

# Promoting computational psychiatry in China

Computational psychiatry holds promise for basic research and clinical practice in safeguarding mental health. In this Comment, we discuss why China needs computational psychiatry, why its development in China will benefit the field globally, and the challenges of promoting computational psychiatry in China and how to tackle them.

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The past decades have witnessed an unprecedented pace in industrialization and urbanization in China, resulting in a rapid growth in wealth. Despite economic prosperity, China is facing severe mental health challenges (Fig. 1). Recent national epidemiological surveys in China showed that the weighted lifetime prevalence of any mental disorder was 16.6% for adult individuals<sup>1</sup> and 17.5% for children and adolescent individuals<sup>2</sup>. Consequently, the medical system (especially clinicians) has become overburdened. In 2017, there were only about 30,000 licensed psychiatrists in mainland China — only 1 psychiatrist per 10,000 patients.

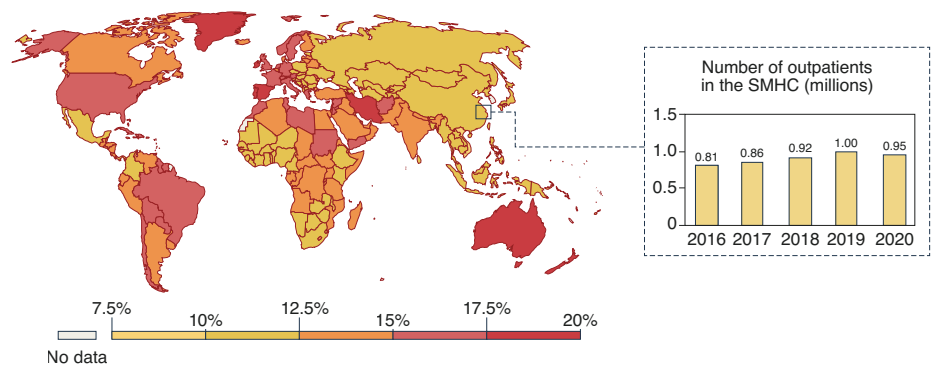
## China needs computational psychiatry

In this Comment, we argue that computational psychiatry (CP) offers the potential to improve clinical outcomes in China, and that flourishing CP in China will in turn benefit mental health research and practice worldwide. We then identify current challenges for the development of CP in China and propose actions to tackle these challenges (Table 1).

CP is an interdisciplinary field that bridges computational neuroscience, psychiatry, psychology and related disciplines. CP uses formal mathematical models or machine learning approaches to uncover mechanistic processes (for example, neural and cognitive processes)<sup>3,4</sup> or latent constructs<sup>5,6</sup> that underlie mental disorders. CP can be classified into theory-driven and data-driven approaches<sup>7</sup>. Theory-driven CP uses a priori-specified mathematical models to understand the social, cultural, psychological and neurophysiological underpinnings of symptom manifestations. Taking advantage of ‘big data’ and machine learning algorithms, the data-driven approach is well-suited to disentangling the natural heterogeneity within and across current categorical diagnoses, as well as to predicting course and prognosis.

## CP needs China

Modern mental health research, including CP research, has relied primarily on data



**Fig. 1 | Severe mental health issues within and outside China.** Left, Around 11.3% of people had one or more mental or substance use disorders in China in 2019. Map taken from ref. <sup>14</sup>, CC BY 4.0. Right, Number of outpatients in the Shanghai Mental Health Center (SMHC). In 2020 alone, this single site received 0.95 million outpatients.

from Western, educated, industrialized, rich, and democratic populations (so-called WEIRD populations). Expanding CP research to non-WEIRD populations (for example, Chinese samples) not only enriches our understanding of mental illness but also provides imperative knowledge to guide clinical practice across diverse sociocultural environments. Furthermore, the booming artificial intelligence (AI) industry in China could fuel the development of CP. For instance, in the medical field, image-based AI systems have been implemented for automated diagnosis of physical diseases<sup>8</sup> such as brain tumours. In psychiatry, the emerging application of AI to computer-aided diagnosis and interventions for mental disorders holds great promise. For instance, companies have developed artificial consultants via natural-language processing algorithms to improve the feelings of clients<sup>9</sup>. These applications make us optimistic that the AI industry in China will facilitate the development of CP and its translation worldwide — in particular, in combination with the substantial patient population in China. Lastly, as many countries and regions are undergoing rapid industrialization and urbanization, and

facing similar challenges in mental health, China could serve as an exemplar to inspire the development of CP in other countries.

## Challenges to promoting CP in China

In contrast to the potential of CP, the development of CP is substantially lagging behind in China. Below, we identify the challenges to fostering CP in China, and then outline actions to tackle these challenges.

### Deficient interdisciplinary training.

CP is an interdisciplinary field that requires comprehensive training in both computational skills and psychopathology. However, the current educational system in China provides little support for such interdisciplinary training. This deficiency originates from the fact that computational education in psychology and psychiatry has long been underappreciated in China. For example, psychology is often known to the public as an applied branch of social science. Consequently, students who choose to study psychology often do not expect to obtain systematic training in quantitative disciplines. This is coupled with a curriculum that usually includes little or no

**Table 1 | Actions for fostering CP in China**

Stakeholder	Role
Researchers	<ul style="list-style-type: none"> <li>• Recognize that CP is promising and far-reaching for psychology, neuroscience and psychiatry</li> <li>• Keep close to clinical questions and collaborate with clinicians</li> <li>• Be active in international communications</li> <li>• Advise policymakers on how to foster CP in China</li> </ul>
Clinicians	<ul style="list-style-type: none"> <li>• Raise awareness of the importance of CP</li> <li>• Be open to computational modelling approaches and consider how the progress of basic neuroscience can aid clinical practices.</li> <li>• Collaborate with researchers in basic science</li> </ul>
Universities and institutes	<ul style="list-style-type: none"> <li>• Initiate CP centres</li> <li>• Appreciate the value of interdisciplinary training and redesign curriculum and training models to foster CP</li> </ul>
Policymakers	<ul style="list-style-type: none"> <li>• Be aware of the importance of CP</li> <li>• Initiate Chinese national institutes of mental health and CP centres</li> <li>• Start funding initiatives to encourage efforts to foster the CP community in China</li> </ul>

formal mathematics, such as linear algebra and probability theory. Similarly, highly specialized medical training starts as early as the undergraduate level in psychiatry, limiting students' exposure to a broader range of education from other quantitative disciplines. For self-driven students who are willing to obtain more computational training, they often find it difficult to get relevant opportunities (for example, machine learning courses).

We foresee that the rapid development of 'e-learning' may help to fill the gap. In recent years, online education platforms such as Coursera are increasingly having important roles. Their accessibility and inclusiveness began as a complement to school education. For example, over four million students worldwide have enrolled in the 'Machine Learning' course on Coursera. Such online education has the potential to ameliorate the dichotomy in the current education of computational neuroscience and psychiatry. In the spirit of openness of e-learning, the Neuromatch Academy<sup>10</sup> launched the first worldwide, online computational neuroscience summer school in 2020. In their 2nd edition (held in 2021), a total of 1,757 students (286 of them from mainland China) and 191 teaching assistants participated in the 3-week-long summer school. The success of the Neuromatch Academy summer school directly prompted us to organize the first online CP summer school<sup>11</sup> (30 students and 7 teaching assistants) in September 2021 (Supplementary Table 1). We expect a hybrid model in which online training is supplemented by in-person training to promote CP in the near future.

**Insufficient international communication.** To date, CP scholars in China have been less involved in international scientific activities

and peer review processes in the field. For example, in previous mini-symposiums of CP hosted during the annual meetings of the Society of Biological Psychiatry and the Methods And Primers for Computational Psychiatry and Neuroeconomics, unfortunately no organizers or speakers were affiliated with institutions in mainland China. Furthermore, only 5 Chinese researchers (among a total of 119 members) are registered in the Transcontinental Computational Psychiatry Workgroup. This impedes effective communications with international CP experts.

Fortunately, more and more Chinese researchers have devoted themselves to building a CP community and to participating in international events. In particular, the Chinese Computational Psychiatry Network ([www.ccpn.site](http://www.ccpn.site)), established by a group of early-career researchers, has taken initiatives to foster CP research in China. The Chinese Computational Psychiatry Network organizes a variety of activities (for example, a CP hackathon or workshop, and conference) with the goal of introducing trainees into the field and fostering active, inclusive and supportive interaction among the communities within and beyond China (Supplementary Table 1). We expect that the Chinese Computational Psychiatry Network will act as a central hub and attract more local researchers into the field of CP. We believe that Chinese scholars will have a more active role in organizing international CP events, initiating international collaborations and eventually contributing more to CP research worldwide.

**Lack of CP centres to integrate resources.** The National Institute of Mental Health in the USA has an essential role in supporting


the translation of basic neuroscience research into clinical practice. The National Institute of Mental Health has launched funding schemes specifically for CP, in an effort to foster novel computational frameworks to identify and validate precise diagnoses and treatments in psychiatry<sup>12</sup>. Additionally, several CP centres have already been established in the USA and Europe (for example, the Center for Computational Psychiatry at Mount Sinai and the Max Planck UCL Centre for Computational Psychiatry and Ageing Research). CP centres are important for interdisciplinary training and connections between computational neuroscientists and clinical psychiatrists. By contrast, despite numerous mental hospitals and medical schools, no such CP centre has been initiated in China. The establishment of the new national headquarters for mental health in 2021 (ref.<sup>13</sup>) promises to initiate local CP centres to bridge basic and clinical research. Additionally, given the limited number of CP experts in China, virtual access to the CP community or CP centres could help to coordinate top Chinese scientists across fields of computational neuroscience and psychiatry for interdisciplinary education and collaborations.

### The future of CP in China

In the near future, by integrating resources from multiple fields, an interdisciplinary education system can be built to train CP experts who not only understand clinical problems but also have the ability to apply quantitative approaches to clinical research and practice. Besides such a training system, we envision that an integrated CP system will provide AI-aided, evidence-based assessment and intervention tools that can be efficiently tested, applied and updated via digital health platforms. In this way, researchers, clinicians and patients can be connected to accelerate online mental-health services. Furthermore, such digital platforms could serve as powerful tools for collecting big data across modalities. For instance, wearable and mobile devices will facilitate the collection of data relating to behaviour and physiology (for example, breathing, sleep, heart rate and skin conductance), self-report questionnaires, and speech and video in naturalistic contexts. Big data combined with advanced AI technologies and theory-driven CP will promote the progress of precision psychiatry and clinical translation. Such data are useful for the early screening of individuals at high risk, disentangling heterogeneity within diagnoses and developing more specifically targeted treatments at the individual level.

## Outlook

We are optimistic for the future of CP within and outside China, especially in the age of digital health. We propose actions to foster interdisciplinary training in China and international collaborations. We believe that these efforts will facilitate the translation of computational models into clinical tools, and help to tackle global challenges in mental health. □

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## Competing interests

The authors declare no competing interests.

## Additional information

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