THE EUROPEAN BRAIN COUNCIL PRESENTS

BRAIN MISSION

UNDERSTAND - FIX - ENHANCE

THE SPACE RACE OF THE 21ST CENTURY

A MAJOR SOCIETAL CHALLENGE

The brain is the most complex human organ. It provides and controls virtually every function of the body, ranging from rational thinking, emotions, heart beat, breathing, food and fluid intake, sleep or sex. In a vision of high quality of life and wellbeing, keeping our brain functioning and healthy is a clear prerequisite. Disorders of the brain are extremely complicated to analyse, diagnose and treat in comparison to other diseases. These brain disorders - to name just the most common ones: depression, Alzheimer's/dementia, schizophrenia, stroke, migraine, sleep disorders, Parkinson's disease, pain syndromes (back pain, in particular), addiction to alcohol and other substances- give rise to a far higher level of disability, including admissions to hospitals and nursing homes, than is widely recognised. Health economists have calculated that brain disorders amount to ca. 45% of the annual health budget of Europe, totaling around €800 billion every year (Gustavsson et al., 2011; DiLuca & Olesen, 2014).

With an aging population in Europe, the prevalence of the most common neurological and psychiatric disorders will dramatically increase and we are still striving to find cures or truly effective means of delaying or reducing the burden they place on individuals and society, including that on care-givers and the resultant loss of productivity, employment and massive economic burden (Morris et al, EJN, 2015).

The continued commitment of funding agencies to basic neuroscience research has advanced our understanding of the nervous system, with Europe leading efforts in basic research aimed at understanding the brain, as well as in the practical and clinical application of this knowledge. Moreover, recent methodological breakthroughs provided a powerful dual opportunity to relieve the societal burden of brain disorders and innovate at the frontiers of technology. Nonetheless, the inherent complexity of the nervous system hampered our translational capacity, suggesting that a higher level of integration is required.

Understanding the brain provides valuable knowledge (critical in a knowledge economy) that has the potential to not only treat diseases, but also to innovate in the areas of artificial intelligence, brain-machine interfaces (BMIs), robotics, and technology.

EUROPEAN BRAIN COUNCIL

THE TARGET

An estimated 179 million European citizens live with a brain condition. This number coupled with the estimated yearly cost of these diseases (€798 billion) make clear the immensity of the problem. Addressing these major costs for European society requires an intensified research effort and the creation of novel solutions.

The target of our proposed Brain Mission will be to decrease this enormous burden through better understanding of the physiology of the brain and disease states, relevant prevention strategies, as well as more generally, an increased awareness of the brain and its diseases.

Continued commitment to basic neuroscience research has advanced our understanding of the nervous system, with Europe successfully leading this effort designed to increase our understanding of the brain, as well as the practical and clinical application of this knowledge.

Engagement of the scientific and clinical community at all levels is required in order for the European population to benefit from discoveries and for advances in basic neuroscience to be translated into new diagnostic tools and treatments for brain disorders.

SMART MILESTONES

Making it specific – measurable – achievable – realistic - timely

- Educating & raising awareness on the specific and complex nature of the brain to foster public & patient engagement
- Coordinating & expanding current patient empowerment programmes
- Creating & promoting EU Strategies for prevention and early detection of brain disorders
- Assessing & monitoring improvements in health outcomes (i.e. mortality, morbidity, quality of life, functionality, societal burden) for people living with brain disorders, against an agreed benchmark
- Fully embedding new knowledge and information technologies (i.e. artificial intelligence) into an integrated approach to brain health and brain research

MAJOR MISSION-RELATED PROJECTS

A variety of major projects have been identified for which there is collective agreement on their urgency and tractability.

Understand

Understanding the brain —from genes to circuits to behavior and back— through a multilevel approach: towards understanding of disease states

Discoveries and advances in basic neuroscience are the prerequisites for describing the normal functioning of the nervous system and revealing the etiology and pathophysiology of brain diseases. We need a clear understanding of how molecular processes act at the level of specific neurons to affect information processing at the level of circuits, and finally how these circuit level processes are integrated within neural systems to control the behaviour and cognition of the subject in both normal and pathological situations (which are often caused by alterations at the genetic/molecular level). To appreciate the complexity of the system, we need bridges between different research fields in order to understand how the brain integrates its activity with that of other systems, including the immune system, metabolism, vascularization and, indeed, the microbiome and how —in a given brain disorder— this integrative brain function is harmed or even lost. Only by understanding how these levels interact will we be able to develop a clear understanding of how neuronal processes control behaviour physiology, thereby defining the strategies to tackle important societal challenges of brain disorders in both development and in adulthood.

Exposing the roots of mental disorders

Mental disorders include those of high prevalence, such as depression, anxiety, and addictions, but also serious and disabling illnesses, such as schizophrenia, autism, bipolar and other psychiatric disorders. Mental health issues in children and adolescents have increased in recent years, manifesting at increasingly younger ages. Other neurological diseases, such as epilepsy and dementia, like mental disorders, present major challenges in terms of provision of services. The economic cost of this mental health problem in Europe is estimated to be €600 billion per year. In addition, patients suffer a significant loss of quality of life during the course of the disease, which also impacts strongly on their families and their social network.

Historically, mental disorders have not been viewed as a health priority at EU level, especially when compared with communicable and non-communicable diseases such as cancer or cardiovascular disease. In Europe, funding for mental health research is much lower than is justified by the population impact of these disorders, with spending being less than half the disability burden. Furthermore, a major part of funding is for clinical research that, if at all, is developing effective therapies very slowly due to the fact that research is frequently guided

by imprecise clusters of symptoms since the aetiology of these diseases is totally elusive. From this perspective, it is easy to understand why private investors have been withdrawing from most of the neuroscience research programs, and that we need a strategy to improve and optimize the development of evidence-based therapies for mental disorders.

We need intense scientific effort to understand normal and abnormal behaviours emanating from impaired brain function, spanning molecular, cellular and network mechanisms to social and environmental determinants. We will be able to solve the problem of mental disorders that impose such an emotional, financial and social burden globally also through a deep understanding of brain mechanisms, especially the function of the non-diseased brain. Only this will give us insight into brain dysfunction, hence the development and manifestation of disease states and symptomatology.

The availability of a critical mass of data and their accurate analysis will also help in the identification of biomarkers for early detection of diseases. (see below)

Improved understanding of neurological diseases

Neurological disorders contribute one of the largest burden and challenge in our society; they include serious disabling disorders such as dementia, Parkinson's and multiple sclerosis. Neurological disorders are the cause of 10,2% of global DALYs (Disease Adjusted Life Years) and, in absolute figures, amount to 250,7 million DALYs. In terms of comparison, this number exceeds that from cardiovascular diseases (228,9 million DALYs, excluding stroke) and cancer (209,4 million DALYs).

Furthermore, neurological conditions resulted in 16,8% of global deaths —which is equivalent to 9,4 million people— and bear an estimated economic cost of €336 billion per year.

Europe has been at the leading edge in research into many neurological disorders, especially due to excellent existing and developing cross-country collaboration between European countries, combining research data and experience. Examples are recently initiated or existing networks in Alzheimer's disease, stroke, Parkinson's disease, restless legs syndrome, insomnia, multiple sclerosis, epilepsy or neuropathic pain, to name only the more well known disorders. All these collaborative efforts are now ready to be maximally exploited to the benefit of patients, provided sufficient funding is available. The emergence of novel technologies means we are set for the first time, to capitalise on the development and introduction of new treatments and hence reduce the disability caused by brain conditions. Therefore, we have a realistic opportunity to increase the quality of life of patients as well as lower the cost to society. Intensive and highly integrated scientific effort in this domain will also make innovation available for prevention, early diagnosis and patients' management.

Research that provides a better understanding of disease foundations will help design healthcare services, devices and therapeutic approaches that can prevent, slow or reverse these.

Fix

Improving treatment

Increasing insight into the pathophysiology of brain diseases —be they metabolic, inflammatory, traumatic, immunological or neurodegenerative— has led to the development of many promising therapeutic agents that could have a tremendous impact on disease processes. The brain, however, is well protected against the entry of many reagents by the blood-brain barrier, which does not allow the passage of large molecules, including antibodies. This is particularly important as monoclonal antibodies that can be tailored to target many relevant dysfunctional molecules have been highly effective in a large variety of systemic disease classes.

The biggest challenge in the design of new neurotherapeutics is to enable them to attain an even distribution within the brain inside the blood brain barrier.

Closer collaboration between basic research, applied research and entrepreneurial innovation will be essential.

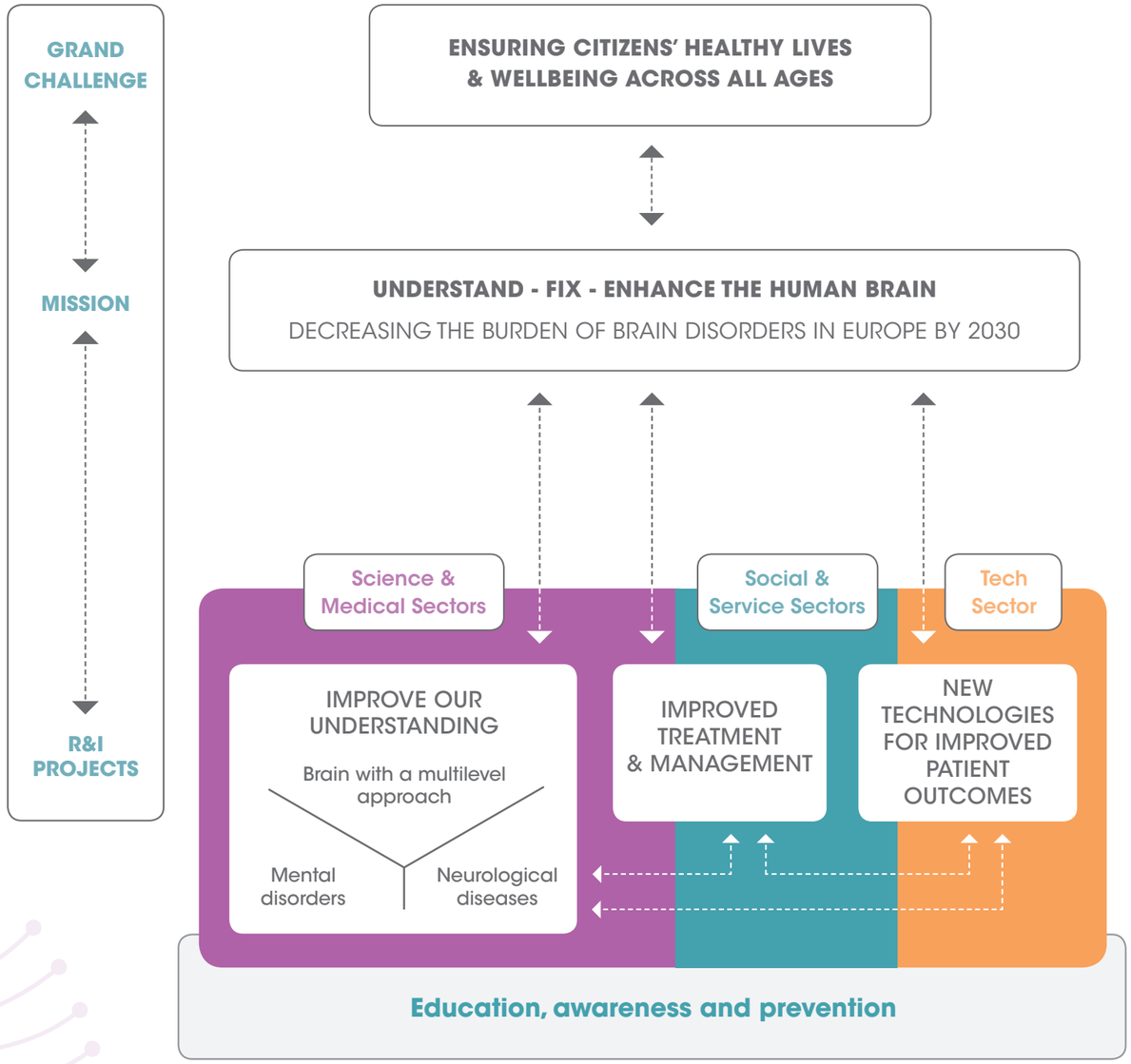
Enhance

New technologies for improved patient outcomes

It is a truism in science that new technologies open new doors to discovery. New ways to study and monitor the activity of the human brain include high-resolution recording/imaging techniques and safe optogenetic techniques that combine optical activation with viral genetic tools. These advanced technologies also include big data analysis, artificial intelligence (AI) and machine learning. As with many other areas in science, we need new methods for big data analysis and the integration of multisource, complex data, artificial intelligence (AI) or machine learning to formulate new theories.

The large number of technological advances in basic neuroscience have led to an exponential growth of data production relating to various aspects of the brain, under numerous different conditions and across several species. Computational neuroscience approaches, including modeling and large-scale data analysis/integration methods, will be essential to turn data into a better understanding of the brain and help develop new tools to deal with brain disorders. The biggest challenge in computational neuroscience is to develop biologically-based mathematical and statistical methods to meet this critical need. Key problems include understanding the mechanisms that bridge multiple spatial and temporal scales, linking the activity of individual components (e.g., molecular biology, genetics, and neuron networks) and their interactions to the overall complex dynamic behaviour of the brain and nervous system.

New frontiers have also opened with the use of AI and machine learning. These are expected to bring benefits and support to researchers, professionals or patients in detection or management of brain disorders. Pattern recognition in brain imaging, precision identification, advances in imaging techniques, early diagnosis or detection of early signs of diseases or change in cognitive function, risk prevention, treatment option assessment and support, self-management, rehabilitation therapies or the introduction of virtual human agent are all fields that have demonstrated first positive results in the appropriate use of big data clustering and analysis or the generation of learning algorithms. This is why it is too crucial not only to investigate these technologies further but also to embed these fully into our integrated approach to brain health and research.



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ECNP european college of neuropsychopharmacology
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and with the contribution of:

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