

Two-Eyed Seeing and other Indigenous perspectives for neuroscience

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The integration of Indigenous perspectives and knowledge with biomedical approaches in neurosciences can significantly broaden the understanding of the human brain and mind. Drawing upon the writings of Elders in Canada, we refer to this integration as Two-Eyed Seeing or *Etuaptmumk*. We discuss how Two-Eyed Seeing and other dual perspectives can bring both breadth of knowledge and humility to the development of research and clinical practices for brain health. In this forward-looking discussion, we include both traditional academic and non-academic traditions and the work of Indigenous scholars on methodologies, life, health, culture, language and history. To describe challenges and consider solutions, we offer broad strategies for allyship, humility and universalism and situate them in four specific examples pertaining to disability, suicide, migration and the environment. We further advance the power of Two-Eyed Seeing in the context of new considerations for communication and public engagement. Two-Eyed Seeing, per se, is only one approach, but as neuroscience becomes ever more global, inclusive and ethically proactive, it must universally see the world of brain and mental health through the eyes of both reductionism and holism.

This Perspective focuses on the integration of traditional Indigenous views with biomedical approaches to research and care for brain and mental health, and both the breadth of knowledge and intellectual humility that can result when the two are combined. We build upon the foundational framework of Two-Eyed Seeing¹ to explore approaches to sharing sacred knowledge and recognize that many dual forms exist to serve a similar beneficial purpose. We offer an approach towards understanding how neuroscience has been influenced by colonization in the past and efforts undertaken to mitigate epistemic, social and environmental injustices in the future.

The principle of Two-Eyed Seeing or *Etuaptmumk* was conceived by Mi'kmaq Elders, Albert and Murdena Marshall, from Unama'ki (Cape Breton), Nova Scotia, Canada, in 2004¹ (Fig. 1). It is considered a gift of multiple perspectives, treasured by many Indigenous Peoples, which is enabled by learning to see from one eye with the strengths of Indigenous knowledge and ways of knowing, and from the other eye with the strengths of non-Indigenous knowledge and ways of knowing. It speaks not only to the importance of recognizing Indigenous knowledge as a distinct knowledge system alongside science, but also to the weaving of the Indigenous and Western world views. This integration has attained Canada-wide acceptance and is now widely considered

an appropriate approach for researchers working with Indigenous communities.

The Indigenous peoples of Canada are not alone in celebrating this approach. Wilson et al.² and Svalastog et al.³, for example, have written about the double perspectives of Indigenous people in various regions of the world, developing the concept and depicting a reality that is not often seen and acknowledged as real in Western academic and health-related education, research and practices. Kulin nations of southeastern Australia refer to *Ngarnga*, a word that directly translates to 'hear', as an affirmation of the understanding of knowledge given and passed on between knowledge holders.

Here we argue that the integration of Indigenous perspectives and knowledge is necessary to further deepen the understanding of the brain and to ensure sustainable development of research⁴ and clinical practices for brain health^{5,6} (Table 1 and Fig. 2). We recognize that, in some parts of the world, the term Indigenous is understood differently. We are guided by the United Nations Permanent Forum on Indigenous Issues that identifies Indigenous people as

[...] holders of unique languages, knowledge systems and beliefs and possess invaluable knowledge of practices for the

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Fig. 1 | Two-Eyed Seeing. Journey, communities and values through different lenses of priority. Illustration by Rudi Taylor-Bragge.

sustainable management of natural resources. They have a special relation to and use of their traditional land. Their ancestral land has a fundamental importance for their collective physical and cultural survival as peoples. Indigenous peoples hold their own diverse concepts of development, based on their traditional values, visions, needs and priorities.

When discussing Indigenous perspectives, we include both academic and non-academic traditions, as well as the work of Indigenous scholars on methodologies, life, health, culture, language and history. As neuroscience becomes ever more global and the goals of inclusivity and equity ever increasingly emphasize holistic world views to understand the brain and mind over, or in addition to, reductionistic ones, the knowledge base on which methods and results are constructed and communicated becomes equally diverse. This is positive; the brain is neither singular nor exact, and global neuroscience recognizes that realities and interpretations will only be revealed when questioned from different perspectives. Ethics for neuroscience, familiarly known as neuroethics, highlights the importance of being mindful of the societal implications of new discoveries and tools; cultural, legal, linguistic and practical dimensions; and the possibilities for a harmonious relationship between scientific progress and human values⁷. In this regard, neuroethics guides neuroscience to take into account Indigenous and other ways of knowing, and epistemologies with their ethical and moral dimensions, tied to places, to ecologies and life systems⁸.

We bring our respective expertise, world views and positionalities to this writing. We describe challenges and consider solutions in the context of brain and mental health, framed as broad strategies for allyship, humility, practical application and universalism, four specific case topics of disability, suicide, migration and the environment, and new methods for communication central to neuroscience today. These are examples of many neuroscience and neuroscience-adjacent topics, and we do not speak outside the envelope in which we present them. We fully acknowledge and respect the collectivism and immense heterogeneity of perspectives among Indigenous peoples around the world in our approach to the task. In this regard, while we use the Mi'kmaq Two-Eyed Seeing terminology to describe an Indigenous–Western dual view strategy, we recognize and honour other dual perspective approaches and the importance of developing them with guidance from community Elders and Knowledge Keepers.

Table 1 | Two-Eyed Seeing as a framework for integrating Indigenous and Western views for neuroscience

Indigenous lens	Western lens
Connectedness	
Relationships, responsibility, community, humility, non-hierarchical ceremony and holistic	Relationships, responsibility, networks, brain connectivity, human-hierarchical organized structure and reductionist
Experience	
Bravery, wisdom, truth, love, respect and honesty	Cellular signalling, synaptic plasticity, anatomy and physiology, learning and memory, emotion and motivation
Brain and mental health	
Physical, intellectual, emotional, cultural, spiritual, ceremony and holistic	Physical, intellectual, emotional, brain resilience, anatomy and physiology, neuromodulation and scientific method
Relatedness	
Family, relationships, respect, community and storytelling	Family, relationships, lineage, evolution and phylogeny

The bold text reflects shared themes between Indigenous and neuroscience views of connectedness, experience, brain and mental health, and relatedness. The non-bold text shows themes that are complementary in principle but divergent in application.

Broad strategies

Allyship and epistemic humility

The study of complex biological systems, from cells to brains to ecosystems, represents an attempt to understand and reconcile opposing yet complementary elements of commonality and diversity. This includes seeking common structures, patterns and mechanisms at a fundamental level while recognizing that these manifest in a wide array of distinct outcomes at an emergent macro-scale. Neuroscience provides a particularly clear example of the challenge of navigating unity amidst diversity; whereas there are commonalities shared across deep evolutionary divides, there are also important differences, even among individual humans. Thus, traits shared across large evolutionary divides allow neuroscientists to use non-human animal models to study the fundamental processes of brain function while at the same time recognizing the importance of exploring differences within species—among populations, across sexes, and even between individuals. This is, of course, true for most biological traits, but when it comes to the study of brains and minds, the imperative to engage in a diversity-informed perspective is particularly pressing.

Moral and professional responsibilities pertaining to any effort to study human diversity are becoming widely recognized and codified in both guidelines and laws. With regard to scientific investigation that involves Indigenous peoples, there is emphasis on putting into practice the six Rs: respect, relationships, relevance, reciprocity, responsibility and representation⁹. We strongly support these principles. We also encourage neuroscientists to embrace and explore a much broader approach. Instead of simply meeting the requirements for ethical research practice, we open the door here to meaningful engagement with diverse ways of knowing, learning, teaching and being and to becoming active in such a way as to earn and maintain, rather than self-proclaim, ally status¹⁰.

There are many compelling reasons for neuroscientists who study the human brain and mind to engage with other ways of knowing and pursue active allyship, and few convincing reasons to not. Fundamentally, a willingness to engage meaningfully with a range of modes of thought, world views, methods of inquiry and means of communicating knowledge is a matter of intellectual and epistemic humility¹¹. Epistemic humility is defined as “the ability to critically reflect on our ontological commitments, beliefs and belief systems, our biases, and our assumptions, and being willing to change or modify them”¹². It shares features

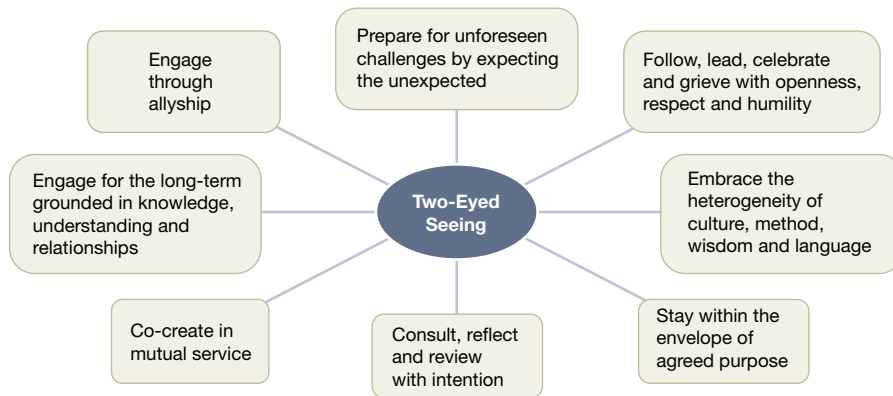


Fig. 2 | Strategic integration. Strategic integration of Two-Eyed Seeing in research practice (for more detailed strategies pertaining to in-person and virtual research, see refs. 4,6).

with interdisciplinary thinking within Western academic traditions, but it stands to be even more enlightening by providing entirely new approaches to understanding. Epistemic humility is an acknowledgment that all interactions with the world, including the practice of neuroscience, are influenced by mental frameworks, experiences and both unconscious and overt biases.

The value of using multiple perspectives, including Indigenous and Western academic world views, is summarized powerfully by Wilson¹³:

[O]ne of the great strengths that indigenous [sic] scholars bring with them is the ability to see and work within both indigenous and dominant worldviews. This becomes of great importance when working with dominant system academics, who are usually not bicultural. As part of their white privilege, there is no requirement for them to be able to see other ways of being and doing, or even to recognize that they exist. Oftentimes then, ideas coming from a different worldview are outside of their entire mindset and way of thinking. The ability to bridge this gap becomes important in order to ease the tension that it creates.

There is a great deal to be gained from learning about and implementing Indigenous ways of knowing, learning and being. Indeed, many of the new approaches to scholarship and pedagogy that are gaining increasing prominence in academic settings are, in fact, practices that have been used by Indigenous peoples for millennia. Community-engaged inquiry, land-based education, experiential learning, holism and an emphasis on relations and connections rather than on reductionism, and restorative rather than punitive approaches to misconduct. These are not mere buzzwords, but approaches at the core of many Indigenous social and educational systems¹⁴. Facilitating meaningful access and connection to culture can function as a lifeline. In this, Indigenous partners are content experts from whom there is a great deal to be learned for the benefit of research programmes, mentees and students and our own communities. Of course, the principle of reciprocity demands that an equal effort towards mutual understanding be undertaken by both sides of a partnership. Given existing power imbalances, Western knowledge largely dominates the world in which Indigenous peoples reside and, as a result, there is often no choice as to whether to engage with it. In contrast, non-Indigenous peoples have the privilege to choose whether to engage with Indigenous knowledge systems. Although significant learning about Indigenous knowledge systems for settler colonialists remains, full reciprocity is not necessarily a requirement.

Why, then, is such engagement with Indigenous ways of knowing not more widespread in human neuroscience research and care? There would seem to be a litany of reasons: ongoing oppression and marginalization of Indigenous peoples in many societies and scientific

communities, individual and systemic epistemic arrogance in which only the Western way of knowing is perceived to be of value, lack of knowledge of other knowledge systems, lack of relationships with Indigenous partners that has been fuelled in part by the exclusion and marginalization of Indigenous scholars in academia, challenges to identifying ways of decolonizing or Indigenizing a particular area of study and fear of consequences for making mistakes or causing offence^{9,15}, among others. Dominant models of care often sideline and erase Indigenous paradigms of wellbeing¹⁶. With intentional efforts, these barriers can be overcome, and many are the result of underlying colonial attitudes, assumptions and practices. An expectation that a person will be punished for making mistakes, for example, rather than anticipating encouragement of growth, is a colonial attitude that is at odds with many Indigenous approaches under which errors are a part of the learning journey.

Of course, there are appropriate and inappropriate ways in which to engage with Indigenous people and knowledge systems. The six Rs pertain to all such interactions and must be incorporated authentically, and never in a performative check-box manner. A key step is to listen, build relationships, earn and continually justify trust, focus on strength-based approaches, acknowledge one's own positionality and privilege and appreciate that Indigenous peoples are diverse, even within a single region, let alone on a continental or global scale. All of this takes work; however, in our view, the benefits are worth the effort.

Cultural humility and trust-building

We carry on the theme of humility in neuroscience with a focus on culture, moving from allyship that concerns why we should have humility, to epistemic humility, which is about what that involves. We define culture as many anthropologists do—as a way of life involving the values, customs, beliefs and practices that inform a complex system¹⁷. Expanding on epistemic humility, cultural humility is “a continuous lifelong process of self-reflection and self-critique that involves one acquiring knowledge of other cultures and becoming more aware of one's own hermeneutical situatedness”^{18,19}.

Brain science has largely drawn on ontological and epistemological cultural ways of being and knowing, which are dominantly held in Western countries, such as those in North America and Europe. In cross-cultural neuroscience involving Indigenous people and communities, both epistemic and cultural humility call for an understanding of the history of colonialism, discrimination, injustice and harm caused under a false umbrella of science; critical examination of the origins of current and emerging scientific assessments; and consideration of the way culture shapes engagement between Western and Indigenous research, as well as care systems for brain and mental health.

Historically, Indigenous peoples have been largely excluded from brain and mental health science, or included but never benefited from the scientific advancements. There are also ample examples, in the brain and mental health sciences and elsewhere, in which the cultural beliefs of Indigenous peoples were patently disrespected. A distinct example is the Havasupai Tribe case, where scientists at Arizona State University in the USA used blood samples they had collected from the Havasupai people to conduct unconsented research on schizophrenia, inbreeding and human population migration²⁰. The Havasupai people, who have strong beliefs about blood and its relation to their sense of identity, spiritual connection and cultural cohesion, were advised that the blood samples were being collected for purposes of conducting diabetes research. The community filed two lawsuits against the university upon learning about the misuse of their blood samples for research questions they do not support.

In another stark example, results from an international genomics study on the genetic structure of 'Indigenous peoples' [sic] recruited in Namibia²¹ were compared to results of a study of the 'Bantu-speaking people of southern Africa'^{22,23}. The Namibian people were the Indigenous San (including the !Xun, Khwe and ǀKhomani) and Khoekhoe people who include the Nama and Griqua, first to be colonized in southern Africa²¹. Among numerous missteps in the research, published supplementary materials contained information entirely unrelated to genomics and other information about the San that was unconsented, private, pejorative and discriminatory.

These examples of violations of research ethics in neuroscience and genomics highlight the need for Two-Eyed Seeing to ensure individual and professional scientific integrity. Indigenous research protocols must not only be included, but they must lead and recognize the collectivism of communities in research engagement, consent and utilization of results. This must occur from the very outset with the method of seeking approval to engage matters: researchers should identify and involve key community leaders—a village Chief, elected or hereditary Chief, Clan Leader or Elders. These community leaders (sometimes referred to as community gatekeepers) will review requests—a handwritten letter in the Indigenous language of the cultural group, delivered in person is ideal (although hard copy mail and email sent to an individual in the community who can deliver it to the leaders are acceptable contemporary formats today, as appropriate)—to assess the benefits and risks to the community and provide permission for contact with community members.

After the experience with the study by Schuster et al.²³ that was featured in a *Nature* rebuttal by Chennells and Steenkamp²², the South African San launched the San Code of Research Ethics in March 2017. It was the first ethics code in Africa developed and published by an Indigenous community²⁴. The code requires that any researchers with an intention to engage with the San communities in health research must uphold the four central values of fairness, respect, care and honesty to protect Indigenous people from harm and to respect and safeguard their cultural heritage²⁵. Cultural humility requires an openness to learn about and understand these historical and cultural fractures so that errors of the past do not repeat in the future.

African scholars—Ned, Kpobi and Ohajunwa—reflect on the value of an African Indigenous world view for understanding mental health and disability²⁶. Guided by Semali and Kincheloe²⁷ and Smith²⁸, consideration of Indigenous people refers to "[...] a dynamic construct that includes networks of people who have been subjected to colonisation of their lands and cultures, thus leading to their cultural identities being shaped and reshaped by colonization. This colonization of lands and cultures prevents Indigenous People from living according to their own practices"²⁶. Their research with the AmaBomvane community, part of the amaXhosa people who are indigenous to Madwaleni in the Eastern Cape Province of South Africa, and with Indigenous healers in the Greater Accra Region of Ghana, underscores the importance of using an Indigenous lens in Africa. This approach expresses how African

Indigenous people conceptualize mental health, thereby advancing culturally appropriate research and care. Their rich reflections on their positionalities as African researchers who are trained in Western psychological and health education frameworks, and who hold the values of Ubuntu (the relational African philosophy often conceptualized as 'I am because we are'), provide a powerful example of practicing Two-Eyed Seeing in a way that informs trust-building with Indigenous communities.

Other successful studies among the amaXhosa people in South Africa in 2020 exemplify the embodiment of cultural humility and trust-building. Gulsuner et al.²⁹ and Campbell et al.³⁰ demonstrated the importance of inviting people with lived experience of a mental health condition, brain and mental health professionals, members of the criminal justice system, local hospital staff as well as traditional and faith-based healers to provide education about severe mental illness and local psychosocial support structures to promote recovery. Through co-design, implementation and evaluation, the researchers assessed the effects of the co-created mental health community engagement in enhancing understanding of schizophrenia and neuropsychiatric genomics research as it pertains to this disorder³⁰. They collaboratively presented mental health information and research in a culturally sensitive way, both respecting the local conceptualization of mental health and guarding against the possible harms of stigma³¹. They incorporated cultural practices, such as song, dance and prayer, with the guidance of key community leaders and amaXhosa people that included families affected by schizophrenia, to foster a process of multidirectional enlightenment and, in effect, Two-Eyed Seeing.

Engaging with different knowledge systems requires responsible engagement practices. The study among the amaXhosa people highlights how culturally sensitive methodologies and collaborative approaches can lead to meaningful outcomes for all partners involved. By integrating traditional Indigenous practices and modern health applications, and involving community leaders and affected families, the research respected local knowledge systems. Therefore, when neuroscience exercises cultural humility, it moves away from binary, power-informed thinking where Indigenous knowledge systems are isolated and viewed against Western knowledge^{32,33}. Instead, it looks at both Indigenous and Western knowledge systems in the pursuit of advanced discoveries and the remediation of mental health and brain disorders for all people³⁴.

We argue for such a pluriversal ethical and meaningful approach to neuroscience research, both for holistic knowledge production and meaningful best practices in the translational pipeline. In recent years, research on humans is increasingly governed by strict laws and regulations delineating what is permissible and ethically sound in such studies, a trend observed in many countries around the world. Researchers must prioritize the involvement of local communities, respect their cultural practices and ensure that their methodologies do not perpetuate historical injustices.

Applied neuroscience

Exploring neuroscience with Indigenous paradigms presents unique practical challenges. Modern understandings of neuroscience have been significantly shaped by many recent technological advancements overshadowing, at times, other approaches, such as theoretical understandings and meaningful insights into the brain and the how and why it functions for daily life. However, there remains significant potential integrating Indigenous theories around the brain and mind. For example, while the Kulin nations conceptualize distinct philosophies of yulendj (knowledge/intelligence), toombadool (learning/teaching) and Ngarnga (understanding/comprehension), views of the mind and brain tend to not be static and individualistic, but holistic, dynamic and interwoven symbiotically within the broader environment. The durndurn (brain) is not just a singular organ, but a part of the body

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that contains some aspects of a murrup (spirit), within the pedagogy of a broader songline.

This concept of a songline is present across many Indigenous cultures³⁵. Although songlines can present as dreaming stories, art, song and dance, their most common use is as a mnemonic. Such is the success of using songlines in memory that it has allowed oral history to accurately survive tens of thousands of years—with accuracy often setting precedent for scientific verification. The breadth of their use would allow the common person to memorize thousands of plants, animals, insects, navigation, astronomy, laws, geological features and genealogy. Whether conceived as songlines, Native American pilgrimage trails, Inca ceques or Polynesian ceremonial roads, all use similar Indigenous methods of memorization³⁶. This aligns with modern neuroscience findings that emphasize the capacity of the brain for complex memory processes and the role of mnemonic techniques in enhancing memory retention. Moser, Moser and O'Keefe were awarded the 2014 Nobel Prize in Physiology or Medicine for research that grounded the relationship between memory and spatial awareness when establishing that entorhinal grid cells form a positioning system as a cognitive representation of the inhabited space. Elevated hippocampal activity when utilizing spatial learning encourages strong memorization through associative attachment, and these techniques are readily used by competitive memory champions. Two-Eyed Seeing songlines for the mind and brain build capacity in facilitating a respectful implementation of traditional memorization techniques in broader contemporary settings³⁷.

We return to the Mi'kmaw view of Two-Eyed Seeing and that it is about life: “[...] what you do, what kind of responsibilities you have, how you should live while on Earth”¹. Mi'kmaw understandings, however, are but one among a multitude of Indigenous views that, while discussed widely in the literature, have had limited or inconsistent applications in brain and other types of health research⁴. Sources of inconsistencies are unsurprising, especially for neuroscience: Two-Eyed Seeing is not a simple ethical protocol that can be followed, and perspectives are not necessarily dichotomous. Oversimplification is a risk. Lack of understanding of the diversity of Indigenous cultures often leads to the assumption that Indigenous world views are all the same. Power imbalances between Indigenous and mainstream scientists often comes with the expectation that Indigenous peoples must change to fit a predetermined colonial framework and may arise more often when there is a lack of Indigenous leaders to guide the research process. The risks of cultural appropriation, tokenism and a lack of acknowledgement of data sovereignty and ownership are otherwise enormous, as in the examples described earlier. Svalastog and Eriksson³⁸ present a framework and history that directly concern ownership, in addition to how it is interrelated with other key research and bioethical concepts. Many guidance documents, such as the First Nations Principles of Ownership, Control, Access, and Possession (<https://fnigc.ca>) and, more recently, CARE Principles for Indigenous Data Governance (<https://www.gida-global.org/care>), exist to counter these risks.

Increasing numbers of national strategies³⁹ and studies from around the world have focused on Indigenous views of mind and brain^{40–42}, Indigenous methods and ethics in brain research^{42,43}, governance of data⁴⁴ and access to advanced technologies^{45,46}, among others. In Cabrera et al.⁴⁰, for example, success in bridging Two-Eyed Seeing was realized for neuroethics research co-created with the Tahltan First Nation in northern British Columbia, Canada, on early onset Alzheimer's familial disease (EOFAD). With its focus on wellbeing over the disease model of Alzheimer's, the more than 10-year-long research collaboration brought the strength of Two-Eyed Seeing to the health needs of the community, their place of being, their ways of doing and their personal and economic interests. Together, the researchers and community rewrote single-lens urban-framed research questions and preliminary study designs framed in a Western perspective to address

concerns about privacy, stigma and fractures in intergenerational knowledge about EOFAD for this community located in a largely rural and remote region of the country.

The complex analyses of narrative interview data in this study revealed the value of looking at the deep relationships between and intersections of traditional knowledge, brain and the environment through multiple lenses⁴⁶, as well as the insights that qualitative methods can bring to neuroscience research⁴⁷. Researchers and community members exchanged and elaborated on their historically oral language descriptions of Alzheimer's disease—*Kadousah*, not knowing if you are coming and going, and *Edu M'Diid Sugo Ta a*, not brain well—with an acceptance of the biomedical nomenclature. Together, they also applied their collaboration to giving back—a key feature of working with Indigenous communities—by actively sharing the power of Two-Eyed Seeing in the journey of human neurodegeneration in writings, academic and government briefings and in freely available resource documents for adults and children (<https://med-fom-neuroethics.sites.olt.ubc.ca/files/2015/08/GTP-Wellness-in-EOFAD-s.pdf>; <https://med-fom-neuroethics.sites.olt.ubc.ca/files/2015/08/GTP-The-Mind-Thief-s1.pdf>).

Universalism

Indigenous wisdom, guided by dual perspectives such as Two-Eyed Seeing, offers a profound lens through which to examine the concept of universalism, including in the realm of neuroethics. In contrast to a singular approach that denies cultural diversity, dual perspectives explicitly acknowledge the moral interconnectedness of all human beings while celebrating and respecting differences.

A 2021 report by the International Bioethics Committee (IBC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO) highlights the centrality of brain activity in shaping cognitive, affective and other brain states. The assertion in the report that “Brain activity provides information inherent to all human beings regardless of gender, nationality, language, or religion” reflects a universalist view that all human beings share the same main neural functioning is an oversimplification because each person could be reidentified today from individual brain mapping that results from personal histories⁴⁸. A dual perspective prompts exploration of this universality and the individual and cultural identities that shape the understanding of health and wellbeing.

French universalism, for example, rooted in Enlightenment philosophy and enshrined in the Declaration of the Rights of Man and of the Citizen, aimed to establish common rules and values for all citizens, transcending cultural and religious distinctions. History reveals, however, that this universalism often serves as a tool of oppression and rejection of differences that leads to discrimination rather than inclusivity. Two-Eyed Seeing challenges the ethnocentric nature of historical universalism. From this perspective, the universality of brain activity does not equate to a uniformity of brains. Scientifically, brains are shaped by a myriad of factors, including genetic variations, environmental influences and epigenetic processes⁴⁹. Even monozygotic twins, who share the same genetic code, have distinct brains from birth⁵⁰. A dual perspective emphasizes that brains are unique, shaped by cultural background and experience, and that this diversity ought to be respected and celebrated. It also emphasizes that brain health is not merely the absence of disease but the balance and harmony of physical, mental, emotional and spiritual dimensions. Disruption of such an equilibrium appears as a main factor in the genesis and evolution of brain disorders. In addition to feeding neuroscience research, the incorporation of traditional healing practices stemming from the interconnectedness between individuals and their environment, physical and cultural, would enhance preventive or care strategies.

Epilepsy serves as a poignant example of how a dual perspective can enrich the spirituality of health and wellbeing, and where collisions with biomedicine can lead to tragic consequences. One example can

be taken from the book *The Spirit Catches You and You Fall Down*, in which author Anne Fadiman⁵¹ documents the story of Lia Lee, a Hmong child affected with Lennox–Gastaut syndrome. Lia’s parents attributed the symptoms of her seizures to the flight of her soul in response to a frightening noise—*quab dab peg* (the spirit catches you and you fall down; translated as epilepsy in Hmong–English dictionaries) and, although concerned, were reluctant to intervene because they viewed its symptoms as a form of spiritual giftedness. Lia’s doctors were faced with limited therapeutic choices, challenges of communication, and a general lack of cultural competence. Exacerbated by disconnects and failures of both traditional and Western healthcare, responsive options and years of effort were eclipsed in a perfect storm of mistrust and misunderstanding.

Since the 1990s when the book was written, closing gaps in health equity, reducing the marginalization of vulnerable and historically neglected populations such as Indigenous peoples and promoting individual and collective autonomy have become a focus in both neuroscience research and clinical care. While universalism is often associated with a homogenizing agenda, bringing a dual perspective to it fosters autonomy and freedom for individuals, irrespective of their beliefs, cultural or social backgrounds. The ban on discrimination, a fundamental tenet of universalism, is a call to protect diverse human identities and rights.

Case topics

Disabilities of the brain and mind

The experience of colonization has led to disproportionately high rates of disability among Indigenous people in comparison to their non-Indigenous counterparts around the world. The dominant Western approach tends to portray disability as a categorization, a label that is imposed. It also emphasizes the understanding of the normative body and mind as a reflection of social structures and uneven power dynamics. By contrast, Indigenous scholarship shows that a deviation from a normative body or brain does not determine personhood. Rather, Indigenous approaches to disability broaden the understanding of personhood and the mind. The social precarity and violence endured by Indigenous communities through colonization have shaped bodies, brains and the lived experience of disability⁵²; understanding the experience of disability for Indigenous people, therefore, requires consideration of its full historical context^{53–55}.

For many years, biomedical and social science have been trying with great difficulty to establish where the cutoff point is between variations of the brain and mind and disability, yet the lines remain blurred⁵⁶. Today, Western literature describes disability as an interrelational phenomenon. It is seen as the result of the interaction between an individual with a health condition, cerebral palsy for example, and personal and environmental factors^{57,58}. Indigenous scholars today are calling for better integration of their lived experience into Western medical practices and theoretical models about disability^{53,59}. Emerging intersectionality reflections in disability scholarship are moving away from dividing people into able and disabled and from solemnly focusing on defining the effect of bodily impairment.

In the USA, for example, Lovern^{57,60} investigated ontological frameworks and concepts around disability at 500 federal and state recognized nations and tribes. Her finding shows an emerging model that focuses on a sense of the wholeness of existence, considering communities, nature, family, past and present, contrasting with traditional Western views on ability or disability.

For the Pitjantjatjara people of Central Australia, there is no word for disability. This community and other Aboriginal and Torres Strait Island nations do not have an abstract concept to differentiate people with impairments from people without⁵⁹. For Aboriginal and Torres Strait Islander people, impairments are seen as an organic part of life, and those living with impairments tend to be well-integrated into community life⁶¹.

In Chile, the Kallfulikan community that belongs to the Mapuches people, adopted the term *kutranche* to describe the fluidity of lived experiences as a person moves around two worlds⁵². The two words for the constant search for balance in a world are not well adapted to the separation of bodies and minds; rather, they allude to the experience of impairments as dynamic and constant search for balance.

Western and Indigenous scholars are increasingly examining rhetorical theories and moving towards a better historical, cultural and context-sensitive understanding of disability and impairment⁶². Word choices, alone, can lead directly to health and public policy locally and globally, with varying implications on affected people and populations. Modern, integrated accounts, such as that enabled by Two-Eyed Seeing and similar dual perspectives of disability, consider human brain functioning from a broader perspective than ever before.

Suicide

The impacts of colonialism, including the breaking down of Indigenous families and communities; loss of land, culture and language; and intergenerational trauma, alongside widespread discrimination and socio-economic inequalities, have led to a mental health and suicide crisis in many Indigenous populations. For example, between 2011 and 2016, suicide was two to nine times higher in First Nations, Métis and Inuit communities in Canada compared to non-Indigenous communities⁶³. The report also noted significant variations between communities with sex and age. In the USA, the situation is just as dire. Findings from the Centers for Disease Control and Prevention showed that, in 2019, the suicide rate in non-Hispanic Indigenous communities and Alaska natives was 20% higher than the non-Hispanic white population⁶⁴.

The high rates of suicide in Indigenous populations are not restricted to North America, although there is a limited amount of published data for many Indigenous populations residing elsewhere. In Australia, for example, data from the Australian Institute of Health and Welfare show that the suicide rate in Aboriginal and Torres Strait Islander communities from 2001 to 2022 were almost three times greater than in non-Indigenous communities. Seventy-five percent (75%) of reported suicides were by males⁶⁵. In New Zealand, suicide rates for Māori are almost twice as high as for non-Māori⁶⁶. Reports consistently demonstrate higher suicide rates in Indigenous youth, with many also showing that suicide rates have been rising.

Some of the highest suicide rates worldwide are found among young Indigenous men in the circumpolar Arctic. For the Sámi people, the rates of suicide vary widely across the different territories in Norway, Sweden, Finland and the Kola Peninsula in northwestern Russia⁶⁷. In northern Europe, research finds that suicide has been approached primarily as a matter of a person’s mental health status in the context of immediate social relations and behaviour, overlooking ethnicity-related maltreatment, and severe circumstances in subgroups of Sámi creating economic and societal obstacles to daily life and future⁶⁸. The researchers call for a broader approach to suicide prevention that challenges the status quo in society, in combination with the promotion of cultural empowerment among the Sámi people⁶⁹.

In the past, deficit-based principles have dominated suicide research in Indigenous communities. They tend to promote ideas that Indigenous peoples are biologically prone to specific mental health conditions or substance use disorders and require intervention⁷⁰. More recently, however, strength-based approaches have been introduced. In North America today, suicide prevention strategies focus on Indigenous resilience that embraces spirituality and culture, and celebrates self-determination (for example, societal infrastructure) alongside supports put in place to ensure their integration⁷¹. Suicide prevention for the Sámi people also focuses on self-determination, with treatments recognizing historical traumas, exposure to violence and ethnic discrimination and taboos

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particularly related to stigma around non-normative sexuality and gender identity^{72,73}.

Migration health

Human mobility is ancient, and the relevance of migration processes to health for the individual and society has not diminished over time. Migratory trends are at a steady increase for the foreseeable future with persisting poverty, inequalities, unresolved and protracted conflicts, human rights abuse and violence in many parts of the world, as well as natural and human-made disasters increasingly linked to climate and environmental changes. For neuroscience, cross-cultural attention to and research on the specific impacts for brain and mental health could not be more profound.

The health and wellbeing of refugees and migrants, as well as host populations, including Indigenous groups, are significantly affected by displacement and migration⁷⁴. Moving from a conflict-ridden area to a peaceful one, or from an area of high unemployment to one with better job opportunities and safety, can lead to improved overall health. However, during different stages of migration, after a time described as a honeymoon period, refugees and migrants may be exposed to conditions that undermine both their physical and mental health and wellbeing⁷⁵. Behavioural and neurobiological sequelae of migration-related trauma exposure, such as the development of internalizing and externalizing symptomatology and adult post-traumatic stress disorder, often ensue^{76,77}.

Multiple determinants of health influence outcomes from these challenges, and these are interconnected and interdependent. Differences in views about disease such as that of the Hmong family described earlier, access to healthcare, receptivity to unfamiliar interventions and varying gene pools and mutations may all influence the pathophysiology of different disorders, including neurological ones, such as dementia, parkinsonism and ataxia for example. External stresses, such as a change of natural environment, legal status, language barriers and low health literacy, further challenge outcomes⁷⁸. Children are a particularly vulnerable group⁷⁹. As Bernhardt et al.⁸⁰ suggest, early integration of children into education can mitigate the negative consequences of forced displacement on neurodevelopment. Adult migrants and youth are not only more prone to neurological and mental health disorders, but they also face greater barriers to healthcare, not in their 'otherness' but in the 'othering' they experience from others, again bringing the need for aligning dual perspectives to the fore.

A wealth of recent literature on migration and neuroscience has also focused on dementia and mental health⁸¹, and brings together dual and multi-tiered approaches to health promotion and clinical management of migrants and refugees⁸². It emphasizes the multiplicity of understandings and cultural dispositions, and barriers of language, resources and support. This applies to both internal and international migration, phenomena that are often blurred together in the literature, yet with distinct characteristics that may variously affect, for example, the dual social role of women, child labour and education⁸³. Specialized methods involving dual approaches that respect culture and language can yield diversity-sensitive research and care for vulnerable migrant populations—within and outside neuroscience.

Environment and country

The environment provides the fourth case study where Two-Eyed Seeing can embrace cultural practices together with scientific constructions for a collaborative enterprise towards wellness of the brain and mind for both Indigenous and non-Indigenous peoples.

The impact of adverse environments on the human lifespan—current and future—was identified as an imperative more than 20 years ago by the World Health Organization, and contemporary environmental neuroethics has specifically triangulated considerations

for environmental change on brain and mental health⁴⁷. Studies of pollution-related epigenetic changes, for example, have revealed changes in methylation at about 2,800 different points on people's DNA, affecting about 400 genes⁸⁴. A recent Canadian study showed changes to functional cortical connectivities, as shown on functional magnetic resonance imaging (fMRI)⁸⁵. Risks of water contamination related to hydroelectric facilities and fracking sites have been raised especially for Indigenous communities living in regions proximate to them⁸⁶, including reports of premature mortality¹⁵. Minamata disease, characterized by ataxia, loss of peripheral vision and, in extreme cases, psychosis and paralysis, has been a particular concern in Japan and the Amazon Basin where the populations ingest large amounts of fish from the waters of the surrounding methylmercury-contaminated environment.

In balance with these risks, industrial innovation can bring vast positive changes to communities, including food security where it did not exist before, jobs and other economic benefits. Still, the impact of the changing environment (for example, increased congestion, air pollution, floods, droughts and fires) remains ever more significant for Indigenous people for whom the inherently homogeneous tenet of Indigeneity highlights the unique relationship between their traditional lands⁸⁷. Across the culturally diverse Indigenous language groups throughout the continent of Australia, this relationship is seldom different. Indigenous conceptualization certainly varies between the localized cultures; however, particular features do regularly emerge, such as totemic structures attached to autochthonous flora and fauna⁸⁸ that are increasingly under threat due to historically unprecedented bushfires, rising sea levels and the most rapid loss of biodiversity in the world⁸⁹. While the effects of a shifting climate on mental health are widely recognized, Indigenous people globally are among those most acutely experiencing these negative impacts^{90,91}. Western constructs, such as solastalgia and ecological grief, explore the relationship between climate change and mental health, but the impact for Indigenous people facing the loss and destruction of land, country and totems is compounded by historical transgenerational trauma⁹². Within this framework exists this concept of country, which is a claimed term representative of the living, sentient and interactive metaecological environment in which Indigenous people reside⁹³. Country is as imperative a facet of Indigenous social and emotional wellbeing as mind, body, family, community, culture and spirituality are conceptualized⁹⁴.

Regardless of nomenclature, the impact of environmental despair for Indigenous people is compounded with historical transgenerational trauma⁹². The harm faced by the anxiety around the helplessness for a situation is conversely at odds with Indigenous practices and ways of being⁹⁵. Indigenous cultures around the world are renowned for their respectful cohabitation with the land, not an exploitative one. Practices can be used to help levy the battle with a changing climate, fostering a demand for the agricultural production of Indigenous foods that are less reliant than their non-Indigenous neurotoxic pesticide, fungicide and fertilizer counterparts^{96,97}.

The status quo has often been 'west knows best'⁹⁸, and has minimized Indigenous cultures as primitive and inconsequential. Evidence overwhelmingly suggests, however, that these ways of life are conducive to extreme sustainability and ripe for partnership towards the sustainability of the planet and human health.

Neuroscience communication

Language is a vital component of understanding world views, such as Two-Eyed Seeing, and knowledge creation and utilization. Yet, many Indigenous languages are endangered. In Canada, for example, 75% are at risk, with some spoken only by a small number of Elders⁹⁹. In Northern Europe, several of the nine living Indigenous languages of the Sámi peoples are vanishing. For the Australian continent, only roughly

145 of the 250+ languages are still spoken, with 110 of these languages labelled as severely endangered.

As language is lost or degraded, there is substantial risk to both cultural and spiritual traditions. In the health context, erosions of language can create challenges in communicating information, especially for individuals with conditions, such as Alzheimer's or stroke, for which language may already be inherently affected. For the Sámi peoples, *joyk*, a folk chant singing style, is today suggested as a health promotion strategy¹⁰⁰. To be able to implement it, however, language competence must accompany a "spirituality and a holistic or systemic world view of health, well-being and life"¹⁰¹.

Poor communication, whether through oral, written or signed language, leads to poor health outcomes, widened health disparities and public distrust especially among historically marginalized populations. Both broad and nuanced cultural understandings are crucial for quality care^{102,103}. Bernardes et al.¹⁰⁴, for example, reported that poor communication skills and a lack of cultural awareness among clinicians in Australia were a causal source for Aboriginal and Torres Strait Islanders to shun local healthcare services. Their findings showed the communication needs among clinicians, including cultural guidance on how best to discuss the impact of psychological trauma on health and the body with patients. Other studies have demonstrated the limitations of clinicians to appreciate culturally specific expressions of medical symptoms, such as pain¹⁰⁵, suggesting that communication challenges are the main reason that Indigenous people refrain from seeking care¹⁰⁶. Such breakdowns in communication were specifically reported between clinical professionals and service providers and the *Atautsikut* community in Nunavik, Canada in the particularly complex context of youth mental health and wellness¹⁰⁷⁻¹⁰⁹, until a decolonizing participatory research plan was introduced several years later¹¹⁰.

Although there is no shortage of studies of failed communication with deficit-based models of communication dominating the narrative, strategies for effective communication in the area of brain and mental health have also been explored¹¹¹. Two-Eyed Seeing is certainly one. Two-way communication between neuroscientists and Indigenous communities has been integrated into educational initiatives and such as the Calgary–Cambridge guide and the Meihana model¹¹². The Calgary–Cambridge guide is widely used in the context of medical interviews. It allows professionals to integrate both process and content, and personal and social history, in working with patients¹¹³. The Meihana model, an adaptation of the Calgary–Cambridge guide, is based on the analogy of *waka hourua*—double hulled canoe travelling from one destination to another—and is intended to reflect the Maori patient's journey through the healthcare system^{114,115}. Both models of communication explicitly bridge the knowledge gap between science and Indigenous understandings^{116,117}.

As Kennedy et al.¹¹¹ have written, conferring responsibility on Indigenous peoples and other historically neglected populations for poor health literacy and health outcomes is unjust. The communication journey is bidirectional if not multidirectional¹¹⁸. Each actor has a role to play: research participants, co-recipients of results, co-designers of research and clinician partners¹¹⁹. Patient and public involvement and engagement and strategies for diverse patient-oriented research¹²⁰ have gained importance in global neuroscience and, together with well-integrated translation services in clinical care, lend themselves well to the mission of improved communication¹²¹⁻¹²⁴.

Connections between scientific perspectives with the rich cultural insights of Indigenous communities are indispensable for advancing neuroscience research, particularly in the realm of human brain and mental health. This synergy can be achieved through effective communication skills and practices that break down language barriers, embrace cultural differences and explicitly recognize the importance of humility in research and healthcare.

Conclusions

Two-Eyed Seeing is not simply about acknowledging the value of Indigenous world views. It is multidimensional and involves long-term relationship-building and trust. The world views of neurologic and psychiatric science and Western healthcare have been intertwined historically with epistemologies and ontologies that have resisted Indigenous life and practices. They have principally operated through the lens of Western beneficence and other classical ethics principles¹²⁵, and ignored a broader understanding of what and who may affect a person's health.

Here we have examined this disconnect in the broad contexts of allyship, humility and universalism, and drawn on literature and discourse around disability, suicide, migration and the environment as examples to more deeply examine it. We emphasize through these examples the urgent need for continued decolonization and work towards justice. We acknowledge that an overall approach to openness and the reality of the lens offered has been used as a framework to encourage Indigenous students to consider education in science, technology, engineering and mathematics¹²⁶, and also been used as a framework for participatory research. All the examples, past and present, highlight the importance of working with and sharing of power with Indigenous nations, communities, Elders and Knowledge Keepers to prevent extractive and exploitative science and cultural appropriation.

There are many applications to which we could have turned our gaze. In ethicolegal context, for example, implementations of the International Labour Organization Convention 169 on the rights of Indigenous and tribal peoples and the International Covenant on Civil and Political Rights Article 27 protecting the cultural, religious and linguistic rights of minorities and Indigenous groups vary significantly among countries. We also note and respect that not all Indigenous communities would follow or even agree with the perspectives and approaches we have explored herein. The implications of similar conventions and complementary perspectives are rich directions for future in-depth examination.

Better intersectoral and multidirectional communication is a unifying theme, as even the best laid intentions will fall short if there is a single dominant dialogue. Recognizing this challenge, Western medicine is progressively adopting holistic and patient-centred perspectives. It considers not only the physical health of individuals but also their mental, social and environmental wellbeing, acknowledging the diversity of patients and their cultural backgrounds^{127,128}. The attention to Indigenous voices and views in science and education is growing, but only action and change will define it.

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This paper explores how Indigenous knowledge is receiving long-overdue recognition for its potential to provide solutions for the mutual thriving of lands and cultures, and addresses the urgent question of how institutions can appropriately support a sustainable future for Indigenous science.

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Author contributions Positionality statement: There are different conventions for the capitalization of Aboriginal and Indigenous peoples. We chose to use the upper case, as is the convention in Canada, the home country of the lead authors. We acknowledge the many differences in approach and knowledge, and offer appreciation in understanding. Self-determination is the foundation of human rights. Self-identification as an Indigenous person ought to be done by individuals and their communities, considering historical, cultural and political contexts. Here we provide self-identification and our positionality for the bicultural and multicultural groups of authors only, and urge others to do the same in their own writings: J.I. is Canadian of European background. M.L.P. is a citizen of the Métis Nation in Ontario, Canada. K.B. is of Middle Eastern origin. J.G.B. and H.C. are of European background. R.L.T.-B. is an lowendjeri Boonwurrung Kulin from the southeast of Melbourne/Birrarrangga-Naarm, Australia.

Perspective

T.R.G. is of European descent and is a seventh-generation Canadian. B.N.K. is a migrant from Asia living in Europe. O.P.M. is umXhosa and a member of the amaXhosa cultural group, which is part of the Nguni people in South Africa. A.L.S. is Norwegian and her parents are from Nesset in Romsdalen and Vinje in Telemark. She has lived 18 years in Sweden/Sápmi. M.R.V. has Purépecha roots from Michoacán, Mexico. We acknowledge the Mi'kmaw principle of conceptualization, which laid the foundation for this work. Although we accept that the term in its traditional form holds a unique and specific principle of understanding, for the purposes of this Perspective, we clarify its application in a rudimentary and broad understanding of interpreting Indigenous and non-Indigenous world views concurrently, so as to accommodate a pragmatic and diverse pan-aboriginal cross-continental application. The term Western was the subject of much debate among the authors of this Perspective because it is inherently insufficient to encapsulate the nuances, distinctions or subtleties in any purposeful detail required when making generalizations about global societies. As a result, we disclaim any meaning of the term beyond the operant term Indigenous, which is in itself used as an operant term. We honour the breadth of diversity across specific Indigenous populations. All authors are members of the Cross-Cultural Working Group of the International Brain Initiative.

Competing interests The authors declare no competing interests.

Additional information

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