

# Responsibility and Sustainability in Brain Science, Technology, and Neuroethics in China—a Culture-Oriented Perspective

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The China Brain Project is in development. Integrating an ethical framework to identify and assess ethical challenges and plan for solutions is a priority. Here Wang et al. discuss ethical questions emerging from brain research in the context of traditional Chinese culture and juxtapose the legacy of Confucianism with contemporary thinking.

## Background

Research into the brain has grown globally in recent years, and the same is true in China. Highlighted in two important national policy documents of China—the 13th Five-Year Plan (2016–2020) and Innovation of Science and Technology Forward 2030—the developing China Brain Project aims to understand the neural basis of human cognition, develop early diagnostic and therapeutic approaches for brain diseases, and develop brain-inspired intelligence technology (Poo et al., 2016).

China has the largest number of citizens suffering from brain diseases—it is estimated that about one-fifth of China's current population of more than 1.3 billion suffers from chronic neurodegenerative or neuropsychiatric disorders (Chan et al., 2013; Phillips et al., 2009). The China Brain Project focuses on three neurologic and neuropsychiatric diseases: autism in children, depression in adults, and Alzheimer's disease (AD) in the aged population. The health burden associated with autism is high—more than a million people are suffering from autism in China,

and a majority of them are mentally disabled (Li et al., 2011; Wang et al., 2018). The prevalence of major depressive disorder in urban China is up to 6% (Gupta et al., 2016), and more than half of the diagnosed patients have had suicidal behaviors (suicidal ideation, plan, attempt, and completed suicide) during their lifetimes (Dong et al., 2018). According to the National Statistics Bureau of China, more than 15% of China's population was older than 60 years in 2014, and this percentage will keep increasing. Given the high incidence of AD in the elderly population, the health problems of AD are pressing.

Urgent needs and strong government and public support have led to rapid development of brain science and technology in recent years. Scientific breakthroughs and the emergence of innovative technology can enable further understanding of brain functions. Yet with rapid development come legal, ethical, and social concerns. If not properly and adequately addressed, these ethical and social questions could undermine the achievement of neuroscience and may,

in the long run, undermine societal prosperity and human well-being. Therefore, as the China Brain Project develops it also aims to integrate methods to address the ethical concerns raised by neuroscience research.

## Neuroethics Is an Integral Part of the Developing China Brain Project

In China, there is broad agreement that every important decision and action ought to be based on the common goal to improve the well-being of people and society. There is a saying from *The Analects of Confucius* that concisely summarizes what were considered “responsible actions”: do not impose on others what you yourself do not desire (己所不欲, 勿施于人) (Figure 1). We have the responsibility to make every effort to avoid any potential harm that might be imposed upon people in society. Potential harms include but are not limited to threats to safety, privacy, and autonomy. Responsible research with goals oriented toward human well-being sets up the basis for the sustainability of brain science and technology.



Recognizing the importance of neuroethics for brain science and technology, Chinese scientists and ethicists have been advocating for the integration of ethical, legal, and social issues into the planning phases and future implementation of the China Brain Project. We assessed the five neuroethics questions for neuroscientists (NeQNs) proposed at the 2017 Global Neuroethics Summit (October 17 and 18, 2017, Daegu City, Korea) (Rommelfanger et al., 2018) in the context of traditional Chinese culture and juxtaposed the legacy of Confucianism with contemporary thinking. In this paper, we summarize ethical issues more relevant to the China Brain Project and explain our plans to address them. Note that opinions and suggestions in this paper are from scientists and ethicists and do not represent official standpoints of the Chinese government.

### Ethical Questions Relevant to Brain Science and Technology Research in China

#### Underemphasized Significance of Independent Personhood

The long and distinct history of China enabled this nation to develop its unique culture. Nurtured within the nation with the largest population in the world through thousands of years, faith in the power of people is deep-rooted in Chinese culture. So, Chinese values are people oriented. In Chinese, the character “人” represents one human being. Two “人”s form “从,” which means people follow or conform with each other. By adding one more “人” we get “众,” which refers to a large group of people together. This group of people can be family members, team members, residents of a community, or all the citizens in a country (Figure 1). The essence of a nation’s prosperity is the well-being of its people; thus, “people-oriented missions and goals” have been widely adopted by Chinese culture and philosophy.

This “people-follow-society” philosophy enabled Chinese people to gain strengths in promoting goals for the com-

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Do not impose on others what you yourself do not desire

人 从 众  
Human follow society

君子而不同

A gentleman gets along with others, but does not necessarily agree with them

**Figure 1. Chinese Culture-Oriented Principles of Responsible Science and Collaboration, Shown in Chinese Characters**

mon good, which set the basis for numerous great achievements. However, in extreme cases this philosophy may fall short regarding the value of individual personhood. Under the guidance of this philosophy, people can be encouraged to restrain their personal values to further benefit common good. However, this emphasis can move toward coercion and may at least partly explain why the importance of privacy, autonomy, or agency has been historically underemphasized in China. Rapid development in neuroscience can impose risks to human personhood. We must pay more and closer attention to issues of privacy, autonomy, and agency.

#### Difficulties in Establishing Brain Banks: Traditional Culture against Organ Donation

The developing China Brain Project aims to understand the neural basis underlying cognition and to develop early diagnosis and therapeutics for brain diseases. Brain banks that contain healthy and diseased samples are important to these aims and will provide valuable benefits to the neuroscience community. However, in China, promoting organ donation is a difficult job and perhaps an even tougher one in terms of brain donation. NeQN 2b—Should special regard be given to brain tissue and its donors, given the origin of the tissue and its past?—is a particularly important question for us to address. A considerably large number of Chinese people believe that an organ or tissue of a person does not ultimately belong to him or her, but rather to his or her parents,

and thus the individual himself or herself does not have the right to donate organs (from “The Classics of Filial Piety,” “身体发肤，受之父母，不可毁伤” in Chinese characters). The Red Cross Society of China and the nation’s health authorities have been promoting organ donation on a large scale since 2010 with little success, as only a little over 80,000 people had registered as donors by 2016 (<http://www.cotdf.org>). That number is disappointing, especially when compared to donor-registration rates in other countries—for example, some

130 million organ donors were registered in the United States by 2016. However, new initiatives in China to encourage organ donation appear more promising, and we will discuss these further below.

#### Social Stigma toward Neuropsychiatric Diseases and Mental Health Problems

One planned aim of the China Brain Project is to achieve early diagnosis and prediction of neuropsychiatric diseases. However, concerns exist around the extent to which prediction studies might increase social stigma about “diseased brains” or “brains that are prone to develop mental illnesses,” as mentioned in NeQN 1a: What are the possible consequences of neuroscience research on social stigma and self-stigma? In China, interpersonal relationships are of vital importance. Traditionally, people tend to view personal issues as issues that concern the whole family or community. Neuropsychiatric disease prediction might have a broader and more profound impact in China than in other more individualistic societies. In July 2018, residents of a community in Shenzhen boycotted cohabitation with 15 families with autistic children (<http://news.163.com/18/0726/07/DNKFNNQ0001875P.html>). Major reasons for this boycott were worries and fears that mentally disabled residents would threaten community safety. Likewise, there have been cases where parents opposed autistic children attending classes with their children (<http://health.sohu.com/20120918/n353436592.shtml>), with similar worries.

Solutions to these social problems are imperative.

**Strategies to Address Ethical and Social Problems in Brain Science and Technology Development**  
**Ensure Adherence to International Ethical Guidelines in Neuroscience Research**

For research projects, adherence to ethical guidelines requires examination of the study purpose to avoid inhumane uses, regulation of methods and strategies for safety and validity, and precautionary measures on applications and deployments of research findings to avoid unintended consequences and impact. There are strict rules at the level of government agencies on general ethical standards on research involving human subjects or animals (Zhou and Poo, 2018). Yet particular ethical standards on neuroscience studies involving the human nervous system and human brain-inspired artificial intelligence are lacking at present in China. Worldwide, these standards are in development and vary internationally in scope. In our country, we are now working toward a series of interdisciplinary research projects on neuroethics. For example, a national-level interdisciplinary research project aiming at evaluating ethical issues of converging technology is ongoing (Wang and Ma, 2016) in which ethical issues relevant to cognitive neuroscience will play a major part as the China Brain Project comes online.

Communicating with and learning from other countries at the International Neuroethics Society meetings (<https://www.neuroethicssociety.org/>) is of great importance to us. Hosting and participation in international workshops and conferences like the International Workshop on Minding Neurotechnology: Delivering Responsible Innovation for Health and Well-being (<http://www.oecd.org/sti/emerging-tech/workshop-on-minding-neurotechnology.htm>) and the Global Neuroethics Summit (<https://globalneuroethicssummit.com/>) allow us to learn from other national brain initiatives, particularly on their infrastructure and integration measures of neuroethics into neuroscience and technology development agendas. Specific steps, such as how to incorporate a neuroethics committee into a brain initiative, who is expected to be in the committee, how to

select committee members, what activities are planned, principles for evaluation of ethical problems, implementation of education and training programs on neuroethics, and practical strategies to increase public engagement are very inspiring and have provided us with excellent examples to learn from and follow. We will continue this collaboration, not only by continually taking part in international neuroethics conferences but also by inviting neuroethics experts to institutions, universities, and hopefully government agencies in China to share their knowledge and experience, and hopefully by sending Chinese students and scholars for overseas study and exchange on neuroethics through support from the China Scholarship Council.

By learning from worldwide expertise and experience, we are confident that we will improve the ethical system in neuroscience and strengthen respect for personhood, autonomy, and privacy. We have seen strides with regards to data protection. Recognizing the necessity to enhance patient safety and standardization of clinical trials regulation, the China Food and Drug Administration in its recently published amendment to laws and regulations on clinical trials of medicine and medical devices in 2017 strengthened the encryption of patient information and emphasized that comprehensive informed consent is a prerequisite for all clinical trials (<http://eng.sfda.gov.cn/WS03/CL0758/>) unless an exemption of conformed consent application has been pre-approved.

**Foster Public Campaigns, Education, and Training Programs on Neuroethics with Innovative Strategies**

As we mentioned, establishing brain banks may be met with great difficulty in China because traditional filial piety culture is against organ donation. Public campaigns promoting organ donation that started in 2010 had limited impact before 2016. The turning point occurred in December 2016, when the China Organ Transplantation Development Foundation (COTDF) began to team up with Alipay, an online payment platform, to provide direct registration service for donors. The first day was immediately a big success: more than 3,000 new donors registered within 12 hr (<http://www.sixthtone.com/>

[news/1729/alipay-organ-donation-just-few-taps-away](http://www.sixthtone.com/news/1729/alipay-organ-donation-just-few-taps-away)). Alipay had more than 450 million registered users by December 2016 who only needed to confirm their names and identification card numbers for registration, and the registration could be canceled anytime if they changed their minds later. The simple and quick registration process via Alipay lowered the threshold for potential donors. Before that, donors had to answer more than 20 questions to register. Jiefu Huang, the chief of COTDF, said he feared that each additional question drove away 1 million potential donors. According to the World Health Organization (WHO), two major reasons for the reluctance of potential donors to register are that they have no idea where to register and that they find the process too laborious.

By the end of 2017, the number of registered donors exceeded 350,000, among which 280,000 registered via the online and mobile registry Love&Hope, which can be directly accessed through Alipay (2017 Annual Report of COTDF, <http://www.cotdf.org/uploadfile/2018/0608/20180608031750257.pdf>). The majority of active Alipay users are young people, who more easily accept new ideas than the older generation. The average age of active Alipay users is 28 years, with only 2% older than 50 years up to 2016 (<https://ab.alipay.com/index.htm?Nummain=13>). Opinions from the younger generation are more diverse, and their attitudes are more open and inclusive. Promoting organ donation among this group of people is likely more effective than among older groups.

This successful experience can be generalized to other activities. For instance, as well as creating neuroethics curriculums in institutions and schools, we are planning to launch training programs on mobile and online social media, e.g., WeChat, which has more than 1 billion registered users (<http://tech.sina.com.cn/roll/2018-03-05/doc-ifyrztfz8050525.shtml>). Posts from popular WeChat official accounts can easily have more than 100,000 reads. We have started and will continue posting education programs on facts of mental health problems through mobile and online social media. Lack of knowledge and understanding of these diseases among the public are major causes for social stigma and fear. Education programs run by neuropsychiatrists

or neuroscientists through social media are very promising strategies to pass on facts and basic knowledge, improve public understanding and acceptance of mental problems such as autism or depression, and hopefully decrease social stigma about these mental problems in the future. Further public campaigns to promote organ donation could also be launched to reach more potential donors. It is likely that collaborations with social media will help to increase public awareness and engagement in neuroethical issues. It may also promote institutional efforts to implement supporting facilities and services for neuropsychiatric disease patients, who are in desperate need. Collaborations with mobile or online social media may work for certain purposes, such as general education and public campaigns, but may not reach groups of people who do not spend much time online. Innovation for plans to cover larger scopes of problems and demands such as strengthening supervisions and regulations on emerging technology should never stop. These methodologies also might prove useful in engaging the public about other complex NeQNs, such as those related to exploring the moral significance of neural systems (NeQN 3), the relationship between brain interventions and autonomy (NeQN 4), and in which contexts neurotechnologies should be used beyond the laboratory (NeQN 5).

### Conclusions and the Way Forward

While many scientists might think that we are nothing more than the neural activities of our brains, some philosophers hold the view that our brains are neither us nor our minds. Neuroreductionism tends to reduce complex mental phenomena to brain states, viewing the brain as the sufficient cause for cognition, emotion, and perception. However, the existence and features of qualia (subjective, conscious experience) shows that a reductionist account of consciousness lacks explanatory power. Our consciousness and mental contents are not shaped or caused by the brain alone but rather by the interaction of brain, body, and environment. While the interaction between body and brain has been ignored by reductionists, the interaction of mind and external environment has been simplified

as well. As sentient and cognitive beings, we are both embodied and embedded bodies. Thus, a robust discussion among scientists and humanities scholars regarding neuroethics will have to go beyond mere discussion on the brain, especially in China, where the education and training between humanities and STEM (science, technology, engineering, and mathematics) majors have long been separated and the conceptual understanding gap remains to be bridged.

The distinct history and culture of China brings specific concerns to brain science and technology development in this country. Underemphasis of respect for independent personhood, traditional filial piety culture against brain donation, and social stigma toward neuropsychiatric patients are some typical examples. Due to a current lack of a neuroethics specialty and expertise in China, learning from the international community is imperative to us. We are and will continue to take a more active part in the international neuroethics dialog. We hosted the International Workshop on Minding Neurotechnology: Delivering Responsible Innovation for Health and Well-being (September 6 and 7, 2018, Shanghai, China), where experts from governments, academia, industry, and private foundations exchanged ideas on the ethical, legal, and policy challenges raised by brain science and discussed strategies for delivering responsible innovation in neurotechnology (<http://www.oecd.org/sti/emerging-tech/workshop-on-minding-neurotechnology.htm>). Meanwhile, we are very glad to share our ideas and experiences with the international community. The teamwork between COTDF and Alipay to promote organ donation in China might serve as an example to spark innovation to cope with neuroethics challenges.

To understand how the human brain works will be a feat in the history of science. To accomplish our mission of advancing human health, we must foster effective collaboration. Back in 2015, the work on gene editing in embryonic stem cells with CRISPR-cas9 by Chinese scientists sparked a global controversy. In fact, current ethical standards and regulations on gene manipulation and stem cell therapies in China are in line with those of international science communities in

both safety and restraints on research with human embryonic tissues (Qui, 2016). However, what happened recently at the Second International Summit on Human Genome Editing in Hong Kong indeed put the strictness and effectiveness of research regulations in China into question and cast deep concerns. At this summit, held in late 2018, Dr. Jiankui He described his work using CRISPR-Cas9 on human embryos to mutate the CCR5 gene. The scientific community and the whole world were alarmed. Here we urge that regulatory agencies put efforts into improving the framework and strengthening strict compliance with rules in research institutes and other related facilities of our country.

Besides regulations, openness and communication are also crucial. These will be implemented in the China Brain Project when it starts, because only through communication can we foster reciprocal understanding, openness, and inclusivity, all being necessary for cooperation. As said in *The Analects of Confucius*, “a gentleman gets along with others, but does not necessarily agree with them” (“君子和而不同”) (Figure 1). Disagreement leads to discussions, brainstorming, opinion sharing, exchange of ideas, a more comprehensive understanding, and, usually, better solutions to problems and more insightful plans. Chinese scientists and ethicists will continue taking responsibility to work with experts worldwide toward a better future world.

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