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Artificial Intelligence-Related Research Funding by the U.S. National Science Foundation and the National Natural Science Foundation of China

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ABSTRACT For the United States and China, artificial intelligence (AI) algorithms, methods, and applications are considered key to a nation's economic competitiveness and security. This paper investigates funding by the U.S. National Science Foundation and National Natural Science Foundation of China from 2010 to 2019, including the key institutions and universities that received AI awards, and the key AI disciplines and applications of focus in the research. Comparisons between the U.S. National Science Foundation and the National Natural Science Foundation of China, including the number of published papers as a result of the awards, are also presented.

INDEX TERMS Artificial intelligence, NSF, NSFC, award.

I. INTRODUCTION

Artificial intelligence (AI) is the ability of a machine (e.g., computer) to learn from experience and react to new inputs based on what was learned [1]. AI attempts to mimic human intelligence to allow systems to act autonomously. AI is widely used in many applications, from ridesharing and shopping applications to power electronics [2], transportation [3], [4], and healthcare [5], [6]. AI has become a market differentiator that has attracted the attention of many industries. Governments have also been encouraging and funding AI-related research and development activities because they are considered to be key to economic competitiveness and national security [7]. In February 2019, the U.S. president issued an executive order on maintaining U.S. leadership in AI [8]. On the other hand, In 2017, the State Council of China released a development plan to ensure China as the global leader in AI by 2030 [9].

There are many ways to look at the trends in AI research and development. For example, numerous studies have examined trends in published AI-related papers [10]–[12] and AI-related patents [13], [14]. Other researchers have examined trends in investments [15]. This paper uniquely focuses on the National Science Foundation (NSF) and National Natural Science Foundation of China (NSFC) funding of AI research, with a focus on the U.S. and China, the two leaders in the research and applications of AI [7].

The U.S. National Science Foundation (NSF) and the National Natural Science Foundation of China (NSFC) are the two major funding sources for basic research in the U.S. and China. NSF is an independent U.S. government agency created in 1950 that provides funding for about 24% of all federally supported basic research conducted by U.S. colleges and universities. The NSF supports all fields of fundamental science and engineering, except medical sciences [16]. The NSFC was established in 1986 and is the major funding agency for China's basic research. In 2017, the total budget for the NSFC was about 27% of China's total investment in basic research [17]. The NSFC funding system focuses on three categories of programs, including research promotion, talent fostering, and infrastructure construction for basic research [18].

This paper presents the funding of AI-related research by the NSF and NSFC to show the level of attention paid by the U.S. and Chinese governments to basic research in the AI domain from 2010 to 2019. Section 2 presents the methodology of identifying and retrieving AI-related awards by NSF and NSFC from their databases. Sections 3 and 4 discuss the funding by the NSF and NSFC, including the growth of funding and number of AI-related awards, the key institutions and universities, and the key AI disciplines and applications of focus in the research. Section 5 compares the NSF and

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NSFC by looking at the amount of funding and number of AI-related awards, including the published papers as a result of the awards. Section 6 presents conclusions.

II. METHODOLOGY

NSF shares awards data, including title, abstract, start date and end date, amount, and investigator, with public (https://www.nsf.gov/awardsearch/download.jsp). In this study, a keyword-based search was used to identify AI-related awards by the NSF. The NSF is divided into seven directorates that support science and engineering research and education [19]. Each directorate is further subdivided into divisions (Table 1). The keyword-based search would capture all the AI-related awards even if they were granted under directorates or divisions unrelated to AI. Although the Division of Information and Intelligent Systems under the Directorate of Computer and Information Science and Engineering may appear to cover AI-related awards, there can still be AI-related awards granted under the directorates and divisions unrelated to AI, when researchers focus on the implementation of AI for various applications. For example, a proposal can be about the application of AI in the field of earth sciences and be classified under the Division of Earth Sciences. Therefore, the keyword-based search makes it possible to identify AI-related awards under all directorates and divisions. The keywords used in this paper have been used by other researchers before [20], [21], and are presented in the appendix. An NSF's award is considered related to AI if there is an AI-related keyword match in its title or abstract.

In this study, the NSFC's AI-related awards were identified using the NSFC's classification system. The bulk data of the NSFC's awards are not shared with public and it is not possible to access the whole of the data at the same time. So, the NSFC's AI-related awards were limited to the awards under the F06 AI section, which are identifiable using authorized search tools and searching by the section code. The NSFC classifies awards into eight technical groups, A to H, based on their technical content (Table 2). Group F corresponds to the Department of Information Science and has seven sections, of which F06 is the AI Section. The ScienceNet virtual community search tool (http://fund.sciencenet.cn/) which has been authorized by the NSFC was used to search through the awards database and identify AI-related awards. Thus, in this paper the NSFC's AI-related awards are the awards under the F06 AI section (classes under F06) of the Department of Information Science, granted between 2010 and 2019 (10-year period). The NSFC funds data are in Chinese RMB in the online searching system, and they are converted by using the average exchange rates in each year to U.S. dollars ($) presented in this paper.

This paper's comparison of NSF and NSFC AI funding focuses on the amount of funding and number of awards under the NSF's Division of Information and Intelligent Systems and the NSFC's AI section, which are purely relevant to AI. The comparison, also, considers the ratios of the amount of funding and number of AI-related awards (NSF to NSFC) and the number of AI-related papers as well as involved researchers.

TABLE 1. Directorates and divisions of NSF.

Directorate	Divisions
Biological Sciences	Biological Infrastructure
	Environmental Biology
	Emerging Frontiers
	Integrative Organismal Systems
	Molecular and Cellular Biosciences
Computer and Information Science and Engineering	Office of Advanced Cyberinfrastructure
	Computing and Communication Foundations
	Computer and Network Systems
	Information and Intelligent Systems
Mathematical and Physical Sciences	Astronomical Sciences
	Chemistry
	Materials Research
	Mathematical Sciences
	Physics
	Office of Multidisciplinary Activities
Engineering	Chemical, Bioengineering, Environmental and Transport Systems
	Civil, Mechanical and Manufacturing Innovation
	Electrical, Communications and Cyber Systems
	Engineering Education and Centers
	Emerging Frontiers and Multidisciplinary Activities
	Industrial Innovation and Partnerships
Geosciences	Atmospheric and Geospace Sciences
	Earth Sciences
	Ocean Sciences
	Office of Polar Programs
Social, Behavioral and Economic Sciences	Behavioral and Cognitive Sciences
	National Center for Science and Engineering Statistics
	Social and Economic Sciences
	SBE Office of Multidisciplinary Activities
Education and Human Resources	Graduate Education
	Research on Learning in Formal and Informal Settings
	Undergraduate Education
	Human Resource Development

III. ARTIFICIAL INTELLIGENCE-RELATED AWARDS BY THE NATIONAL SCIENCE FOUNDATION

From the approximately $60 billion in awards granted by NSF in the decade 2010–2019, $1.9 billion (about 3.1%) was granted to AI-related proposals, and among the 122,290 awards made by the NSF in the decade, 4547 awards (about 3.7%) were associated with AI. Both the amount of funding and the number of the NSF's AI-related awards experienced an increasing trend between 2010 and 2019. The AI-related funding increased from $141 million in 2010 to $368 million in 2019. Meanwhile, the number of AI-related awards rose from 277 to 869 (Figure 1). In other words, the amount of funding and number of AI-related awards experienced 161.6% and 213.7% rise during the 10-year period. However, the increase in the amount of funding and number of AI-related awards was more considerable after 2016, which shows the U.S. government's special attention to basic

TABLE 2. Artificial Intelligence section F06 and its classes under the NSFC's Department of Information Science.

Group	Section	Class
A – Department of Mathematical Science		
B – Department of Chemical Science		
C – Department of Life Sciences		
D – Department of Earth Science		
E – Department of Engineering and Material Science		
F – Department of Information Science	F01 - Electronics and Information Systems	
	F02 - Computer Science	
	F03 – Automation Science	
	F04 – Semiconductor Science and Information Devices	
	F05 – Optics and Optoelectronics	
	F06 - Artificial Intelligence	F0601 - Artificial Intelligence Foundation
		F0602 - Machine Learning
		F0603 - Machine Perception and Pattern Recognition
		F0604 - Natural Language Processing
		F0605 - Knowledge Representation and Processing
		F0606 - Intelligent System and Application
		F0607 - Cognitive and Neuroscience-inspired Artificial Intelligence
	F07 – Information Science in interdisciplinary	
G – Department of Management Science		
H – Department of Medical Science		

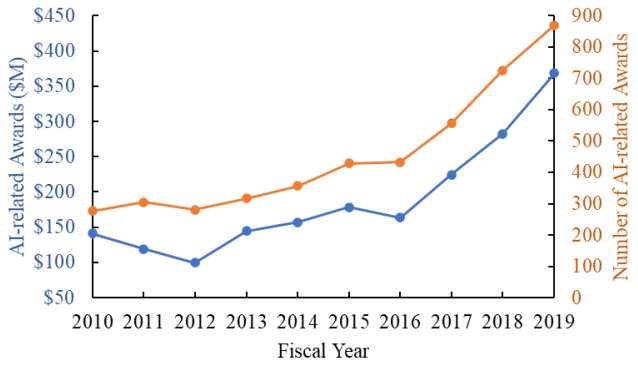


FIGURE 1. Amount/number of AI-related funding granted by the NSF per fiscal year.

research in AI after 2016. In 2016, the first National Artificial Intelligence Research and Development Strategic Plan was published by the U.S. government, which laid out the strategic plan for Federally-funded research and development in the domain [22].

A. INSTITUTIONS WITH THE HIGHEST AMOUNT/NUMBER OF ARTIFICIAL INTELLIGENCE-RELATED AWARDS

The top 10 institutions with the highest amount of AI-related awards received $342 million for 715 awards during the 10-year period, which is around 18.2% of the total funding and 15.7% of the number of awards. Carnegie Mellon University received the highest amount of AI-related awards (∼$70 million) during the period 2010–2019, followed by the University of Michigan Ann Arbor (∼$40 million) and the University of Illinois at Urbana-Champaign (∼$33 million). Figure 2 shows the top 10 institutions with the highest amount of NSF AI-related awards from 2010 to 2019. However, the ranking based on the number of awards is different. In Figure 2, the number in parentheses for each university shows the number of received awards. For example, the University of California-San Diego received 51 AI-related awards, which is relatively low in comparison with the other top 10 institutions.

B. ARTIFICIAL INTELLIGENCE APPLICATIONS AND TECHNIQUES

The NSF is divided into seven directorates and each directorate is further subdivided into divisions (Table 1) [19]. Each NSF award is granted under a single directorate and division, so the application field of granted awards can be identified by considering their related directorates and divisions. The Directorate of Computer and Information Science and Engineering granted the highest amount of AI-related awards (∼$880 million) from 2010 to 2019, followed by the Directorate of Engineering (∼279 million) and Directorate of Mathematical and Physical Science (∼$210 million) (Figure 3). In addition, the top three divisions with the highest amount of AI-related awards are the Divisions of Information and Intelligent Systems, Computing and Communication

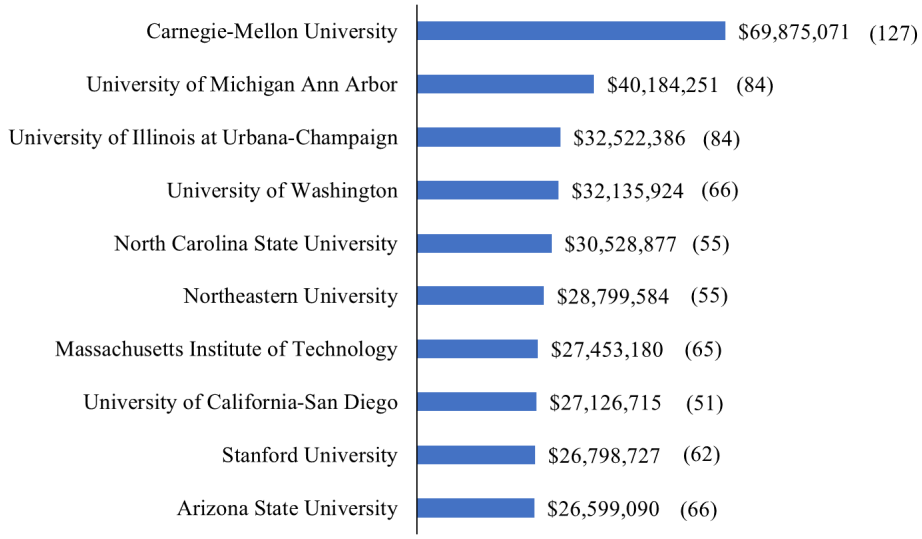


FIGURE 2. Institutions with the highest amount of AI-related awards from the NSF in 2010–2019 (fiscal year).

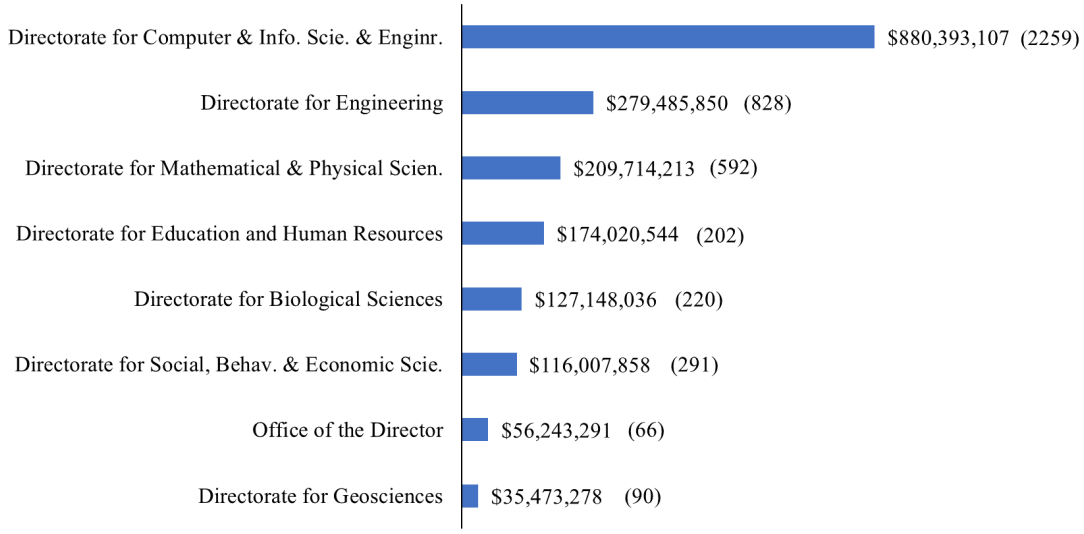


FIGURE 3. Amounts of AI-related awards per NSF directorate in 2010–2019 (fiscal year).

Foundation, and Computer and Network Systems. Figure 4 shows the top 10 divisions with the highest amount of AI-related awards. All three top divisions are

under the Directorate of Computer and Information Science and Engineering, which covers the fields of computing, communications, and information science and engineering. The other highly considered applications of AI are in the fields of mathematical and physical sciences and engineering. In Figure 3 and Figure 4, the number in parentheses shows number of awards.

The most frequently used keywords can represent the most considered techniques in the AI-related awards. ''artificial intelligence'' is the most used keyword and was found in more than 22% of the identified AI-related awards. ''data mining'' and ''neural network'' are the next most used keywords, and each one showed up in about 20% of AI-related awards (Figure 5). In addition, about 10% of identified AI-related awards include ''natural language processing'' and 6% of them include ''reinforcement learning,'' which shows high applications of these techniques in research activities. Figure 6 shows the 10 most frequent keywords per year for 2010, 2012, 2014, 2016, and 2018. ''natural language processing'' and ''reinforcement learning'' were usually between the top 10 keywords. There was a decrease in using ''data mining'' in AI-related award proposals, although it was the most frequently used keyword between all the AI-related keywords until 2018. ''object recognition'', ''decision support system'', and ''sparse representation'' were

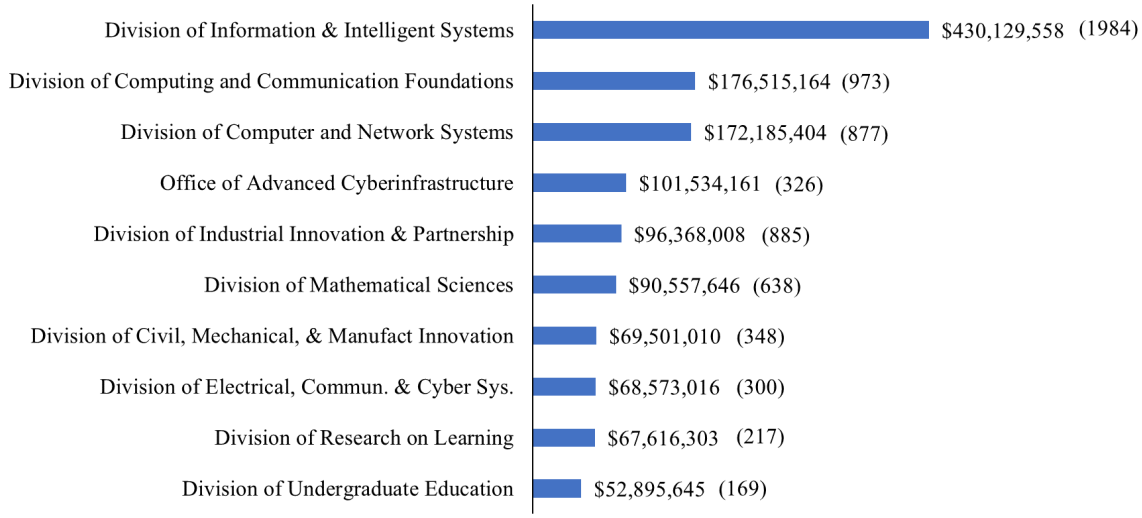


FIGURE 4. Amounts of AI-related awards per NSF division in 2010–2019 (fiscal year).

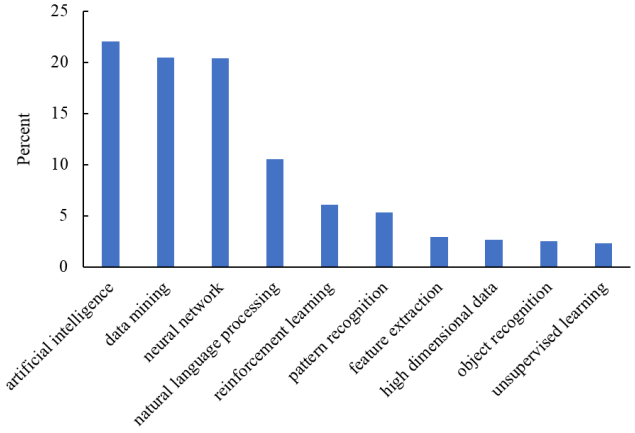


FIGURE 5. Most considered keywords in AI-related awards made by the NSF in 2010–2019 (fiscal year)

among the 10 most frequently used keywords in 2010 that disappeared during the period. "deep learning" and "recurrent neural network" emerged among the top 10 keywords in 2018, which shows that a high number of researchers started to use these techniques in the proposals.

IV. ARTIFICIAL INTELLIGENCE-RELATED AWARDS BY THE NATIONAL NATURAL SCIENCE FOUNDATION OF CHINA

For the NSFC, the data of the awards under the AI section (F06) in the Department of Information Science are collected to show the trends in AI-related research funding. From 2010 to 2019, the total AI funding by the NSFC under the AI section (F06) was $299.8 million, and the total number of awards was 3770. In 2010, the total amount of AI funding under the AI section (F06) was $9.1 million. It increased to $59.1 million in 2019, which was about a 550% increase compared to 2010. Meanwhile, the total number of awards increased from 226 to 595 (Figure 7). The AI funding increased markedly after 2017. These statistics show that under the AI section, on average, the NSFC granted more money to each project in 2019 compared to 2010.

A. INSTITUTIONS WITH THE HIGHEST AMOUNT/NUMBER OF ARTIFICIAL INTELLIGENCE-RELATED AWARDS

The top 10 institutions with the highest amount of AI-related awards received $70.19 million for 652 awards under the AI section (F06) for the 10-year period, which is around 23.4% of the total funding and 17.3% of the number of awards in the AI section. The Institute of Automation, Chinese Academy of Sciences (CAS), received the highest amount of awards from 2010 to 2019. They received about $14.71 million for 153 projects. Tsinghua University and Xidian University were in the second and third-ranking with $12.22 million and $7.84 million awards (Figure 8). In Figure 8 the number in parentheses shows number of awards. In the number of AI awards, again, the Institute of Automation, CAS leads the other institutions.

B. ARTIFICIAL INTELLIGENCE APPLICATIONS AND TECHNIQUES

The NSFC's AI section is further divided into 7 classes (Table 2). The highest amount of AI-related awards during 2010-2019 was granted under the class of Machine Perception and Pattern Recognition (F0603), which was about $123.4 million granted to 1634 proposals (Figure 9). This amount represents about 40% of the total awards under the AI section. The projects under F0603 are related to technologies such as pattern recognition, image recognition, and biometric recognition, as well as target detection, tracking, identification, and human interaction. The second-ranking is Knowledge Representation and Processing (F0605), with $40.6 million awards. Not all the awards under the F06 AI

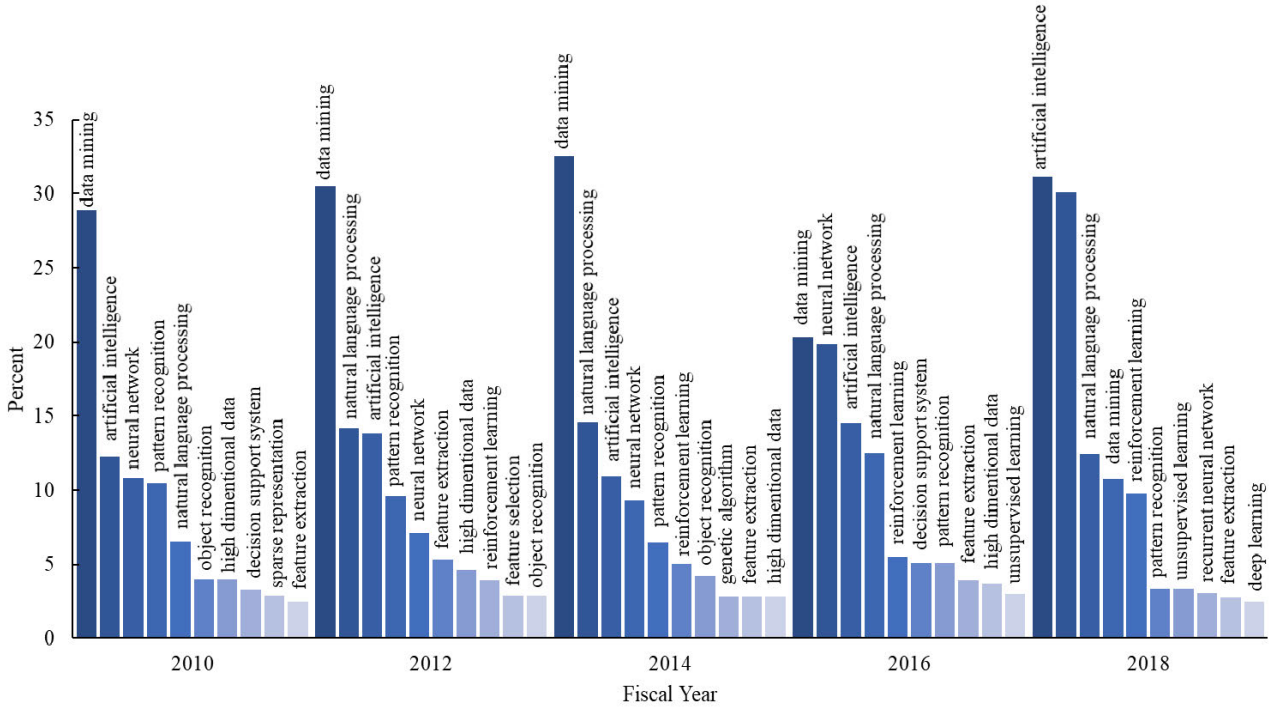


FIGURE 6. Most considered keywords in AI-related awards made by the NSF per fiscal year.

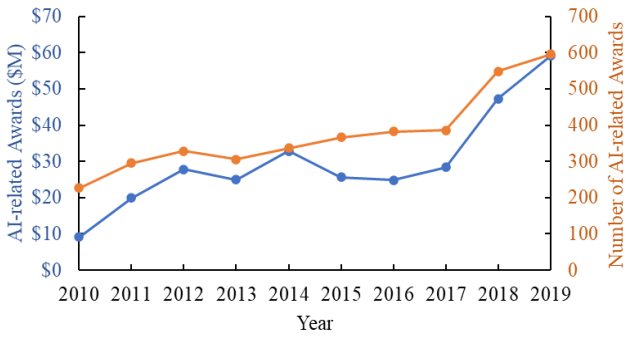


FIGURE 7. Amount/number of AI-related awards under the AI section (F06) granted by NSFC per year.

section were assigned a class. So, in Figure 9, the code of F06 is related to projects for which the class is not determined. In Figure 9 the number in parentheses shows number of awards.

The ranking of the classes under the AI section based on the amount of funding varies over time. Figure 10 shows the top 3 NSFC classes that received the highest amount of funding in the AI section (F06) per year. The code of F06 is related to projects for which the class is not determined. The AI-related research under the class of Machine perception and Pattern Recognition (F0603) received the highest amount of funding each year during the period in comparison with the other classes under the AI section. The class of Artificial Intelligence (F06), Machine Learning (F0602), Knowledge Representation and Processing (F0605), Intelligent System and Application (F0606), and Cognitive and Neuroscience-inspired Artificial Intelligence (F0607) are also in the top 3 lists either ranking the second or third. In 2018, the class of Intelligent System and Application (F0606) became the second-ranking while it was not in the top 3 before that, and it had a remarkable increase in 2019.

V. NSF VS. NSFC

The awards under the Division of Information and Intelligent Systems for the NSF and the AI section for the NSFC (which will be called AI-core awards) are compared. The NSF granted a higher amount of funding and number of AI-core awards in 2010–2019. The NSF granted about $2 billion in AI-core awards through 5454 projects, while these numbers for the NSFC are $0.3 billion and 3770 projects (Figure 11). The amount of AI-core awards by the NSF was about 6.6 times higher than the NSFC in 2010–2019. Also, Table 3 compares the top 10 institutions that received the highest amount of funding from the NSF and the NSFC, and it can be seen that the total funding received by the top 10 U.S. institutions is 7.1 times higher than the top 10 Chinese institutions.

Although there is a considerable difference in the number and amount of AI-core awards between the NSF and NSFC, the growth rate of the NSFC's AI-core awards is higher (Figure 12). Awards provided by the NSF and NSFC are in different currencies – U.S. dollars ($) and RMB (¥). The NSFC AI-related funding can be converted to U.S. dollars ($) using the purchasing power parity rate, instead

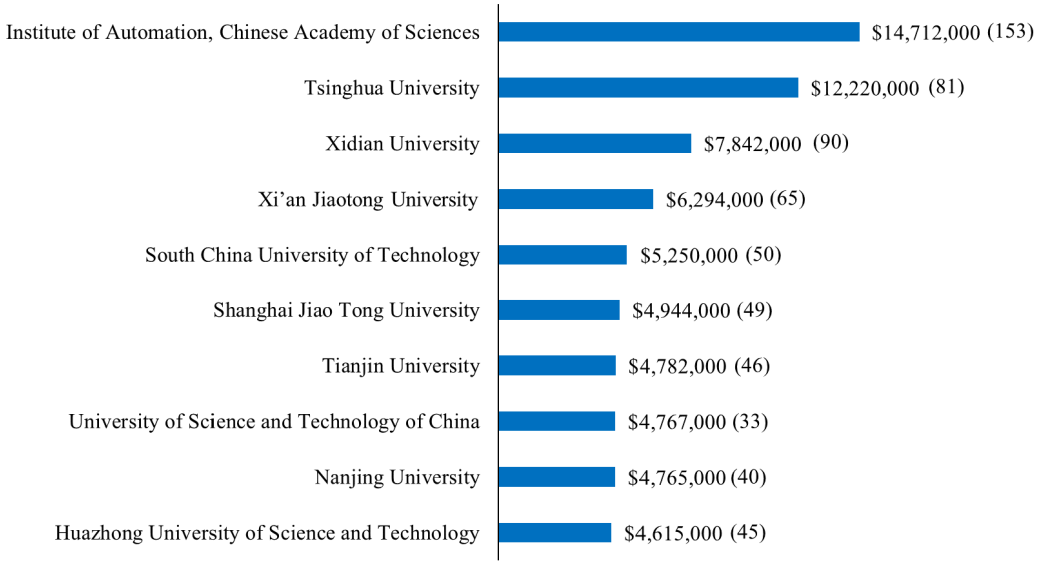


FIGURE 8. Top 10 institutions with the highest amount of AI-related awards under the AI section (F06) from the NSFC in 2010–2019.

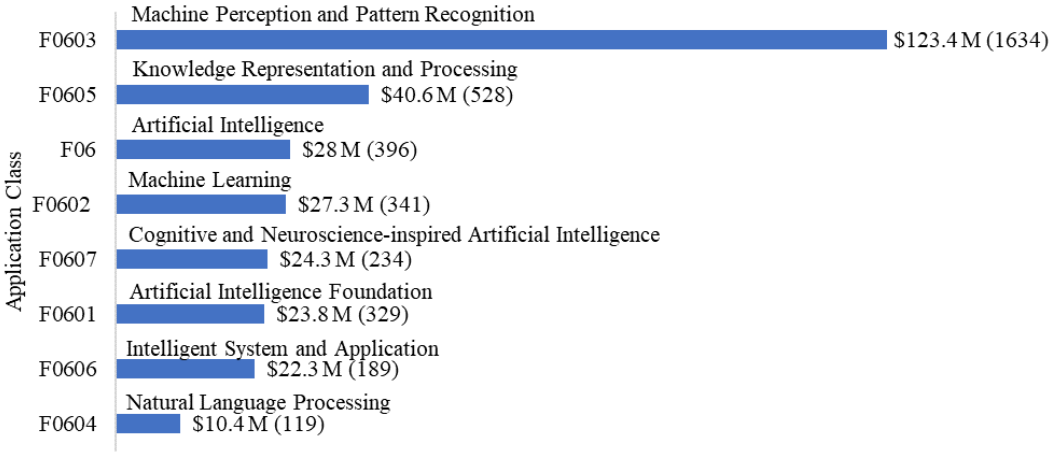


FIGURE 9. Amount/number of AI-related awards under the NSFC's AI section per application class.

of conventional currency exchange rate. Purchasing power parity is a rate to compare purchasing power of different currencies by considering the price of the same basket of goods and services in the different countries. The basket of goods and services is a sample of all expenditures. For China, purchasing power parity rates adjustment increases value of RMB (¥) as compared to Currency exchange rate and this can be observed in Figure 12(a). Table 4 compares purchasing power parity rate and currency exchange rate for the U.S. and China in 2010-2019. Furthermore, in 2019 the NSFC surpassed the NSF in the number of AI-core awards (Figure 12(b)).

The comparison between NSF and NSFC can also be conducted by looking at the ratio of the number of NSF AI-core awards to the number of NSFC AI-core awards and the ratio of the amount of NSF's AI-core awards to the amount of NSFC's AI-core awards (Figure 13). Both ratios experienced decreasing trends during the 10 years and the NSFC surpassed the NSF in number of awards in 2019. A linear estimation shows that the NSFC can overtake the NSF in amount of awards as well in 2023.

A. GROSS DOMESTIC PRODUCT

The ratio of AI-related funding by the NSF to NSFC is comparable when one considers the ratio of gross domestic product (GDP) per capita during the ten years for the United States to China. The GDP is the value of goods and services produced in a country. The growth rate of the GDP is an indicator for the country's economic health. The GDP per capita is the country's GDP divided by the population. GDP per capita shows a country's economic output per person and it is used as a measurement for a country's standard

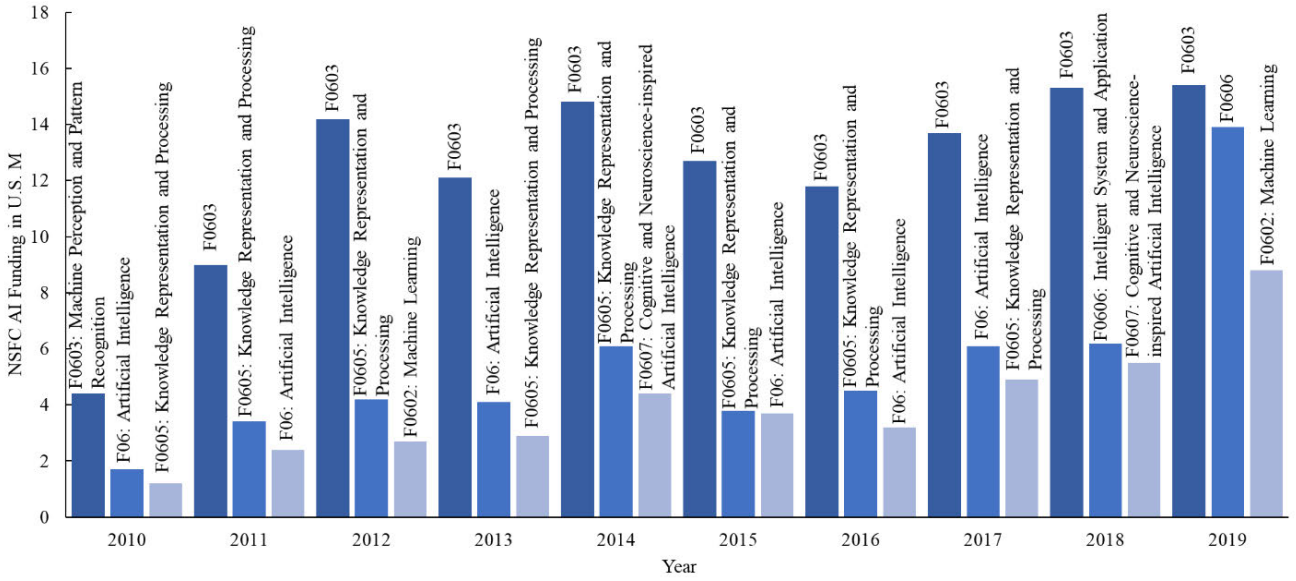
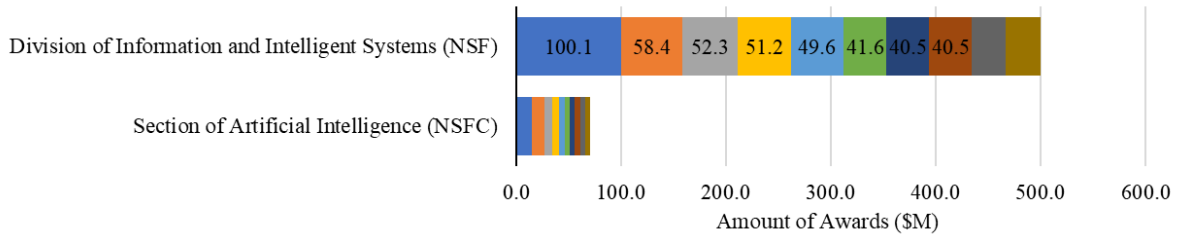


FIGURE 10. Top 3 NSFC AI funding per year, sorted by application class, 2010-2019.

TABLE 3. Top 10 institutions with the highest amount of awards under the Division of Information and Intelligent Systems for the NSF and under the AI section for the NSFC in 2010–2019.

Division of Information and Intelligent Systems (NSF)	Awards ($M)	Section of Artificial Intelligence (NSFC)	Awards ($M)
Carnegie-Mellon University	100.1	Institute of Automation, Chinese Academy of Sciences	14.7
University of Washington	58.4	Tsinghua University	12.2
Georgia Tech Research Corporation	52.3	Xidian University	7.8
Cornell University	51.2	Xi'an Jiaotong University	6.3
Massachusetts Institute of Technology	49.6	South China University of Technology	5.3
University of Michigan Ann Arbor	41.6	Shanghai Jiao Tong University	4.9
University of Minnesota-Twin Cities	40.5	Tianjin University	4.8
University of California-Berkeley	40.5	University of Science and Technology of China	4.8
University of Maryland-College Park	32.7	Nanjing University	4.8
Stanford University	32.7	Huazhong University of Science and Technology	4.6



living. The GDP per capita is also an indicator for the average revenue per person in a country. The average GDP per capita in the U.S. was 7.3 times higher than China for the period 2010-2019 [23]. Table 5 shows GDP and GDP per capita for the U.S. and China in 2010-2019.

The funding specified to AI-related basic research can be evaluated based on each of the gross domestic product and gross domestic product per capita. During the period 2010-2019, the ratio of the funding granted under the Division of Information and Intelligent Systems to the U.S. GDP were higher than the ratio of the funding granted under the AI section to China GDP (Figure 14). This matter shows that the AI-related awards have a larger proportion of country's economic output for the U.S. than China.

Considering the GDP per capita is an indicator for average revenue per person in a country, the ratio of AI-related awards to GDP per capita is an estimation for the number of people who can be hired for research in the domain. In 2010-2019, the ratios of funding granted under the Division of Information and Intelligent Systems to the U.S. GDP per capita and funding under the AI section to China GDP per capita were similar, however, after 2017 there was an increase for the

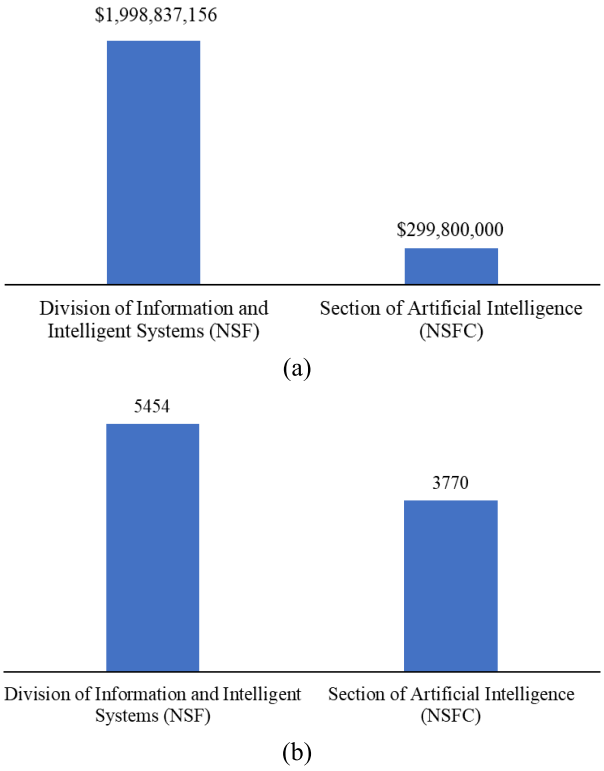


FIGURE 11. (a) Amount of funding and (b) number of AI-related awards granted under the Division of Information and Intelligent Systems by NSF and under the AI section by NSFC in 2010–2019.

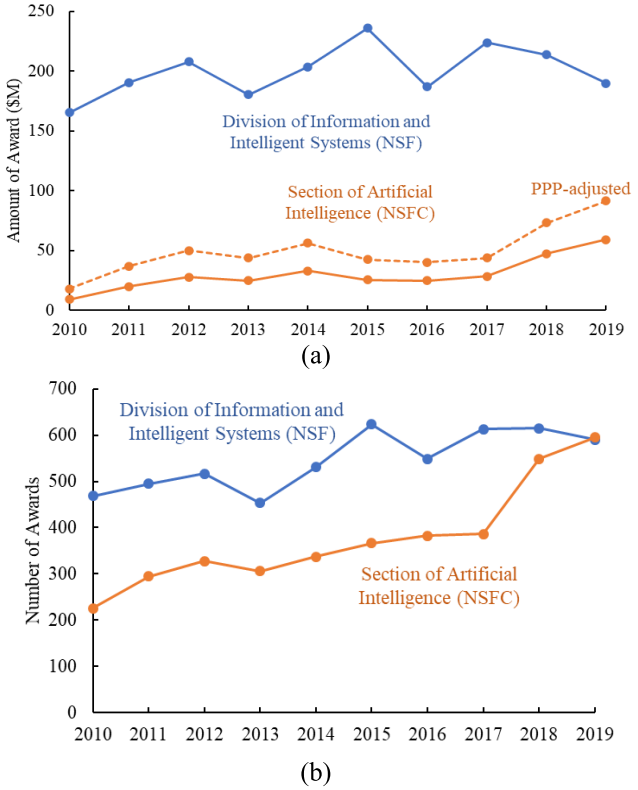


FIGURE 12. (a) Amount of funding and (b) number of AI-related awards granted under the Division of Information and Intelligent Systems by the NSF and under the AI section by the NSFC per year.

TABLE 4. Purchasing power parity and currency exchange rate for the U.S. and China.

	Purchasing Power Parity (U.S. $ = 1.0)	Currency Exchange Rate (U.S. $ = 1.0)
	China	China
2010	3.3	6.8
2011	3.5	6.5
2012	3.6	6.3
2013	3.7	6.1
2014	3.8	6.2
2015	3.9	6.3
2016	4	6.6
2017	4.2	6.8
2018	4.2	6.6
2019	4.2	6.9

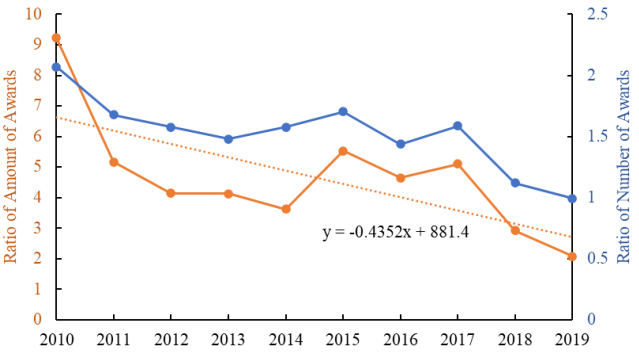


FIGURE 13. Ratio of the amount of funding and number of AI-related awards (NSF to NSFC).

NSFC (Figure 15). In 2019, the ratio for the NSFC increased to about 5800 while for the NSF decreased to 2900. The interpretation of these difference in the ratios after 2017 is that although the amount of award by the NSFC was less than the NSF, the value of funding seems to be higher for the NSFC in a way that higher number of people could get involved in AI-related research projects by Chinese government than the U.S. government.

B. PUBLICATIONS

The number of publications produced as a result of the research supported by the NSF and NSFC can be a measurement of the range and impact of the support. AI-related publications are identified by a keyword-based search using the IEEE Xplore research database advanced search (ieeexplore.ieee.org) and Web of Science advanced search (www.webofknowledge.com) which provide the ability to filter search results by the funding agency. The keywords used to identify AI-related papers are presented in the appendix. A publication was considered related to AI if there is an AI-related keyword match in it. Although the number of AI-related papers in which the authors recognized NSF or NSFC support experienced increasing trends, the NSFC-supported papers increased by a far higher rate (Figure 16).

TABLE 5. Gross domestic product and gross domestic product per capita.

	Gross Domestic Product (U.S. $B)		Gross Domestic Product per Capita (U.S. $)	
	U.S.	China	U.S.	China
2010	14,992.1	6,087.2	48,467	4,550
2011	15,542.6	7,551.5	49,886	5,618
2012	16,197.0	8,532.2	51,610	6,316
2013	16,784.9	9,570.4	53,117	7,050
2014	17,521.7	10,475.7	55,047	7,678
2015	18,219.3	11,061.5	56,822	8,066
2016	18,707.2	11,233.3	57,927	8,147
2017	19,485.4	12,310.4	59,957	8,879
2018	20,580.2	13,894.8	62,996	9,976
2019	21,427.7	14,342.9	65,280	10,261

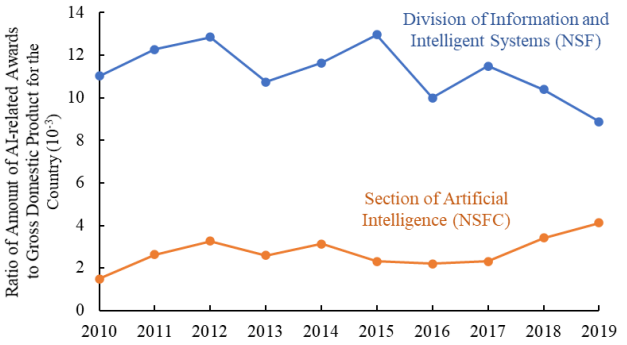


FIGURE 14. Ratios of awards granted under the NSF's Division of Information and Intelligent Systems to the U.S. GDP and awards granted under the NSFC's AI section to China GDP.

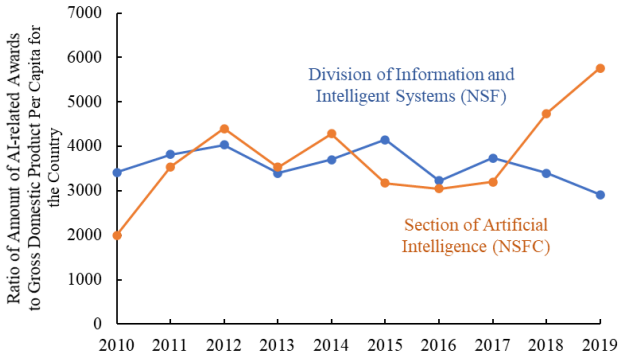


FIGURE 15. Ratios of awards granted under the NSF's Division of Information and Intelligent Systems to the U.S. GDP per capita and awards granted under the NSFC's AI section to China GDP per capita.

Considering the AI-related paper publications identified by using the Web of Science advanced search, a higher number of individual researchers and different affiliations were involved in AI-related research activities supported by the NSFC than the NSF (Figure 17). For the NSF, 39,425 individual researchers with 23,196 different affiliations contributed to the publications. While, for the NSFC, 129,738 individual researchers with 90,650 different affiliations had contribution.

Number of citations shows impact of the research. The papers in which the authors recognized support from the NSFC were cited nearly 4 times more than the NSF supported

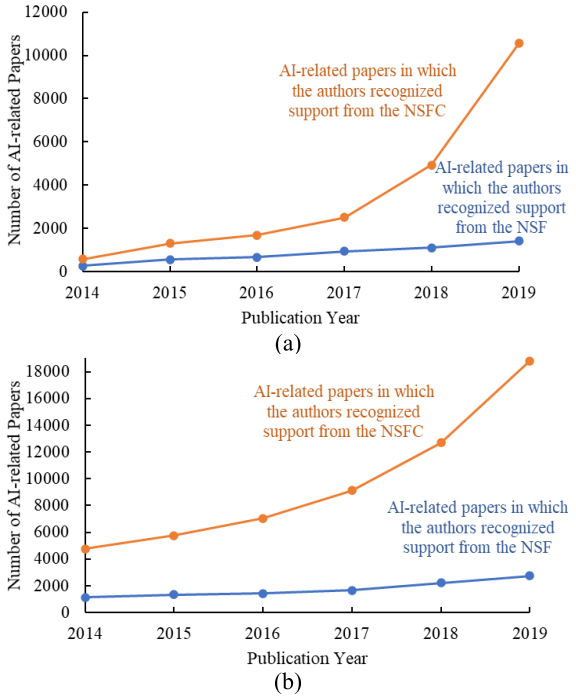


FIGURE 16. Number of AI-related papers in which the authors recognized support from the NSF or NSFC using a) the IEEE Xplore b) the Web of Science.

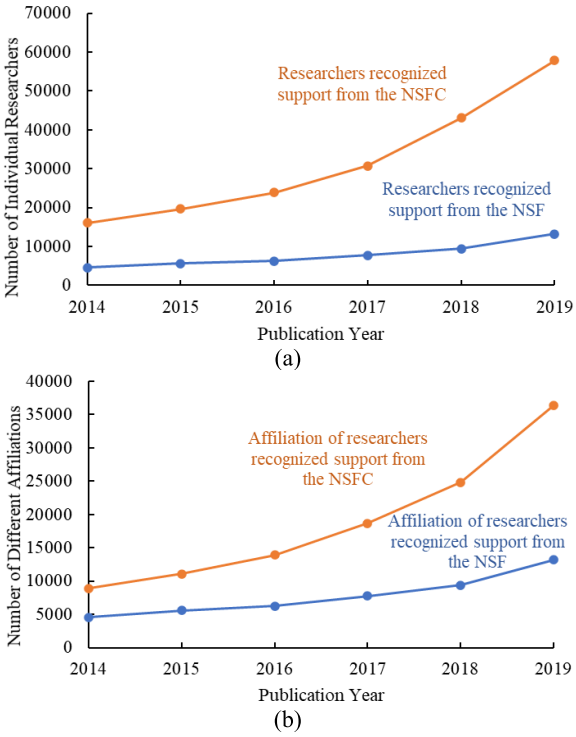


FIGURE 17. Number of a)individual researchers and b)different affiliations contributed to the paper publications recognized support from NSF and NSFC (papers identified by using the Web of Science advanced search).

papers (658,287 versus 158,469). Although, the average number of citations per paper was larger for the NSF. The NSF supported papers were cited on average 15.5 times, while for

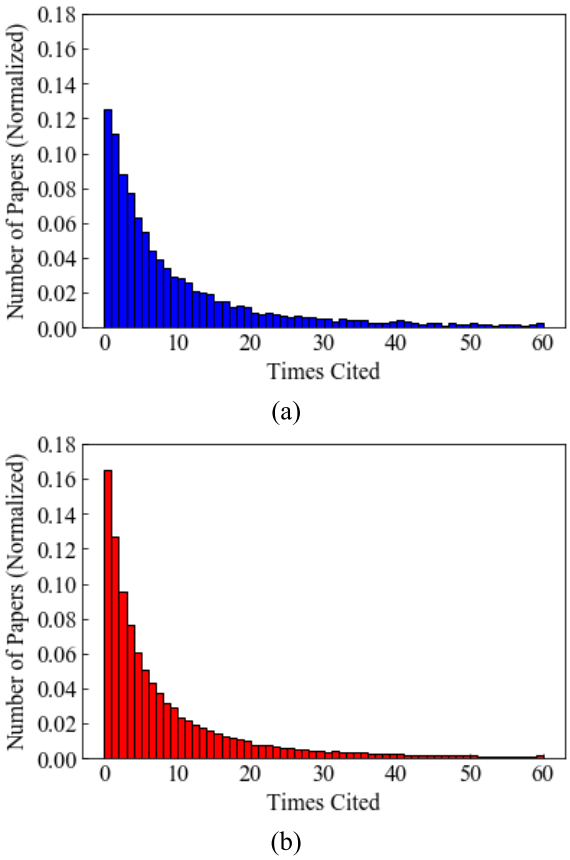


FIGURE 18. Normalized citation counts for the papers supported by the a) NSF and b) NSFC were cited.

the NSFC this number is 11.3. In addition, the median number of citations for the NSF supported papers is 6 and for the NSFC supported papers is 4. However, the distributions of number of citations for the papers supported by the NSF and NSFC are similar (Figure 18).

VI. CONCLUSION

This study analyzed the funding for artificial intelligence (AI)-related research by the U.S. National Science Foundation (NSF) and the National Natural Science Foundation of China (NSFC) during the decade 2010–2019. The purpose was to identify trends in AI-related research funding and the impact on the research activities in the domain.

The amount of AI-core awards by the NSF was about 6.6 times higher than the NSFC in 2010–2019. However, taking into consideration the difference in salaries, the funding value in China is likely greater than the U.S. For example, a faculty member in China is paid about 1/8 that of a faculty member in the United States, and also graduate students in China are for the most part unpaid. The higher value of NSFC's awards can be seen in the data where the numbers of AI-related publications and involved researchers in the field as results of the research supported by the NSFC is much higher than the NSF; in 2019, based on the web of science advanced search, China had more than 18,000 AI-related papers from about 58,000 authors that recognized support from the NSFC while these numbers for the NSF were less than 3,000 papers from nearly 13,000 authors.

Furthermore, although the NSF supported research in the field of AI more than NSFC during the decade 2010–2019 by providing more funding, the difference is decreasing. The ratio of NSF AI-core awards to NSFC AI-core awards has been declining, from about 9 times higher than the NSFC AI-core awards in 2010 to about 2 times higher in 2019 and based on the funding trends, it is expected that the NSFC overtakes the NSF in the amount of awards by 2023. So, the general conclusion is that China has been increasing the support for AI-related research faster than the U.S., and may have already been successful to overtake the U.S.

The NSFC does not share the bulk data of the awards with the public and there are some search tools authorized by them, which does not provide access to the aggregate data at the same time. Therefore, in this study, the NSFC AI-related awards were limited to the awards under the F06 AI section, which were identifiable using the section code. In addition, although NSF and NSFC are major funding sources for basic research in the U.S. and China, they provide just a proportion of the total funding in the countries.

Finally, as of August 31, 2020, Chinese officials began to revise the 2008 rules that govern the sale of certain kinds of technology to foreign buyers. The updated list includes data processing, speech and text recognition, according to government notices. The Chinese Ministry of Commerce and Ministry of Science and Technology said the changes were meant to ''formalize the management of technology export'' and ''protect national security.'' This rule change comes as China realizes that its research is now leading-edge and being implemented in a manner that they need to protect.

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