importance of ethics in research and the necessity of reporting problems through the appropriate channels.

Auditing

A step beyond supporting whistle-blowing that institutions can take is to routinely audit research data. Auditing can be more effective at preventing and detecting violations of ethical or legal rules than whistle-blowing, because people often do not report problems that they know about or observe.⁷⁴ Auditing can not only uncover major problems, such as misconduct, but it can also expose minor ones, such as errors and irregularities in recording data. Auditing is a common practice in research sponsored by pharmaceutical or biotechnology companies, because the companies want to produce data that regulatory agencies will accept, and problems with the data can cost companies time and money. Auditing is less common in research that is not supported by industry, because auditing costs a significant amount of money, and universities often cannot afford to pay people to audit research. Also, academic researchers may not want to share their research records with an outside party.⁷⁵

Open communication

Open communication is also essential for promoting integrity in research. Openness plays a key role in collaboration, publication, peer review, criticism, replication, the evaluation of government projects and industry activities, and in making decisions about social issues that involve science, such as global warming, preparing for natural disasters, or food safety. Interference in scientific communication—by the government or private industry—can undermine the integrity of science in many different ways.⁷⁶ Restrictions on scientific communication may prevent scientists from publishing important results, reporting illegal or unethical activities, conducting some types of controversial research, or engaging in debates about ethical issues. China has taken some steps toward promoting openness in scientific communication in recent years—the internet has provided a useful outlet for discussion and debate—but additional steps may be necessary.⁷⁷

Open government

Open government also helps to promote research integrity because it involves scientists and citizens in the state's decision-making.⁷⁸ Important decisions about science, such as funding priorities and research policies, as well as decisions that are informed by science, such as food and drug safety or environmental protection, should be open for public comment and review. Open government is necessary so that scientists can take part in the decisions that can affect the country's research agenda and the quality and integrity of research. For example, if the government plans to adopt a new policy concerning the use of human subjects in research, scientists and citizens should be informed about the policy and should help to craft it. If the government is considering a plan to shift resources toward an expensive scientific project, such as building a new supercollider, scientists and citizens also need to take part in that decision.

For many years, China's government was far from open. Important decisions were made in secret, and the public had little input into government policies. The government also has kept other countries from learning about events taking place in China.⁷⁹ Although China's government has become much more open in recent years, it can go further.⁸⁰ The openness exhibited by the government during the Sichuan earthquake of May 12, 2008 and the contamination of infant formula with melamine are steps in the right direction, but more are needed.⁸¹

CONCLUSION

China is now a global leader in science and technology. Like other countries at the forefront of knowledge development, China has encountered some ethical problems related to the

conduct of research. To keep moving forward, China needs to continue to take measures to promote research integrity. The current government and Communist party leaders understand the importance of ethics in research. In an interview published in *Science*, Chinese Premier Wen Jiabao said, 'our scientists need to cultivate scientific ethics; most importantly, they need to uphold the truth, seek truth from facts, be bold in innovation and tolerant of failure. Only science and the spirit of seeking truth from facts can save China.'⁸² China has already taken significant steps to promote research integrity by developing policies, conducting investigations of the problem, and establishing oversight committees. We expect that further action will be forthcoming as the China's leaders deal with these new challenges.

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