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Cultural neuroscience and global mental health: addressing grand challenges

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Abstract

Mental, neurological and substance-use (MNS) disorders comprise approximately 13% of the global burden of disease. The Grand Challenges in Global Mental Health Initiative has recently identified research priorities for the next decade to address prevention and treatment of MNS disorders. One main research priority is to identify the root causes, risks and protective factors associated with global mental health. Recent advances in cultural neuroscience have identified theoretical, methodological, and empirical methods of identifying biomarkers associated with mental health disorders across nations. Here we review empirical research in cultural neuroscience that address meeting the grand challenges in global mental health.

Keywords

Cultural neuroscience; Global mental health; Health disparities; MNS disorders

Introduction

Mental, neurological and substance abuse (MNS) disorders are leading contributors to the global burden of disease around the world. Access to effective treatment and cure for MNS disorders remains a significant barrier to global mental health, particularly in developing regions of the world. Closing the gap in population disparities requires comprehensive understanding of the key factors that contribute to unequal resource distribution of

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preventative and treatment interventions for global mental health. A gap in understanding in MNS disorders around the world is the limited understanding of the human brain and its molecular and cellular mechanisms.

In 2011, the Grand Challenges in Global Mental Health (GCGMH) consortium, including researchers, advocates, programme implementers and clinicians, identified research priorities that, if addressed, would help to alleviate the burden of mental, neurological, and substance-use (MNS) disorders globally (Collins et al. 2011). The GCGMH stipulated an agenda for filling the knowledge gaps necessary to meet the mental health needs in low-, middle- and high-income countries (LMIC-HMIC). Given the substantial financial costs associated with treatment of MNS disorders worldwide, allocation of resources to promote mental health and to prevent the indirect contribution to mortality due to MNS disorders is essential. Accordingly, a focused effort involving scientific discovery, intervention development, and implementation science will be crucial in order to find cures, interventions, and care delivery models that will reduce the global burden of MNS disorders.

In 2013, the International Cultural Neuroscience Consortium (ICNC), an interdisciplinary community of researchers representing anthropology, psychology, neuroscience, epidemiology and psychiatry, reviewed key priorities for addressing issues of global mental health and population disparities with advancement of research and methods in cultural neuroscience. The ICNC discussed themes for conceptual and methodological advances in cultural neuroscience as well as linking cultural neuroscience to issues of global mental health. In this article, we review cultural neuroscience research as an evidence-based resource to identify root causes and risk for MNS disorder as well as resilience and protective factors for cures in global mental health.

Global mental health: Agenda and priorities

The GCGMH consortium reported 40 challenges identified through use of the Delphi method, a structured consensus method, with panel members representing the global mental health community (Collins et al. 2011, see Supplementary Information¹ for full details). Researchers from disciplines including genetics, neuroscience, neurodevelopment and behavioral science constituted approximately one-third of the panel. One of the grand challenges identified included questions about the etiology and treatment of MNS disorders with a life course approach. Given that MNS disorders may manifest in early life, it is important to determine risk factors and disorders across the age continuum, from early childhood to older ages. Cultural neuroscience bolsters understanding of root causes of mental disorders associated with brain regions and cultural environment for the development of targeted prevention and treatment. Cultural neuroscience allows for a dimensional approach to the investigation of mental health conditions. Dysregulations in certain brain regions are associated with multiple groups of disorders, which may vary by individual cultural experiences.

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The determinants of—and likely the remedies for—mental illness are manifold and interdependent. Mental capital, or the cognitive and emotional resources available to an individual for contributing to society and pursuing a fulfilling life, was suggested by the GCGMH consortium as a primary goal for bolstering mental wellness and preventing or ameliorating the course of MNS disorders (Beddington et al. 2008). Social exclusion and discrimination can be addressed with communitywide mental health resources to effectively prevent MNS disorders. In cases of extreme or harsh environmental conditions, including poverty, political instability and natural disasters, empirical work in humanitarian settings may be helpful to assess viable mechanisms for prevention and intervention of MNS disorders across cultural contexts. Worldwide, the delivery of state-of-the-art, evidence-based strategies to prevent and treat mental illness at multiple levels (e.g., individual, familial, societal) will require not just a life course approach, but also the systematic scientific discovery that incorporates the diversity of global populations, cultures, and environments.

Cultural neuroscience: bridging cultural and biological sciences

Global mental health prevention and treatment relies on an evidence-based understanding of the root causes, risks and protective factors that lead to health. The broad discipline of cultural neuroscience encompasses mutual influences of socio-cultural processes and neurobiological mechanisms that shape human behavior and potential (Baltes et al. 2006; Han and Northoff 2008; Li 2003). As the study of cultural and neurobiological factors that lead to healthy behavior, cultural neuroscience seeks to identify determinants of health and disease, including gene-environment interaction as well as the identification of unique or common biomarkers associated with health promotion and varying disease risk across cultural contexts (Chiao and Ambady 2007; Han et al. 2013; Kim and Sasaki 2014; Kitayama and Uskul 2011).

Considerations of the methods used in cultural neuroscience have produced a number of key priorities for advancement of cultural neuroscience investigation. Cross-cultural studies rely on standardized instrumentation and methods across units of analysis, including behavioral, neuroscience and genetic procedures. Behavioral methods for cross-cultural investigation of human experience has progressed with the design of qualitative and quantitative instruments, including ethnographic, open-ended interviews and self-report surveys. Neuroscience methodology for cross-cultural study of brain circuitry has relied on non-invasive procedures, including primarily functional magnetic resonance imaging (fMRI), event-related potentials (ERP), and neuropsychological studies. These quantitative methods allow for the identification of relations between behavioral and neural indices, and inferences regarding the commonalities and diversities of human brain function and behavior across cultural contexts. Genetic methodology for cross-cultural studies of neurotransmission and behavioral systems range from genotyping of functional polymorphisms to cross-national genetic index.

Further integration and advancement of methods in cultural neuroscience will be essential to facilitate systematic analysis of the role of social and cultural context in shaping risk and protective factors for mental health within and across nations. First, building research

infrastructure of large-scale studies, including participants of multiple cultural and national backgrounds, has been challenged due to funding and practical issues. Development of funding and training opportunities for research advancement in cultural neuroscience may facilitate implementation of large-scale studies. Second, sampling methodology may be enhanced on which groups to recruit based on theoretical understanding of cultural differences. Relatedly, methods for the study of sub-cultures within nationally- and geographically-bound cultural groups may be refined. Third, implementation of improved strategies for administration of consistent neuropsychological assessment and psychological testing for generation of data that can be compared across multiple cultural neuroscience studies may further strengthen research infrastructure in the field. Fourth, acceleration of development in neuroscience methodology for the study of culture at the molecular and cellular levels of analysis may expand scientific discovery.

Recent advances in cultural neuroscience have identified key domains with which the underlying root mechanisms of MNS disorders may be explored (Chiao et al. 2016). Investigations in cultural neuroscience have shown the influence of culture on psychological domains across levels of analysis, including affective and cognitive systems as well as social processes. Neurodevelopmental trajectories and environmental influences on psychological constructs represent a third dimension of cultural neuroscience research. Research programmes that systematically investigate cultural influences on psychological domains across units of analysis may lead to the identification of root causes and mechanisms underlying the etiology of mental disorders as well as protective factors for mental health in a global context.

Cultural factors are known to modulate neural systems of human behavior (Chiao et al. 2013). Brains are structured and organized from birth largely by social interaction and cultural involvement (Turner and Whitehead 2008; Domínguez et al. 2009). One of the most robust discoveries in cultural neuroscience is the influence of culture on social processes, such as neural representations of the self. Across several neuroimaging studies, cultural orientations, such as individualism-collectivism and independence-interdependence, are reliable predictors of neural variation of social processes when comparing cohorts in the United States, Europe and Asia. Neuroimaging studies of culture and self-knowledge have found that neural circuitry within social brain regions, such as the medial prefrontal cortex (MPFC) (Zhu et al. 2007) is robustly recruited during evaluations of self-knowledge. Cross-national neuroimaging investigation in U.S. and Japan and shows that the amplitude of neural response within the MPFC varies depending on the degree of cultural valuation (Chiao et al. 2009). These findings identify neurobiological circuitry of social processes, related to the perception and understanding of the self, that are modulated by culture.

Culture has been shown to influence neural mechanisms underlying social perception and understanding of others. Effectiveness of cultural acquisition may be affected by modulation of neural mechanisms of imitation due to racial group membership (Losin et al. 2014). In a within-nation study of culture and imitation, African-American and European-American participants living in the United States showed heightened neural response in lateral frontoparietal and visual regions when imitating African-Americans relative to European-Americans or Chinese-Americans. These findings demonstrate cultural influences on neural

circuitry of social communication related to learning from other people. In a within-nation neuroimaging study of social identity and empathy in African-Americans and Caucasian-Americans living in the U.S., results showed that the degree of racial identification predicts neural response during empathy for members of one's group in a natural disaster within cortical midline structures, including the MPFC, anterior cingulate cortex (ACC) and posterior cingulate cortex (PCC) (Mathur et al. 2012). These findings illustrate greater recruitment of neural circuitry underlying social processes in African-Americans relative to Caucasian-Americans due to racial identification. A cross-cultural neuroimaging investigation of Caucasian-Americans living in the U.S. and Koreans living in Korea found that neural response within the left temporoparietal junction (L-TPJ) predicts the degree of empathy for group members in a natural disaster while dependent on hierarchical orientation (Cheon et al. 2011). These results suggest that in a harsh or extreme environmental condition, empathy may act as an emotional resource of the individual to help in response and recovery.

Culture also shapes neurobiological mechanisms of emotion and its regulation. In a cross-national study of emotion recognition in the United States and Japan, response in the human amygdala was heightened for facial expressions of fear expressed by ingroup compared to outgroup members (Chiao et al. 2008). Japanese participants showed greater bilateral amygdala response to fear facial expressions of Japanese people, relative to Caucasian-American participants who showed greater amygdala response to fearful facial expressions of Caucasian-American people. These findings provide initial evidence that culture shapes the neural circuitry of fear within the evolutionarily-ancient limbic system. A psychophysiological study of culture and emotion regulation found decreased late positive potential (LPP) during the suppression of emotional expression in East Asian (China, Japan, Singapore, or South Korea), but not European-American participants living in the United States (Murata et al. 2013). These results show that a cultural difference in production of facial communication is related to the psychophysiological index of LPP. The regulation of emotion and social communication is also guided by genetic mechanisms that reinforce patterns of culturally-adaptive behavior (Kim and Sasaki 2012; Sasaki et al. 2016). In a study of gene-culture interaction and emotional support seeking, American participants with social distress who carry the GG/AG genotype of the oxytocin receptor polymorphism (OXTR) reported more emotional social support seeking relative to American participants carrying the AA genotype, whereas Korean participants did not (Kim et al. 2010). These findings demonstrate that cultural influences on genetic and neural circuits of emotion across several levels of analysis. More broadly, these results suggest that the mental capital of the individual is stored in neurobiology and shaped by cultural context.

Developmental approaches suggest the relevance of socio-cultural context for behavioral and brain plasticity across the life course. The importance of the lifespan approach is evident as elementary processes of cognition (Li et al. 2004), emotion (Carstensen and Turk-Charles 1994) and motivation (Heckhausen et al. 2010) across the lifespan. When neurocognitive resources are undergoing maturation or have already declined, the reliance on socio-cultural context may be particularly great (Baltes 1997; Li 2003). A neurodevelopmental study of cognition across cultures found young Chinese-Canadian children showed greater N2 waveform relative to European-Canadian children during a behavioral inhibition task (Lahat

et al. 2010). The N2 waveform is typically associated with executive function and goal-directed behavior, whereby greater N2 amplitude is observed during successful cognitive inhibition. Although no cultural differences in behavior were observed, N2 amplitude was heightened for young Chinese-Canadian children relative to European-Canadian children. These findings suggest that cultural context affects the neurodevelopmental trajectory of cognition during an early stage of child development. During adolescence, cultural contexts that emphasize familial obligation influence neural circuitry of approach motivation. Latino youth show greater reward response in dorsal and ventral striatum during costly donation relative to White youth in the U.S (Telzer et al. 2010). These developmental neuroimaging findings show culture shapes neurobiological mechanisms of decision-making during late childhood. In late adulthood, cultural differences in neurobiological mechanisms of cognitive systems are observed in neural circuitry of visual perception. A neuroimaging study of culture and aging revealed elderly East Asians demonstrated reduced adaptation response within neural mechanisms for objects, such as lateral occipital cortex, relative to elderly Westerners during a visual perception task (Goh et al. 2007). During later stages of aging, cultural variation may be readily observed in biomarkers of perception and cognition of the elderly due to decreases in neural plasticity (Park and Gutchess 2002).

Community-wide mental health resources can address social exclusion and discrimination to effectively prevent MNS disorders. A gene-environment interaction study of intergroup bias found greater exposure to environmental conditions, such as negative social contact or perceptions of danger in the social environment, lead to greater bias and discrimination amongst genetically sensitive individuals (Cheon et al. 2014). Reduction in societal risks for MNS disorders may be achieved with regulation of the social environment, such as greater exposure to positive social contact and greater perception of social safety. For immigrants acculturating to a novel cultural setting, integrating positive attitudes towards the heritage and host culture may also facilitate cultural competence and reduce societal risk for MNS disorders (Berry 1997; Yang et al. 2007).

While research in cultural neuroscience has begun to identify theoretical and methodological strategies for studying cultural and biological mechanisms of healthy behavior, future collaborative research is needed to comprehensively investigate the etiology of MNS disorders across the life course, and to develop evidence-based treatment programmes for mental health researchers and clinicians serving the global community. Several challenges and opportunities for building research capacity in cultural neuroscience need to be further addressed. One key issue is the expanding the level of infrastructure and funding for standard neuroscience methods in LMIC countries. While the majority of cultural neuroscience research outside of Western HMIC countries has been in East Asian countries, much of the global mental health research is focused on LMIC countries. Broadening opportunities for institutions to support training opportunities in cultural neuroscience and global mental health in HMIC and LMIC countries may help to address key issues with regard to building research capacity in both fields.

Practice in cultural neuropsychology suggests ethical questions to address regarding assessment of people from ethnically and linguistically diverse communities (Brickman et al. 2006; Manly 2008). One ethical concern is with regard to the consideration of level of

education and language familiarity in neuropsychological assessment. Cultural factors, including acculturation, language and education, have been shown to affect cognitive performance (Manly et al. 2004). In a large study of cultural and educational experience on neuropsychological test performance in healthy African-American elderly, reading level was found to be the most influential predictor of cognitive test performance, after accounting for demographic factors and cultural experience. Another ethical concern relates to the use of race- and ethnicity-based norms for neuropsychological assessment. When race- and ethnicity-norms are utilized in neuropsychological assessment, health disparities in neurocognitive measures are reduced. These findings highlight the relevance of socio-cultural context in neuropsychological settings, and illustrate the importance of consideration of cultural factors in neuroscience for delivery of mental health care.

Implications

Addressing the Grand Challenges in Global Mental Health will require collaborative efforts to rapidly translate scientific advances into the development of initiatives and applications to deliver mental health services to culturally diverse populations, in varying environmental contexts, and across the life course. Prevention and treatment of mental illness involves a comprehensive understanding of research and policy interventions to facilitate training of mental health-care researchers and providers in low-, middle- and high-income nations. The translation of scientific findings into effective policies and practices for preventing and treating mental illnesses remains a top priority for the global mental health community and a guide for development of policy-informed research in cultural neuroscience.

Conclusion

In summary, here we advance the notion that research in cultural neuroscience addresses one of the grand challenges in global mental health: to identify root causes and risk and protective factors underlying MNS disorders. In particular, research in cultural neuroscience is well-positioned to address key questions identified as a primary goal by the GCGMH consortium, such as “what are the phenotypes and endophenotypes of MNS disorders across cultural settings?”, “what gene environment interactions are associated with the increased risk for mental disorders?” and “what factors promote resilience and prevent mental disorders in persons at extreme social disadvantage?” Answers to these and other questions comprise a fundamental step towards alleviating the individual and collective suffering caused by mental illness worldwide. In all nations, sustained social and financial investment in fundamental research activities for the prevention and treatment of MNS disorders will increase opportunities to produce timely solutions that address the grand challenges of global mental health, and ultimately, a cure for MNS disorders across the globe.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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