



Establishing a Brain Research Initiative for Canada

Written Submission to the Standing Committee for
Science and Research

By: Canadian Brain Research Strategy
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<https://canadianbrain.ca/>

Recommendation:

The CBRS and its broad network of stakeholders recommends that Canada establish a national brain research initiative.

Executive Summary

- Understanding the brain - in health and disease, across the entire lifespan, and in interaction with emerging technologies - will be critical to Canada's success and well-being in the 21st century.
- Canada's neuroscience and mental health researchers are among the most productive and influential in the world, despite operating with more limited funding than many of their global colleagues.
- The Canadian Brain Research Strategy (CBRS) has united Canada's brain researchers, in coalition with Indigenous Peoples, private and public science funders, industry leaders, and people with lived experience of brain disease or injury, to develop a clear and compelling vision for how to revolutionize the study of the brain and translate our research into applications that will benefit all Canadians^{1,2,3,4}.
- This coalition has collectively envisioned six near-term initiatives that position Canada as a world leader in brain research that is open, collaborative, transdisciplinary, ethical, inclusive, and critically, successful at the large scale needed to make real progress on one of the most complex systems ever known.
- Canada's emerging brain research strategy has also been informed by its leadership in the International Brain Initiative (IBI). Unlike some of its IBI counterparts (the US, EU, and Japan), Canada has never had a national brain research initiative.
- The coalition convened by the CBRS believes that the time for a Canadian Brain Research Initiative is now. We have the network, partnerships, vision, and strategic plan in place. Now we need the funding to catalyze this network into concerted, bold, and concrete action.

Establishing a Brain Research Initiative for Canada

1. Why is this approach critical for brain research?

In 2016, science academies from 14 nations, including Canada, declared that the human brain is civilization's most precious resource. Investment in brain science is, therefore, an investment in the future of society, and nations must cooperate to understand, protect, and foster optimal development of the brain⁵. The brain underlies who we are, what we do, and how we interact with each other. To unpack such a complex system that gives rise to such a range of human health and life necessitates large-scale collective efforts that span countries and political boundaries.

National and pan-national brain research initiatives are establishing around the world. In a way this is similar to the 'big data' revolution that swept the genomics field decades ago, when international teams of biologists, engineers, and computer scientists came together to crack the code of life and committed the data to open

¹ Illes et al (2019) A Neuroethics Backbone for the Evolving Canadian Brain Research Strategy *Neuron* doi:[10.1016/j.neuron.2018.12.021](https://doi.org/10.1016/j.neuron.2018.12.021)

² Menard et al (2021) The Canadian Brain Research Strategy: A Focus on Early Career Researchers *Can J Neurol Sci* doi:[10.1017/cjn.2021.81](https://doi.org/10.1017/cjn.2021.81)

³ Perreault et al (2021) An Indigenous Lens on Priorities for the Canadian Brain Research Strategy doi:[10.1017/cjn.2021.501](https://doi.org/10.1017/cjn.2021.501)

⁴ Neurological Health Charities Canada (2021) A National Neurological Strategy for Canada <https://mybrainmatters.ca/wp-content/uploads/NationalNeurologicalStrategyEN-Aug2021.pdf>

⁵ G Science Academies (2016) Understanding, Protecting, and Developing Global Brain Resources <https://canadianbrain.ca/announcement/2016-g-science-academies-statement-on-brain-research/>

science principles. The Human Genome Project transformed the life sciences and medicine in the 1990s. Applying a similar approach to the brain, the Human Brain Project has been established in Europe, the BRAIN initiative in the U.S., and the Japan Brain/MINDS project – while South Korea, China, Australia are each developing their own.

Within Canada, one model is the Pan-Canadian Artificial Intelligence (AI) Strategy, whose success in fueling research innovation in AI goes hand-in-hand reciprocally with neuroscience. This \$125 million investment by the Government of Canada in 2017 brought together Canada’s three national AI institutes – Amii in Edmonton, Mila in Montreal, and the Vector Institute in Toronto, as well as universities, hospitals, and organizations across the country. Another recent approach, announced in the last budget, is the National Quantum Strategy to grow the quantum ecosystem and establish Canada as a global leader. A Canadian Brain Research Initiative fits well into the brain research ecosystem that already exists within Canada. We have been at the forefront of brain research for decades and this investment in infrastructure to enhance collaboration will maximize the impact of past and future investments in both research excellence and downstream innovation, and protect Canada’s competitive advantage to ensure that we will continue to be a leading contributor to this global effort.

2. Why is this approach so important now to transform the neurological and mental health of Canadians?

Brain research is burgeoning rapidly as technological advances have enabled an unprecedented variety and quantity of information about the brain. This is exciting due to the complexity of the brain and because a more comprehensive approach based on large-scale heterogeneous dataset is certainly needed to understand the diversity of humans and to address highly complex issues in neurological and mental health. As rapid technological advances mean that data on the brain is accumulating at a rate like never before, now is the time to leverage this critical mass of information. Other countries and pan-national groups have taken this approach – we have much to contribute to humanity’s understanding of the brain, and we need to join in.

With the complex nature of the brain, neuroscience and mental health research is drawing in experts from biology, chemistry, ecology, computer science, philosophy, mathematics, and more to become an area of biomedical science that pushes technological needs, and thus innovation, to their extreme. Beyond improving health outcomes and associated economic burdens, a coordinated effort to understand the brain that is committed to collaborative, transdisciplinary, open, and ethical approaches will fuel innovations that can be applied to understanding other complex systems, expand the boundaries of technology, and drive the development of new tools to benefit science and society, such as next-generation machines and generalized artificial intelligence. In order to reap the societal and economic benefits from technology and intellectual property that arises from the cutting-edge brain research carried out across the country, Canada needs to establish a Canadian Brain Research Initiative as a stand-alone neurological health policy that reflects the diverse realities of our country.

The annual healthcare costs of neurological health disorders in Canada are upwards of \$61 billion and growing⁶. Furthermore, there are persistent challenges in neurological disorders and the mental health crisis that has only been exacerbated by COVID-19. It is more critical than ever to build infrastructures that enhance research collaboration and efficiency and to connect research to pressing societal needs. Economic recovery and restart will depend on scientific research in Canada.

⁶ 2016 Report of INMHA Evaluation Panel from the CIHR Institute of Neurosciences, Mental Health and Addiction <https://cihr-irsc.gc.ca/e/50448.html>

3. How is this an opportunity for Canada to lead?

Canada has a rich history in pioneering brain research and world leaders in many fields in neuroscience and mental health research across basic biomedical, clinical, health systems services and population health research approaches. Canadian neuroscience and mental health research ranks in the top five in the world. This is even more remarkable given that among the 20 most active countries in brain research, Canada only ranks 11th in research spending and 9th in terms of the number of researchers in the workforce⁷. What allows us to punch above our weight is in the unique way we approach brain research – enabling principles in **how** we carry out brain research in Canada with a collaborative, transdisciplinary, open, and ethical approach.

Canadians also specialize in neuroscience more than any other research area and more than other countries⁷. Given the transformational potential of new tools and practices in neuroscience, it is especially critical that Canada invest in collaborative, transdisciplinary, open, and ethical brain research that will amplify the strengths and efforts of the next generation of young scientists as they lead the way in building upon the distinctive way in which we carry out brain research in Canada.

Canada can be a role model for how brain research is done. Canadian brain research is exceptional in working across traditional boundaries, whether geographical, disciplinary barriers, or differences in perspective. **In an approach unique among the member countries of the International Brain Initiative**, CBRS has brought together a pan-Canada coalition of researchers, large initiatives and projects, public and private funders, health charities, industry, as well as Indigenous Knowledges Holders and patient representatives to collectively envision a nation-wide brain research strategy. The coalition has identified six near-term initiatives to scale up successful models of open, collaborative, transdisciplinary and ethical research.

Current progress on national brain research strategy development

A foundational investment has supported a ground-up effort in CBRS⁸. In 1.5 short years, CBRS has built a pan-Canadian coalition of research leaders including early career scientists, Indigenous Knowledges Holders, patient representatives, and organizations supporting brain research to identify near-term priorities for advancing collaborative, transdisciplinary, open, and ethical brain research.

CBRS Leadership⁹ includes the Conference of Neuroscience Leaders, which is comprised of the **heads of more than 30 neuroscience and mental health institutes and programs across the country as well as large pan-Canadian initiatives**. It covers expertise across basic biomedical, clinical, health services, and social science research approaches and includes leaders of the Canadian Association for Neuroscience, initiatives funded by the Canada First Research Excellence Fund, CIFAR, provincial networks, and Canada Research Chairs.

From its outset, CBRS has recognized nation-wide, multi-sectoral consultation as a vital element to the development of a robust strategy for Canadian brain research. In addition to our scientists, **CBRS leadership encompasses the voices of early career researchers, Indigenous Peoples, and people with lived experience**^{2,3,4}. This process has been critical in producing an emerging research strategy that is inclusive,

⁷ Larivière et al (2016) Bibliometric Analysis of INMHA-related Research, 2000-2015. Prepared for the CIHR Institute of Neurosciences, Mental Health and Addiction.

⁸ CIHR Institute of Neurosciences, Mental Health and Addiction Network Catalyst Grant https://webapps.cihr-irsc.gc.ca/decisions/p/project_details.html?applId=417339

⁹ Canadian Brain Research Strategy Leadership <https://canadianbrain.ca/about/>

broadly supported, and continues to meet the challenges of today and tomorrow in brain research to benefit the neurological and mental health of all Canadians.

CBRS is bringing together stakeholders across the brain research ecosystem in a collaborative and mobilizing unified effort to amplify Canada's strengths and current investments. In our initial gathering of the brain research funding ecosystem last fall, we convened **21 leaders of organizations funding neuroscience and mental health research across the country, including federal and provincial research granting agencies, non-profit organizations, health charities, and private foundations**. Despite a diverse range of focus in disease and health, these organizations showed incredible alignment of their current and future funding priorities with the six initiatives we have identified to transform brain research in Canada. Further investment in collaborative, transdisciplinary, open, and ethical research approaches to understanding the brain will benefit not only neuroscience and mental health research but will transform how science is carried out and maximize the impact of investments in other fields as well.

Already, promising engagement across sectors has revealed extraordinary goodwill to learn from each other: funders—patients, researchers—Indigenous Knowledges Holders, patients—researchers, and so on. As we continue to bring in stakeholders across the brain research ecosystem – for example, to deepen our relationship with industry and entrepreneurs who are pushing the bounds of translating new knowledge in brain science – we will build on and develop other key initiatives to add our list.

The collective national vision for brain research and societal impact we are building represents a deep, informed perspective on the Canadian brain research landscape. At this critical inflection point in making progress to understand the human brain, we need to position Canada to seize the opportunity in advancing standards and continuing to lead international efforts around coordination. In developing a new cross-sectoral approach to support transformative research and development, a Canadian Brain Research Initiative will unleash bold new research ideas, drive technological breakthroughs, protect Canada's competitive advantage and help Canadian companies grow and create highly skilled jobs.

Six initiatives to transform brain research in Canada

Over multiple meetings in consultation with neuroscience and mental health leaders and key stakeholders across the country, six areas of strength and distinction in how Canada approaches brain research have been identified. These transformative initiatives¹⁰ are representative of Canada's unique take on collaborative, transdisciplinary, open, and ethical brain research that allows us to be a leader and role model on the international stage. Building on these strategic initiatives have the potential to transform neuroscience and mental health research by bridging scales of complexity across the brain, behaviour, and society.

Platform Science

- Scientific platforms act as shared resources and are unique environments for innovative collaboration – providing open access to specialized equipment, data, service and expertise – by fostering the development and democratization of cutting-edge technologies across disciplines.
- Breaking down geographical and institutional barriers to creating and sharing new brain research tools, technologies, and methods through platforms also promotes equity and collaboration to multiply the innovation and productivity of research.

¹⁰ Canadian Brain Research Strategy Transformative Initiatives <https://canadianbrain.ca/transformative-initiatives/>

Neuroscience-Artificial Intelligence Interface

- Artificial intelligence is a transformative tool in tackling some of our most complex and challenging issues, from public health to manufacturing, sustainable development of natural resources, and climate change
- The beneficial relationship between neuroscience and AI is reciprocal: AI is contributing to the rapid generation of new knowledge that informs our understanding of how the brain works. This new knowledge, in turn, can be applied to improve our models of AI and to generate more sophisticated tools to advance our understanding of the brain.

Diversity & Team Science

- Neuroscience as the scientific study of the brain is not one field of research but has a rich history in the team approach, as an alliance of different disciplines that came about as a convergence of diverse perspectives.
- CBRS has assembled a cross-sectoral coalition of scientists, Indigenous voices, patient perspectives, funders, and other organizations that are committed to working together to address systemic inequities in research – on teams, in the research environment, and experimental design – and improve disparities in the health outcomes of Canadians.

Transdisciplinary Training

- Building on the strength of Canadian brain research that is rooted in a collaborative and inclusive transdisciplinary approach reinforces Canada's world-leading capabilities in life sciences and biomedical research, and is needed to cultivate and retain Canada's brightest young researchers, to bring them back to Canada following foreign training, and to help attract international talent².
- Transdisciplinary research approaches build a brighter future for Canadians through collaboration, engagement, and the use of science and evidence-based decision-making by going beyond academia to involve stakeholders from business and industry, policy, civil society, and other non-academic groups.

Neuroethics

- We are making discoveries about the brain at an incredible pace. In order to encourage the most beneficial uses of neuroscience and mental health research, it is essential to examine its actual capabilities, potential risks, benefits, and broader social impact.
- Canada is already considered a global leader in neuroethics. Continuing and expanding these efforts in neuroethics is key to ensuring Canadian values are well reflected in this rapidly advancing landscape¹.

Open Neuroscience

- Member countries of the IBI recognize that data sharing is critical in facilitating discovery, innovation, and the future of understanding the brain as one of the most complex systems ever known
- Canadians are international leaders in open science for brain research - committed beyond just sharing data but to making all scientific inputs, outputs and processes accessible as early as practical in the discovery process. Building on the success of Canadian open neuroscience efforts will expand the boundaries of technology and drive the development of new tools towards achieving the Government of Canada's vision for open science to benefit science and society.

Recommendations towards a brain science-driven nation

CBRS has brought together stakeholders across the brain research ecosystem in a collaborative and mobilizing unified effort to amplify Canada's strengths and current investments in cutting-edge collaborative brain research, to drive policy as well as social, health, and economic advancement for Canada and the world.

- The complexity of the human brain necessitates far-reaching collective efforts that span countries and political boundaries. Large-scale international efforts are the new collaborative model that is needed to advance our understanding of the human brain. Canada is a world leader in many fields in brain research and needs to be able to keep up with, connect to, and draw on the efforts of other national and pan-national brain initiatives.
- In order to reap the societal and economic benefits from technology and intellectual property that arises from the cutting-edge brain research carried out across the country, Canada needs to establish a Canadian Brain Research Initiative as part of a stand-alone neurological health policy that reflects the diverse realities of our country.
- Transformative initiatives in Platform Science, Neuroscience-AI Interface, Diversity & Team Science, Transdisciplinary Training, Neuroethics, and Open Neuroscience build on Canada's strengths in our unique collaborative, transdisciplinary, open, and ethical approach to brain research and allow us to bridge the scales of complexity across the brain, behaviour, and society.
- As evidenced in established and developing brain initiatives around the world, investment in brain research stimulates growth in many other fields beyond the health sector as a major driver for innovation, economic, and technology development.

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