



Caught in the crossfire: Fears of Chinese–American scientists

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The US global leadership in science and technology has greatly benefitted from immigrants from other countries, most notably from China in the recent decades. However, feeling the pressure of potential federal investigations since the 2018 launch of the China Initiative, scientists of Chinese descent in the United States now face higher incentives to leave the United States and lower incentives to apply for federal grants. Analyzing data pertaining to institutional affiliations of more than 200 million scientific papers, we find a steady increase in the return migration of scientists of Chinese descent from the United States to China. We also conducted a survey of scientists of Chinese descent employed by US universities in tenured or tenure-track positions ($n = 1,304$), with results revealing general feelings of fear and anxiety that lead them to consider leaving the United States and/or stop applying for federal grants. If the situation is not corrected, American science will likely suffer the loss of scientific talent to China and other countries.

American science | immigrant scientists | China | academic freedom | China initiative

A 2007 report, *Rising above the Gathering Storm* (1), shocked the scientific community with an alarming message that American science may be in decline and soon lose its long-held leadership in the world. Evidence cited in support of this claim included inadequate US investments in science education at all levels and in scientific research, in an era when competing countries, the People's Republic of China in particular, had been increasing science-related investments and narrowing gaps with the US. This report received a great deal of attention from policymakers, spawning over two dozen bills in Congress within a year of its release, with objectives ranging from improving K–12 science and mathematics education to investing more in basic science research (2).

Addressing this science policy question, sociologists Xie and Killewald published a book in 2011, *Is American Science in Decline?* (2). After examining a variety of indicators on science, Xie and Killewald dismissed the alarmist view of the 2007 report and concluded that American science had fared reasonably well. One of the main reasons for their relatively optimistic conclusion was that America had benefitted from immigration: even if the United States does not train an adequate number of scientists and engineers that it needs for its modern economy, it is able to attract the best and the brightest scientists and engineers from around the world. For example, China has been the most important foreign supplier of US-based scientists for more than two decades (3).

Chinese Scientists in the United States

Out of about 34,000 Ph.D. recipients in science/engineering (S/E) fields awarded by US institutions in 2020, 46% (approx. 15,000) held temporary visas, a lower bound estimation of “foreign students”. Among these 15,000 recipients with temporary visas, the largest portion came from China, at 37%, three times the proportion from India, the second largest sending country. In other words, 17% of all 2020 US doctoral degrees in S/E went to foreign students from China (*SI Appendix, Supplementary Materials 1*). Most foreign-born noncitizen recipients of US S/E doctorates remain in the United States for subsequent employment. For those from China, about 87% of new PhDs in 2005 to 2015 intended to stay in the United States (*SI Appendix, Supplementary Materials 1*). Along with native-born Chinese Americans, Chinese immigrants have become a large and visible demographic group in American science and technology (4). Today, it is hard to open an issue of any major scientific journal and not to find a Chinese name among its contributing authors. It is well known that China's rapid scientific advancements have been fueled by proactive talent schemes to attract scientists of Chinese descent back to China (5). However, both the future supply and retention of current scientists and engineers from China have been dampened by the China Initiative launched following the onset of the US–China trade war in 2018 (6).

Significance

Our study reveals the widespread fear among scientists of Chinese descent in the United States arising from conducting routine research and academic activities. If this fear is not alleviated, there are significant risks of underutilization of scientific talent as well as losing scientific talent to China and other countries. Addressing the fear of US-based scientists of Chinese descent and making the American academic environment welcoming and attractive to all will help retain and attract scientific talent and strengthen the US global leadership in science and technology in the long run.

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The China Initiative

In 2018, formalizing standing concerns about “Chinese economic espionage”, the Department of Justice launched the China Initiative (7). In reality, the Initiative mostly targeted US-based academic scientists of Chinese descent for “research integrity” issues, the most prominent being failure to disclose relationships with Chinese institutions on federal grant applications (7, 8). The Initiative was heavily criticized for racial profiling—though views varied on the extent to which this was intentional—by both the scientific community and civil rights advocates, leading to an ending of its official name in early 2022 (9). There are questions, however, regarding the extent to which the formal dropping of the “China Initiative” name has been accompanied by substantive changes in the government’s practices that address the chilling effects experienced by scientists of Chinese descent. So far, the China Initiative has openly investigated about 150 academic scientists and prosecuted two dozen of them with criminal charges (7, 9), with many more investigated in secret (8).

One high-profile case was against Gang Chen, a former head of the Department of Mechanical Engineering at MIT and a member of the US National Academy of Engineering. After his arrest on January 14, 2021, his lab was closed, and his research group dispersed. A year later, all charges were dropped (10). The chilling effect of the Gang Chen case was significant and consequential; it resulted in greater community awareness among Chinese–American scientists and scientists of Chinese descent regardless of their nationality and heralded nationwide discussions in the community as to how to protect oneself and address the emerging challenges. For example, a new nonprofit organization, the Asian American Scholar Forum (AASF), was established in response to Gang Chen’s case to promote academic belonging, openness, freedom, and equality for all. Since 2021, three surveys of scientists of Chinese descent have been conducted to understand their concerns and feelings in this new climate (*SI Appendix, Supplementary Materials 2 and 3*). Expanding on previous research reporting racial profiling experienced by scientists of Chinese descent under the China Initiative (11), we systematically evaluate the long-term consequences of the China Initiative on brain drains and America’s global leadership in science and technology.

The Reverse Brain Drain

The China Initiative caused widespread concern in the Chinese American scientific community. It has potentially contributed to the departure of some leading academic researchers of Chinese descent in the US. In 2019, Song-Chun Zhu, an accomplished computer scientist and the then-director of the Center for Vision, Cognition, Learning, and Autonomy at the University of California at Los Angeles, announced his intention to return to China. While Zhu’s return to China was largely attributable to his greater career opportunities there, an article was widely circulated on Chinese social media, publicly thanking the China Initiative for sending top Chinese–American scientists like Zhu back to China (12). Zhu currently serves as the dean of the Institute for Artificial Intelligence at Peking University.

Zhu’s case illustrates that US–China geopolitical tensions have led to brain drains from America’s perspective, yet brain gains from China’s perspective. While China’s contribution to the world’s science and technology was minor only three decades ago, it is now a major contributor of science and technology (5). In terms of the total number of science and technology publications in scientific journals, China has now surpassed the United States as the world leader (13). Four explanations accounting for China’s

recent success in science and technology development are 1) a large population and human capital base, 2) a labor market rewarding academic meritocracy, 3) a centralized government willing to invest in science, and 4) the return migration of foreign-trained scientists and engineers of Chinese descent to China (5, 14). Scientists of Chinese descent living and working overseas have been recruited to China by a combination of factors: large and fast-growing investments in science, high social prestige and attractive financial rewards tied to positions in Chinese institutions, and capable research collaborators and assistants. In this study, we investigate whether—net of these “pull” factors—the China Initiative has contributed to the return of scientists of Chinese descent to China.

We conducted an analysis to estimate trends in return migration of scientists of Chinese descent to China using bibliometric data (15), identifying Chinese descent with Chinese surnames (see details in *SI Appendix, Supplementary Materials 4*). The trends, respectively, for life science, mathematics and physical science, and engineering and computer science, are presented in Fig. 1, separately for junior scholars (Fig. 1A) and experienced scholars (Fig. 1B). We define experienced scholars as those with 25 or more publications (*SI Appendix, Supplementary Materials 4*). The *y* axis represents the ratio of the number of returning scientists each year relative to the baseline in 2005 to 2010 by corresponding fields. It is apparent that the number of returning scientists had been increasing steadily before the China Initiative, and that this was true for both junior scholars and experienced scholars.

By 2018, the factor ranged between 4 and 5 for junior scholars and 3 and 4 for experienced scholars, across each of the fields. After 2018, when the China Initiative was first implemented, the trend picked up speed, reaching the 5 to 7 range in 2021, except for life scientists. While the return rate slowed for junior life scientists, it increased for experienced life scientists after 2019. This finding is consistent with the reported sharp fall in dual affiliations

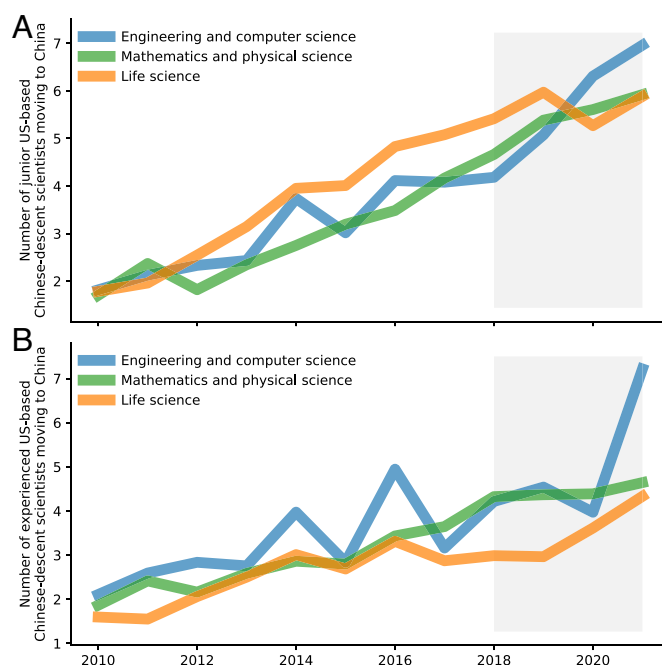


Fig. 1. Normalized number of (A) junior and (B) experienced Chinese scientists leaving the United States each year for China from 2010 to 2021. Note: Chinese scientists are counted as “leaving” if they published their first paper with an affiliation in the United States and later published with a China affiliation but without an affiliation in the United States. Yearly numbers are normalized by the average number of leaving Chinese scientists in 2005 to 2010 to ensure the reported numbers are comparable across disciplines. The shaded portion highlights the notable increase after 2018.

and collaborations between the United States and China by 2021 due to scholars' fears of the federal government's suspicion (16). Similar trends are observed among scientists of Chinese descent when we extend the analysis to those migrating out of the United States to other countries, including China, with an increasing fraction relocating to China. (*SI Appendix, Figs. S4 and S5*).

Fears of Chinese–American Scientists

Relative to the size of the total Chinese–American scientist/engineer population, the number who have returned to China is very small. The vast majority prefer to stay and continue their work in the United States. However, they now fear that their work and lives in the United States may be jeopardized by the China Initiative.

Between December 2021 and March 2022, we conducted an online survey of US-based scientists of Chinese descent on behalf of the AASF. We obtained responses from 1,304 Chinese–American researchers currently employed by US universities. They are well represented in terms of geography, institution type (private versus public), gender, field of study, and seniority (*SI Appendix, Supplementary Materials 2*). By survey standards, the AASF survey is a “convenience” sample. It is not a probability-based sample because there is no national sampling frame from which we could draw such a sample. In *SI Appendix, Supplementary Materials 5*, we compare the representativeness of the sample with data from the American Community Survey.

A methodological caveat is in order. There are two sources of potential bias with our survey data (discussed in more detail in *SI Appendix, Supplementary Materials 2*): “sample selection bias” and “social desirability bias”, both in the direction of exaggeration of the negative impact of the China Initiative. Therefore, caution is needed when we interpret the results. However, the high degree of consistency of our survey results with those from two other similar surveys (*SI Appendix, Supplementary Materials 3*) lends credence to the results we report below.

In Fig. 2, we present our main findings with eight indicators: five “psychological indicators” and three “intention indicators”. Our results are largely consistent with the findings from two earlier similar surveys (17). In *SI Appendix, Supplementary Materials 3*, we compare both the design and the findings across the three surveys. All five psychological indicators reveal a strong sense of uneasiness and fear: 35% of respondents feel unwelcome in the United States, and 72% do not feel safe as an academic researcher; 42% are fearful of conducting research; 65% are worried about collaborations with China; and a remarkable 86% perceive that it is harder to recruit top international students now compared to 5 years ago. The intention indicators address the potential impact of these psychological concerns on behavioral intent: 45% of respondents who have obtained federal grants say that they now wish to avoid applying for federal grants; and a shocking 61% have thought about leaving the United States (for either Asian or non-Asian countries).[†] Among those who intend to continue applying for federal grants, 95% indicate they rely on grants to conduct research, especially life scientists. Despite an overall fearful sentiment, an overwhelming majority (89%) of our respondents indicated their desire to contribute to the US leadership in science and technology.

Regression analyses predicting the first two behavioral intentions with demographic and professional characteristics, presented in

^{*}The anonymous survey began with a consent form and an agreement that their responses can be used for statistical analysis and aggregated results can be reported. The project was approved by Salus IRB (Institutional Review Board).

[†]*SI Appendix, Supplementary Materials 2 and Table S2* reported that, 47% and 46% of survey participants indicated their intention to relocate to Asian and non-Asian countries, respectively.

SI Appendix, Supplementary Materials 6 (Models 1A and 1B), reveal that faculty members in engineering and computer science, those of senior ranks, and those from public institutions are much more likely to consider avoiding federal grant applications. Our results also show that junior faculty and those who have been funded by federal grants are much more likely to consider relocating abroad. This is particularly worrisome because junior researchers and federal grant awardees are important to the global competitiveness of the United States in cutting-edge science and technology.

As reported in *SI Appendix, Supplementary Materials 6* (Models 2A and 2B), we also find that indicators of fear (shown in Fig. 2) strongly predict the first two intention measures—avoiding federal grant applications and considering relocating abroad, after adjusting for demographic, professional, and geographical covariates. Variables capturing perceptions of professional belonging and university leadership are not significantly predictive of those two intentions. After accounting for psychological indicators, engineering and computer science faculty are not statistically different from other respondents in avoiding federal grant applications, suggesting that fear of conducting research explains the observed difference. After accounting for these fear effects, junior faculty and federal grant awardees remain much more likely to consider leaving the United States.

These survey data on Chinese–American scientists should be interpreted in the broader US context. Anti-Asian and anti-Chinese sentiments in the United States have increasingly prevailed since the COVID-19 pandemic began (18, 19). The high percentage of those considering leaving the United States is partly attributable to a Chinese-hostile societal environment in the United States nowadays. Our data show that 83% of the respondents had experienced insults in a nonprofessional setting in the past year, and experiencing insults of this kind significantly heightened individuals' intention of leaving the United States. However, this large societal effect of insult experiences does not explain away the net effects of “fear” and “feeling unwelcome” related to the China Initiative on the intention of leaving the United States.

We further explore the reasons behind our respondents' fears. *SI Appendix, Supplementary Materials 7* displays the detailed results. Our analysis suggests that engineering and computing science faculty, life science faculty, federal grant awardees, senior faculty, and males are relatively more likely to feel fearful of conducting research in the United States. As shown in *SI Appendix, Supplementary Materials 8 and Fig. S6*, of the five possible reasons for “not feeling safe as an academic researcher in the US”, most survey respondents pointed to fears of “US government investigations into Chinese-origin researchers” (67%) and “Anti-Asian hate and violence in the US” (65%). Meanwhile, relatively small percentages of respondents expressed other fears, such as that “US government officials often attack the Chinese government or Chinese policies” (38%), “My family, friends, or collaborators might be targeted by the US or Chinese government in retaliation for something I say or do” (37%), and “Others might report what I say or do to the US or Chinese government” (31%).

Our survey uncovers many Chinese–American scientists' intention to avoid applying for federal grants out of fear of federal government prosecution under the China Initiative. In our data (reported in *SI Appendix, Fig. S7*), of the 445 respondents who intended to avoid applying for federal grants, 84% indicated that this was “Because I am afraid that I would have legal liability if I made mistakes in forms and disclosures”, while 65% reported that this was “Because I worry that my collaborations with Chinese researchers or institutions would place me under suspicion”.

Differences of fear by gender are relatively small, whereas differences of fear by fields are significant (*SI Appendix, Supplementary*

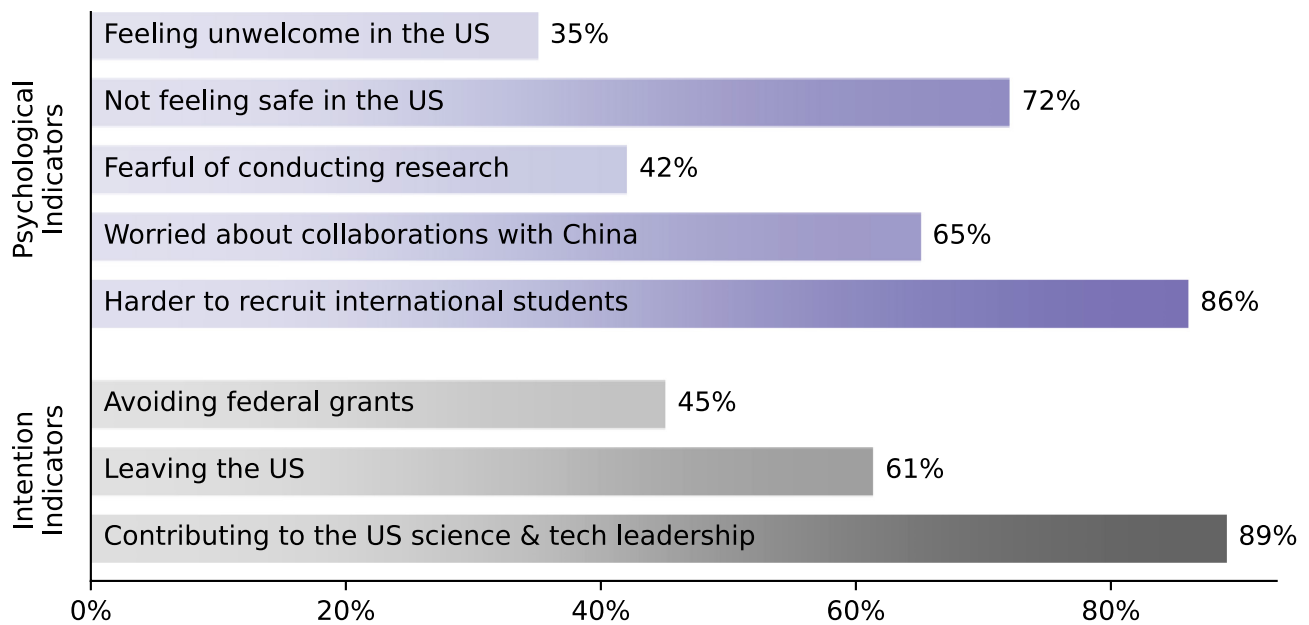


Fig. 2. Perceptions and intentions of scholars of Chinese descent. Note: Only past and current grant awardees were asked the question of whether they were considering “avoiding applying for federal grants”.

Materials 9). Men are slightly more likely than women to be fearful of the US government’s investigations and family/friends/collaborators being targeted by the US/Chinese government, after accounting for men’s higher concentration in engineering and computer science. Compared to natural scientists, social science researchers are less fearful of the US government’s investigation into researchers of Chinese descent, consistent with social science’s less sensitive nature with regard to the US–China technological clashes. Also, researchers in the areas of engineering and computer science and life science showed the highest percentages of feeling fearful for all the listed reasons for not feeling safe.

Our survey instrument allowed our respondents to make open-ended comments at the end of the survey, yielding hundreds of comments. *SI Appendix, Supplementary Materials 10* reports summary statistical patterns that emerged from open-ended comments. The comments elaborate fearful feelings, with “China initiative” mentioned 23 times, and “discrimination” mentioned 19 times. One respondent, self-identified as a US citizen and a former recipient of the NSF CAREER Award, told us that he quit his academic position exactly because of what he perceived as an “anti-Chinese atmosphere”. He then wrote:

If it were not because the COVID pandemic cuts off international traveling and I am a U.S. citizen, my family would have left the U.S. permanently without any intent to come back in the future. What I have experienced at my former institution was not only disgusting, but a system[ic] corruption that I believe [is] illegal. I had never thought of somewhere in this count[r]y to be dark and corrupted like this. If I had, I would not have become a naturalized U.S. citizen, which I regret now. What I ha[ve] experienced not [only] ruined my academic career, but also destroyed my American dream.

Conclusion

Modern science has been making tremendous progress since its inception in the seventeenth century because it has been open,

benefitting the entirety of humanity. The world center of science has shifted several times in the past, from Renaissance Italy to England in the seventeenth century, to France in the eighteenth century, and to Germany in the nineteenth century, before crossing the Atlantic in the early twentieth century to the United States (2). Still, scientists everywhere should have belonged to a single world-wide community, as they share new knowledge with one another through publications in the public domain. What attracts scientists the most is not only material comfort but also academic freedom and opportunities to pursue one’s ideas and careers. For a long time, the United States has been providing an outstanding work environment with academic freedom and opportunities for all (2). This is and should remain a distinctive advantage of the United States.

Immigrant scientists and engineers from China have been an integral part of the US research enterprise for decades. In the past, there have been complaints that while they contributed a large share of the hard work, on the whole they failed to achieve leadership positions or commensurate recognition, reaching a “bamboo ceiling” (20, 21). The rising US–China geopolitical tensions in recent years have reinforced the American public’s outgroup perceptions about Asians (22, 23), exacerbating the “bamboo ceiling” effect. Against this backdrop, the China Initiative has undermined the trust in scientists of Chinese descent in particular. Under the China Initiative, a majority of US-based scientists of Chinese descent now feel the chilling effect of potential federal investigations and prosecution and have a new reason to be pessimistic about their careers in the US. Indeed, although an overwhelming majority would like to contribute to the US leadership in science and technology, many feel unwelcome and fearful of conducting research in the United States. For some Chinese–American scientists, this fear leads to their consideration of avoiding federal grant applications, especially among engineering and computer science faculty, and of leaving the United States, especially among junior faculty and federal grant awardees. There are indications that applications for NSF grants declined significantly between 2011 and 2020 (24). While the decline was 17% overall, it was much higher, at 28%, for Asian American scientists. Like many Asian Americans, scientists of Chinese descent have fallen victim to rising US–China geopolitical tensions.

In this article, we have shown unintended consequences of the China Initiative that are harmful to American science: 1) discouraging new Ph.D. recipients of Chinese descent from working in the United States; 2) making the working environment unwelcoming, and even hostile, for prominent scientists of Chinese descent to continue their work in the United States; and 3) discouraging scientists of Chinese descent from securing federal sponsorship and seeking US–China or international collaborations, especially among those in engineering and computer science. To attract new scientific talent from China and keep scientists of Chinese descent from returning to China or moving to other countries, it is imperative to alleviate their fears and nurture an inclusive and safe academic environment conducive to scientific research. Indeed, American science and American society should continue to welcome and attract Chinese scientists to maintain the US global leadership in science and technology in the long run.

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Data, Materials, and Software Availability. The bibliometrics data analyzed in this paper were originally sourced from Microsoft Academic Graph (15), and the authors have published the processed data on yuxie.com. To address privacy concerns, ensure the consent of survey respondents, and minimize the risk of potential participant identification, researchers can request authorized access of the individual-level survey data analyzed in the paper by contacting the authors. Summarized statistics derived from the raw responses are available in the [Supplementary Materials](#).

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