

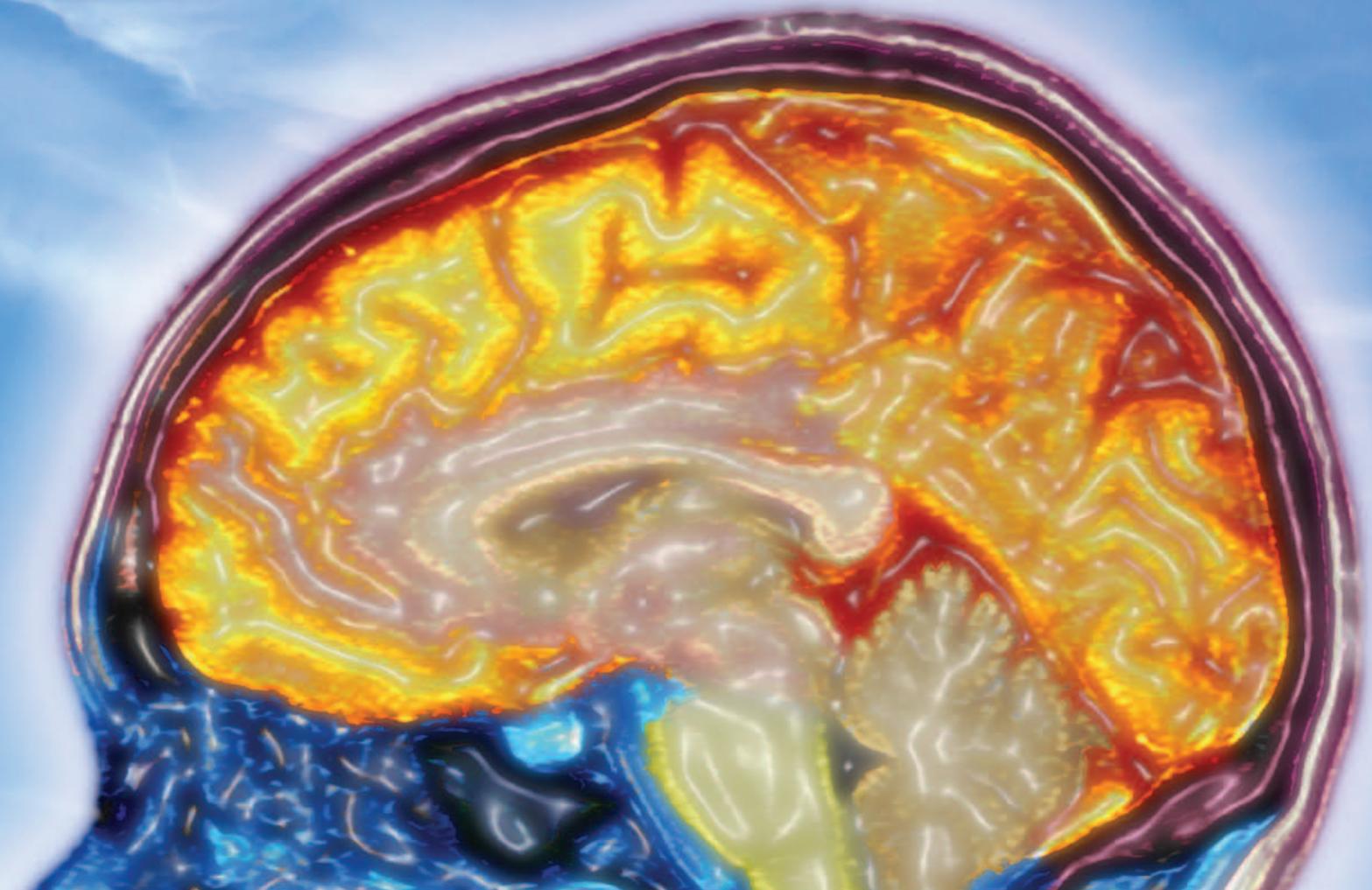
BNA



British
Neuroscience
Association

Neuroscience Summit

Held at The Royal Society, London
Thursday 11 April 2013





Neuroscience Summit

held at The Royal Society, London
on Thursday 11 April 2013



Supported by



and

Nuffield Department of Clinical Neurosciences



Executive Summary

In 2011, the European Parliament launched a research paper commissioned by the European Brain Council (EBC) entitled 'Cost of disorders of the brain in Europe 2010'¹. It found that nearly 800 billion Euros were spent on managing brain disorders in one year. This figure is more than that spent on cancer plus diabetes plus cardiovascular diseases. The world's population is getting older. Between 2000 and 2050, there are expected to be an extra billion people aged 65 or older. This population change will inevitably lead to a large increase in disorders such as stroke, Alzheimer's disease and Parkinson's disease, which affect older adults disproportionately since the incidence of these diseases increases exponentially after age 65.

This, coupled with the inexorable increase in the incidence of obesity has led the World Health Organisation (WHO) to conclude that brain disorders will become the major medical need of the 21st century². Therefore, there has never been a more pressing time to take stock of where British neuroscience is heading and strategically address the societal and health challenges of brain disorders that lie ahead.

At the same time, there are significant advances in neuroscience as the subject uncovers more and more aspects of brain activity and function, using an increasingly diverse array of approaches. For example, MRI and PET scans reveal images of brain circuits and neurotransmitters. Stem cell therapy is showing great promise and deep brain stimulation is an effective form of treatment for thousands of people with Parkinson's disease and other neurological disorders.

The British Neuroscience Association (BNA) organised a Neuroscience Summit which brought together neuroscientists, leaders from research councils, industry and patient organisations. The Summit was a joint venture between the BNA, the European College of Neuropsychopharmacology (ECNP), and the EBC. It was supported with a grant from the Federation of European Neuroscience Societies (FENS).

The Summit addressed the following questions:

- What has been achieved nationally and internationally?
- What are the key issues to be addressed now?
- What tools are needed?
- How to develop the appropriate infrastructure?
- What to do with large data sets?
- How to promote, encourage and support translational research?
- What role(s) should the funders play?
- How should the UK coordinate resources?

Presentations from experts and active discussion from delegates addressed topics including: the role of patients and other stakeholders in actively driving the change agenda for research and treatment of brain diseases; innovative and interdisciplinary approaches to research activity that will help the UK retain its position as a world leader in neuroscience; the need to break down boundaries between disciplines, companies and academia, as well as across international borders to maximise the impact and translation of research; and to consider how to reform policy and regulations to ultimately provide

1 *(Gustavsson, A., et al., *Eur Neuropsychopharmacol.* 2011 Oct;21(10):718-79. doi: 10.1016/j.euroneuro.2011.08.008. Epub 2011 Sep 15.)

2 Christopher JL, Murray, A.D.L. (1996) *The Global Burden of Disease (Global Burden of Disease & Injury)*. Harvard University Press.

patients with the therapies they so badly need. A key aim of the summit and this report is to make recommendations on future strategy and the next steps of British neuroscience. These recommendations are summarised in the conclusion of this document.

In his concluding remarks, Professor Russell Foster, President of the BNA, focused specifically on the BNA's role in tackling the societal challenges of brain diseases. He pointed out that neuroscience is “in the business of developing a broader and more proactive strategy to expand and sustain world-class neuroscience research, public engagement, industry and health in the UK.”

The speakers were:



Mary Baker
President, European Brain Council



Hugh Perry
Chair, Neurosciences and Mental Health Board, MRC



Melanie Welham
Director of Science, BBSRC



Gary Gilmour
Principal Research Scientist,
Lilly UK



John Williams
Head of Neuroscience and Mental Health, Wellcome Trust



Richard Morris
Professor of Neuroscience,
University of Edinburgh



Colin Blakemore
Professor of Neuroscience and Philosophy, University of London



Sharmila Nebhrajani
Chief Executive Officer,
Association of Medical Research



Jackie Hunter
Chief Executive,
OI Pharma Partners



David Nutt
Current Past President of the BNA and the European College of Neuropsychopharmacology



Russell Foster
President of the BNA



Trevor Robbins
Professor of Cognitive Science,
University of Cambridge



Chairman **Quentin Cooper**
BBC science presenter

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Introduction

“**The Neuroscience Summit** was headed by the BNA with the European College of Neuropsychopharmacology (ECNP), and the European Brain Council (EBC). The Summit sought to bring together some of the UK’s most renowned neuroscientists, leaders from research councils, industry and patient organisations to discuss how to meet the research and societal challenges of brain disorders in the UK and Europe.

The importance of the issue and the need for the UK to interact closely with the rest of Europe and beyond with regard to the challenges presented by brain disorders emerged as a recurrent theme. It is, therefore, notable that the Summit received messages of support from the Prime Minister and the Minister of State for Universities and Science.

The presentations from our eminent speakers were divided into two sections. First, the current status, future challenges and funding were considered. Next, working with other organisations to maximise developments was explored. Reflecting these issues the audience comprised neuroscientists from industry and universities, and representatives of medical research charities, the Research Councils, funding agencies, learned societies and science journals. A key element was to enable these various experts to contribute to the discussions that followed the presentations.

This report summarises all the various talks the delegates heard and discussed. It contains action points, potential solutions, and recommendations. Many of the messages were positive as the UK is seen to have a leading role in neuroscience research with great potential for translation of this research into valuable applications. At the same time, numerous obstacles and shortcomings were highlighted, often with constructive suggestions of how to go forward.

I would like to take this opportunity to thank all the speakers and the chairman, Quentin Cooper, for delivering a very complicated subject with great coherence and wisdom. The discussions were stimulating.

Despite the problems we face with the rise in brain disorders, I believe we have a promising start with the rapid pace of progress in research into the brain and nervous system. But we can only solve the problems if we work together.”



Russell Foster FRS FMedSci
Professor of Circadian Neuroscience at Oxford University
President of the British Neuroscience Association



Statement from David Cameron, Prime Minister

Neuroscience is pushing the envelope on one of science's last great frontiers and the progress made during the last few decades has raised the prospect of genuine breakthroughs and insights into a range of neurological and psychiatric disorders. I believe that major breakthroughs in our understanding of the brain and central nervous system are now very close and I hope that the Summit will help to generate innovative research that will enable us to treat many prevalent and disabling illnesses, such as epilepsy.

May I wish you all the best for a successful event.

Statement from David Willetts, Minister of State for Universities and Science

I congratulate the British Neuroscience Association for organising and hosting this important Summit event and for the invitation to attend. I regret that I am unable to attend in person but thank you for the opportunity to provide this statement. Looking at the list of speakers I am sure you will have an interesting and engaging discussion.

Neuroscience is a particularly exciting field in the life sciences with the brain and nervous system representing an incredibly complex and intricate system. But the effects of ill health in this system can be profound. To take just one example, dementia can be a truly debilitating disease, robbing the individual of their memory, mobility and identity. The disease therefore has major implications for families and for society as a whole. Luckily, progress is being made thanks to the work of scientists and researchers like those present at the Summit today.

The Government has made a significant commitment to the life sciences in general and to dementia in particular. The recent Life Sciences Strategy – One Year On report has highlighted the work of the life sciences sector and the support the Government is providing to drive collaboration and innovation. The Prime Minister's Challenge on Dementia shows the desire at the heart of Government to see dementia effectively tackled, pushing for new drugs and effective care.

Of course in mentioning dementia I've only touched on a small area of neuroscience. The field is large as are the challenges. However, I look forward to hearing more of the rapid developments not only in dementia but in the other areas of neuroscience. I wish you well for your Summit today and look forward to seeing your report.

I. Putting patients first: tackling societal and health challenges in Europe

“Patients and other stakeholders can actively drive the change agenda for research and treatment of brain diseases,” said **Dr. Mary Baker, MBE, President of the European Brain Council (EBC)**. She reviewed how patients, researchers, and pharmaceutical companies could help society to help itself in adapting to the demands of an ageing population and the associated burden of chronic diseases.



“It’s not the strongest of the species that survives, nor the most intelligent that survives; it’s the one that’s most adaptable to change! And we’re not adapting,” Dr. Baker said, quoting Charles Darwin.

As the EBC prepares for Europe’s Year of the Brain in 2014, the organisation will focus on how society needs to adopt responsibility for its own health. In 2011, the European Parliament launched a research paper commissioned by the EBC entitled ‘Cost of disorders of the brain in Europe 2010’³. It found that nearly 800 billion Euros were spent on managing brain disorders in one year. “This figure is more than that spent on cancer plus diabetes plus cardiovascular. It is an enormous amount.”

Dr. Baker pointed out that living longer meant a greater likelihood of chronic illness with more brain diseases and the challenge of co-morbidity, and added: “Of all the people who’ve ever been on this planet and who’ve made it to 65, two-thirds of them are on it now. What a challenge.”



Ms. Sharmila Nebhrajani, Chief Executive Officer of the Association of Medical Research Charities (AMRC) also focused on the role of the patient. The AMRC is comprised of 125 leading national medical and health research charities including many charities for brain diseases.

Excluding the Wellcome Trust, most of the UK-based funding for medical research comes from the public. Early data suggest that AMRC members provide £1,137m annually, compared to approximately £798m from the Medical Research Council (MRC) and £921m from the National Institute of Health Research (NIHR). But the AMRC’s early data also suggest that only 2% of the money identified as being spent on research into specific diseases (rather than basic science) is currently being spent on neuroscience. By comparison, over 30% is spent on cancer.

Good reasons to involve people with brain disorders in research

Ms. Nebhrajani pointed out that demand for funding exceeded supply and consequently charity funders needed to better prioritise allocation of funds to research projects. “The involvement of patients and non-research clinicians may bring a crucial insight into this.”

³ *(Gustavsson, A., et al., *Eur Neuropsychopharmacol*. 2011 Oct;21(10):718-79. doi: 10.1016/j.euroneuro.2011.08.008. Epub 2011 Sep 15.)

Various surveys show that patients welcome involvement in research:

- Ipsos MORI poll 2011, 72% of adults would like to be offered chances to take part in research trials.
- National Cancer Patient Experience Survey 2011/12 found that 95% of patients who had discussed research appreciated the opportunity.

“Patients are indeed the research funders. Around 11 million people in the UK give to medical research every month,” asserted Ms. Nebhrajani. “There’s a demand for patients to be involved, they’re certainly an important funding voice.”

Dr. Baker highlighted the need for greater involvement of patients in clinical trials, and the need for a new approach to trial recruitment, stating that 30% of trials failed to recruit a single person. “In Parkinson’s disease, it is almost part of their legacy to be involved, to find a way forward. But fewer than 10% were ever involved.”

Trial exclusion criteria also need revision, according to Dr. Baker. She commented that in an ageing society, it did not make sense to exclude the elderly nor to exclude the young and pregnant women when evidence was needed to support use of medicines in these populations too.

“In our society, women are having children later in life, and with earlier diagnosis and better treatments, women are on a lot of medication prior to having children. Is it slowing up their ability to conceive? What is the effect on the foetus while pregnant?” remarked Dr. Baker.

Choice of endpoints and patient reported outcomes were also discussed. Referring to Parkinson’s disease, Dr. Baker asked, “what good does it do to measure arm swing and length of stride when actually what concerns the people living with this is depression, the inability to sleep, the pain, their bowels and bladders, sexual dysfunction?”

Data clarity and patient contributions towards driving therapies into the clinic

Recent pressure to make the European Medicines Agency’s (EMA) procedures more transparent included improving accessibility to original data in the public domain. However, Dr. Baker noted that the language currently used actually limited accessibility of data to patients and general public. “This needs to change if patients are to get involved in tackling brain diseases.”

Furthermore, Dr. Baker highlighted that patients need a better understanding of the language to engage with health authorities. For example, understanding Health Technology Assessments (HTA). “Distress is not enough now for the patient groups.”

In a key recommendation on how she would like to see future neuroscience research processes develop, Ms. Nebhrajani provided an analysis of how patients could take a more active role:

1. **Gap analysis:** This aims to identify current needs and gaps from a patient’s perspective that are not reflected in research strategies currently. The patient perspective can surface some key uncertainties and be used to set research strategies.

2. **Early involvement of patients in the formulation of research strategy:** Research strategies currently harbour a tension between funding the best quality research and encouraging research of importance to patients – a better dialogue between patients and research might resolve this.
3. **Patient involvement in funding decisions:** Patients can help to scope better research and influence funding decisions, providing insight on the practicalities of proposals. For example, Arthritis UK set up a patient committee, which reviews each grant application. “Our patient reviewer was the only person to spot that a researcher had assumed patients would only have one artificial joint,” the charity said.
4. **Information to meet patient needs:** AMRC charity members support every scientific paper having a well-written lay summary. The AMRC is keen to ensure funding committees acknowledge the importance of ensuring the patient voice does not feel patronised and is fully represented.
5. **Patient involvement in licensing and regulation:** The University of Glamorgan and The Genetic Alliance formed a patients’ jury to question what patients thought were the most important considerations when faced with an unlicensed treatment. “It was very clear that they wanted the regulatory authorities to consider non-biological implications of treatments, for example, psychosocial factors such as how the drug will impact on ability to work or the ability to socialise when making licensing decisions.”

AMRC encourages regulatory authorities to use flexible regulatory models such as ‘adaptive licensing’ that respond to a patient’s and clinician’s view of risk and benefit. They also support patient participation across the drug development continuum particularly in relation to pharmacovigilance data.

Recognising a patient’s need for inclusion

A patient’s journey is long and complicated. Dr. Baker pointed out that when they receive a diagnosis it is a watershed in their life. “They remember very clearly ‘before I was diagnosed, and after I was diagnosed, and they need information in order to regain the control that they have lost when they hear that diagnosis.”

Information is essential. “The real challenge for us in the future is how do we engage with our society?”

The informed patient is a highly cost effective patient, said Dr. Baker. She added that the scientific community needed to involve patients and carers in research. “It is about working together – patients are experts in living with an illness and they can give many clues to the research programmes.”

Key points: Putting patients first

- More patients should be actively involved in trials; patients need improved access to trial recruitment processes. Outcome measures need to consider what the patient considers important as a disease measure
- Transparency should require that data in the public domain is presented in patient-friendly terms
- Patients need information on how best to approach the authorities e.g. Health-Technology Assessment (HTA) courses
- Patients should be key partners both in setting research strategies and assessing benefits of possible research projects – they have a unique perspective that researchers should value
- Patients have an important voice in subsequent licensing and regulatory decisions that might help to catalyse innovation

Action points

- 1** Patients and other stakeholders, specifically in relation to research, policy and management of brain diseases, need to actively take steps to adapt to the demographic changes happening in our society today.
- 2** More attention should be given to family lifestyles to achieve two more years of healthy living to alleviate distress to patients and their families and considerably reduce the cost to the health system.
- 3** Help society to help itself: patients need to be encouraged to become proactive, seek out and engage with opportunities to become involved in the research process e.g. through participating in trials.
- 4** The power inherent in the patient community should be harnessed and used to effect change.

II. Innovative and interdisciplinary approaches to research activity

Neuroscience needs to optimise use of all available resources across various related disciplines according to experts from some of the UK's largest research funding agencies. In particular, neuroscience in the UK should capitalise on its strengths to ensure it retains its place as a worldwide leader in research.

Dr. John Williams, Head of Neuroscience and Mental Health at the Wellcome Trust said that neuroscience was carried out in an intensely competitive global space. "We really need to ask, 'How do we ensure that we position the UK so that it can continue to contribute and shape significantly the worldwide conversation in this area?'"



In essence, Dr. Williams said that UK neuroscience needed to find ways to make 'the whole greater than the sum of the parts'. It needed to draw on its excellent pool of researchers, skill, and initiative to ensure that the UK continued to rank amongst the top nations for innovation and translation and to drive knowledge gain in the field.

Capacity and UK institutional strength

He added that a dominant challenge was to facilitate interactions between leading UK institutions to ensure a considerable international presence. Regarding new neuroscience graduates, he pointed out: "There's a global market out there, so we need to ask, 'how do we retain the best of our talent and attract them into the UK system to allow us to contribute to the innovation agenda, to the economic agenda, and to the knowledge gain agenda in the United Kingdom?'"

The Wellcome Trust provides personal support for researchers, large-scale collaborative awards, translation awards, and uniquely amongst funding agencies, significant investment in the humanities and public engagement. With respect to capacity, Dr. Williams pointed out that neuroscientists represented approximately a third of the Wellcome Trust's highly competitive basic fellows and about a quarter of their clinical fellows.

"There is an interesting question about whether we need to add to that resource, and whether we create the right opportunities to allow that resource to thrive?"

Breaking down boundaries

One of the Wellcome Trust's most successful strategic initiatives formulated by Professor Richard Morris, former Head of Neuroscience and Mental Health at the Wellcome Trust, is a powerful collaboration with colleagues at the Medical Research Council (MRC).

This opportunity involves strategic awards that invest significantly in three world-class groups working in Alzheimer's, Parkinson's, and motor neuron disease. "We've seen the fruition of intriguing cross-fertilisation due to networking across disease areas. Intriguing ideas have emerged at the interface between these disciplines," said Dr. Williams.

He emphasised a key message that arose from this work. “Research is not about silos, we have to break down barriers. It’s not about more for this area, more for that area. It’s actually about saying how do we bridge across these disciplines? How do we learn? How do we explore? How do we gain that edge?”

Adding a note of caution, Dr. Williams reminded the science community to be humble about what neuroscience has and indeed might deliver in the future and to ensure that the work is contextualised and the limitations fully understood by society.

Innovative approaches to research activity

MRC spend on neuroscience

The Medical Research Council’s (MRC’s) mission is to:

- Encourage and support research to improve human health.
- Produce skilled researchers.
- Advance and disseminate knowledge and technology to improve the quality of life and economic competitiveness of the UK.
- Promote dialogue with the public about medical research.

Hugh Perry, Chair of the Neurosciences and Mental Health Board, MRC, and Professor of Experimental Neuropathology, University of Southampton, reported that remit spans all of health research with neuroscience and mental health research representing about 20% of MRC’s spending. The annual neuroscience spend in 2012 was £111m across a broad spectrum covering neurodegeneration, dementias, mental health and addiction, cognition, neurobiology, development etc. In order to fit this portfolio, discovery science applications to the Board need to have evidence of relevance to human health or the underlying mechanisms of disease.



MRC’s strategy for neuroscience

The Neuroscience and Mental Health Board embraces the four ‘c’s – capacity, creativity, cross-disciplinarity and culture. These key themes are typified in the approach adopted in response to the 2010 comprehensive review of mental health and wellbeing, which prioritised the areas of severe mental illness, anxiety, depression, intellectual disabilities, and pathways to mental wellbeing. The MRC has concentrated its recent efforts into a £3.8m call in experimental medicine for mental health with a population-based approach to identify risk factors; £2.2m for a national clinical training programme to increase capacity; £1m for data sharing in population science (culture) and a new £3m call in intellectual disabilities research, which is to explore risk factors that either lead to the onset or drive these diseases.

Similarly, the MRC is currently involved in a number of strategic activities relevant to dementia research. The Prime Minister’s Challenge in March 2012 charged the MRC and other organisations to fund research that will make significant progress in the prevention, treatment and even cure in

regard to the dementias. There are two flagship international activities; Joint Programming in Neurodegeneration (JPND) involves 27 European countries and ran a €15m call in 2011 and two calls in 2013. The Centres of Excellence in Neurodegeneration (COEN) call has eight partners and encompasses MRC Units/Centres, WT-MRC neurodegeneration programmes and the NIHR translational dementia network.

Additionally, a hugely successful MRC funded infrastructure has been the Brain Banks coming together to form the UK Brain Bank Network, directed by Professor James Ironside. In order to maximise advances in human diseases like Alzheimer's we need a generation of molecular pathologists who exploit these high quality resources.

The MRC addiction strategy continues to support clusters of collaborative workers across different institutes or within institutes who bring together the expertise needed to deal with this difficult area. There is also an important emerging strategy to deal with harms related to alcohol.

The Board welcomes creativity – new ideas, new technologies, new ways to approach a problem. The MRC has a highlight notice in systems biology for medicine and a £50m call in medical bioinformatics, this includes quantitative approaches to neuroscience, which should not be isolated from medical bioinformatics.

The Board recognises the complexity of brain disorders and the impact these can have on the whole body, and equally the impact of other diseases (co-morbidities) on the health of the brain. Therefore, neuroscientists need to work with vascular biologists, immunologists, and experts in metabolomics, the physical sciences, engineers, material scientists and similar to understand the impact of systemic co-morbidities on brain disease.

For capacity, cross-disciplinarity, and creativity to work effectively neuroscientists have to change the culture of how they approach the problems and we ask them to embrace these areas where we have called for action.

Key points: MRC support for neuroscience

- The MRC funds a large portfolio (over £100m per annum) of neuroscience and mental health research of relevance to human health or underlying mechanisms of disease.
- Researchers are encouraged to consider innovative approaches or steps rather than being solely iterative or incremental.
- The global challenges in neuroscience requires us to embrace the opportunities for cross-disciplinary interactions, for example, with the immunology, vascular biology, ageing and medical informatics communities.

BBSRC support for neuroscience and related research

The Biotechnology and Biological Sciences Research Council (BBSRC) supports excellent bioscience research, including fundamental neuroscience and behaviour research much of which underpins

medically-related neuroscience research supported by other funders. **Professor Melanie Welham, Director of Science at the BBSRC**, said the Council also supports the training of PhD and post-doctorate researchers throughout their careers. “We also want to drive social and economic impact from the research that we fund as well as promote public engagement.”

The overall budget for the BBSRC is between £400m and £500m per year. According to Professor Welham, just under 50% of the entire BBSRC research grant portfolio is funding world-class, underpinning bioscience. “For two years between 2010 and 2012, £250m was committed to funding responsive-mode research grants, £51m of which (20%) supported neuroscience and behaviour research.”

Professor Welham would like to see more cross-disciplinary research. “We see linkage to ageing, some linkage to systems biology, but there could potentially be more cross-disciplinary research going on within the neuroscience portfolio and this represents a real opportunity.”



The BBSRC website provides details of grants awarded over the past few years⁴. “We see grants supporting a whole range of different fundamental neuroscience projects, and that’s the key. We fund basic neuroscience research and behaviour across a wide range of areas. In particular, developmental neurobiology, which provides fundamental understanding and underpins a lot the disease-related work that would then find its natural home at the MRC perhaps.”

Furthermore, Professor Welham added that approximately half of the entire BBSRC neuroscience and behaviour funding portfolio, about £34m from 2010/11 and 2011/12, is actually for standalone neuroscience.

BBSRC Funding Opportunities

Highlighting potential opportunities for BBSRC funding, Professor Welham said they were keen to support work on foetal and maternal interactions and life course events, and early life events that may have impacts later on.

The Council is also interested in model systems and developing strategies around nutrition and health. “I think this could also play into neuroscience in terms of the behaviour around food choice and food consumption and obviously we’re very interested in biotechnology for health.”

Strategic longer term and larger grants, which over a five-year period have a value in excess of £2m are also funded by the BBSRC. These bring together consortia of researchers to address big challenges that might require the effort of interdisciplinary teams. For the 2013 call, one focus for these grants was ageing across the life course, from development to older age, particularly those that exploit new model systems.

4 (<http://www.bbsrc.ac.uk/PA/grants/>)

Key points: BBSRC support for neuroscience

- BBSRC supports excellent fundamental neuroscience and behaviour research
- BBSRC-funded research underpins medically-related neuroscience research supported by other funders
- There are opportunities for neuroscience researchers to address strategic priorities particularly in relation to lifelong health and exploiting new ways of working
- Half of the BBSRC neuroscience and behavior research grant portfolio, about £34m from 2010/11 and 2011/12, is actually for standalone neuroscience

Action points

MRC:

The community is asked to embrace the following strategic priorities:

- 1 A focus on early markers of disease for prevention and early intervention strategies.
- 2 The use of high-quality tissue resources and the insights that molecular pathology can offer.
- 3 Quantitative approaches to systems neuroscience.
- 4 Understanding co-morbidities in the context of neurological disorders.

BBSRC:

- 1 For researchers to consider how they can contribute to tackling the grand challenges facing an ageing society.
- 2 To maintain the health of the research base, in terms of both human capital and infrastructure, at times of increasing economic constraint.

III. Industry, academia and investors: innovations, strategies and collaboration to maximise the impact and translation of brain research

How can neuroscience be made more attractive to investors including venture capitalists and the pharmaceutical industry? The Summit heard suggestions and examples of good practice from industry, academia and joint projects.



Neuroscience has been an unattractive investment option for venture capitalists in recent years due to a lack of low risk phase II assets. **Dr. Jackie Hunter, Chief Executive from OI Pharma Partners** took the opportunity to discuss how industry and academia are aligning to maximise the impact of brain science, in the context of not only facilitating excellent research, but also ultimately of helping society, be it in terms of informing policy or supporting the development of new medicines or devices for patients.

Providing an overview of the current challenges inhibiting investment in neuroscience, Dr. Hunter highlighted:

- the sustainability of the wastage and duplication in research. For example, the capsaicin receptor has been investigated by 25 companies with patents for 20 indications over a 10-year period. No medicine has been forthcoming yet.
- Companies' shareholders often seek quicker returns from R&D than is reasonable given the lengthy nature of research and development. This can fuel short-term demands and even premature closure of projects. "You've got to realise if you're in there, you're in there for the long-haul."

Dr. Hunter pointed out that focusing on more productive collaborations between industry and academia, where both parties bring expertise, not just cash, might be forthcoming. Successful partnerships provide greater access to tools, reagents, resources, and an improved infrastructure, staff interchange, mixed project teams, and flexible master agreements allowing for a range of projects, and helping to build productive networks.

Merck Serono has a scheme where they take academics on a 'boot camp' and come up with new ideas. "Now, there are also large, pre-competitive consortia across most phases of R&D."

Dr. Hunter also remarked that Lilly was actively making resources available to external individuals and academics. Lilly's Phenotypic Drug Discovery Initiative enables academics to submit compounds with potential for development into therapeutic compounds. "I think a lot of it is about having the right people in your collaborations and driving your projects forward."

The Innovative Medicines Initiative

The extensive Innovative Medicines Initiative (IMI) shows how pharma's contribution in kind can be a recipe for success, according to Dr. Hunter. In figures, the IMI has 40 projects ongoing, 594 academic and research teams, 109 small and medium enterprises, 363 European Federation of Pharmaceutical

Industries and Associations (EFPIA) teams, and over 4,500 researchers. She pointed out that the scheme shows that the right incentive drives a much closer collaboration between academia and pharmaceutical companies, and as a result of that there has been a real appreciation and build up of trust across the various project teams involved.

By way of example, showing how collaborations through the IMI are reducing duplication and wastage, an innovative rodent touch screen technology used by both the NEWMEDS (rats) and PharmaCOG (mice) consortia has resulted in a reduction in animal use, but also enabled pre-validation of a rodent cognitive battery that is predictive of drug effects in man by cross-laboratory experimentation between Orion, UCAM, Janssen, Lundbeck, Roche, Abbott, Lilly and Pfizer.

“This is incredibly valuable, rather than every company having to do the same thing. NEWMEDS, has also shown that by pooling the clinical trial data you can reduce the duration of a trial,” said Dr. Hunter. This would reduce the cost of Phase II trials in schizophrenia by an average of €2.8m.

Action points

<p>1 By working together, academia and industry could build networks of trust and engagement that could actually make translational neuroscience happen.</p>	<p>2 Governments and funders have an important role in stimulating and catalysing new ways of working as in the Innovative Medicines Initiative.</p>	<p>3 Making reagents and tools available under an open access platform from closed projects in industry (and potentially academia) could reduce duplication and stimulate new areas of research.</p>
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Dr. Gary Gilmour, Principal Research Scientist at Eli Lilly, UK, is involved in the NEWMEDS project. “There are four neuroscience calls that we’re involved with, spanning disease states from schizophrenia, Alzheimer’s disease, chronic pain conditions through to autism. The oldest research here has been running for roughly three years.”



Eli Lilly: An industry perspective on neuroscience research today

Dr. Gilmour provided some insights as a leading researcher in the neuroscience field and an industry partner in various collaborative projects. Lilly’s principle focus for neuroscience is on schizophrenia and Alzheimer’s disease, with scientists working on molecules and genes all the way through to intact animals.

He noted:

- publication bias was a major issue in that often only the positive results are reported

- animal behaviours require more accurate definition, with broader and more precise domains of function in animals. “We really need to push towards a fully translational axis so measurements in animals are as close as possible to the same measurements in man and vice versa.”

Key points: The Centre for Cognitive Neuroscience: A Lilly funded industry-academia project

- The Lilly Centre for Cognitive Neuroscience (CCN) illustrates the strength of the industry-academia partnership.
- The CCN scheme brings academic experts together to resolve neuroscience issues that enhance productivity. Ultimately, it aims to improve patient outcomes for cognitive dysfunction in neuropsychiatric disorders. Lilly deals with the drug hunting part, while the academics help obtain the basic drug-hunting tools.
- CCN aims to develop a web of post-doctoral scientists to span expertise from molecules up to behaviour and provide – for each molecule targeted at cognition – a translational, clinical, neuropsychological and biomarker profile as the basis for phase one proof-of-concept studies.
- A notable achievement of the CCN programme is the development of a technique called in-vivo oxygen amperometry that is used as a surrogate for bold functional magnetic resonance imaging (fMRI). Within four years CCN has progressed from no experience at all to developing a technique that promises translational value.

Public-private and private-private partnerships

Dr. Gilmour says the IMI models how public-private partnerships as well as inter-company collaborations can deliver incredible benefits and opportunities. He provided some personal insight. “I think for me as a scientist, I’ve really appreciated this ability to problem solve with colleagues from other companies. The information that you can gain within 15 minutes of conversation is incredible.”

In conclusion, Dr. Gilmour admitted that competition was indeed important on certain projects, and that as a pharmaceutical company the intellectual property was mainly around the molecules themselves, “but we also have to learn how to collaborate here. Most of the problems we’re facing in industry around validation and translation are really pre-competitive problems,” he emphasised. “It doesn’t really benefit any one company to try and do this on their own- the problems are too large both scientifically and financially.”

Action points

- 1 Review of neuroscience drug discovery success rates suggests that much more needs to be done to enhance the translational validity of preclinical 'efficacy' packages.
- 2 Publication bias needs to be addressed, publishing the negative as well as the positive findings.
- 3 A greater awareness is needed of the practical realities of routine application of animal models and assays for drug discovery research.

The value of collaboration versus competition

Addressing the positive influence of competition, **Colin Blakemore, Professor of Neuroscience and Philosophy, University of London** explained that pitching people against each other competitively had long been an effective strategy in science, just as in politics and industry, and that crucially it harnesses the power of ambition.

However, he pointed out that in science, the flipside of a strongly competitive approach comprises a waste of resources if there is unnecessary duplication of effort. "A competitive environment also encourages hype; and pressures on individual achievement can encourage people to exaggerate their claims," he said.



Should competition be encouraged?

The decision over whether it is more productive for researchers to collaborate rather than to be competitive becomes a question not only of waste and efficiency, but of whether it is actually unethical to have systems that over-encourage competition. Professor Blakemore cited an example from China: post-doctoral scientists in the same laboratory were competitively set against each other to investigate the same problem. "It was totally destructive."

Yet, he added, scientific institutions have clearly demonstrated many benefits from following the competitive process. For example, the appointment of individuals on the basis of personal achievements, and grant allocation based on the assessment of individuals and their track records earned through a competitive success.

Action points

- 1** Rethink the authorship of publications: the convention of recognising primarily the first and last authors can mean people in the middle get lost.
- 2** Encourage multidisciplinary research, which, by definition, needs collaboration because one individual cannot have all the necessary expertise.
- 3** Funders should facilitate opportunities for collaboration by building infrastructure and sharing resources, for example, the UK Brain Banks, digital brain atlases, genomic repositories and bioinformatics facilities.
- 4** Reward altruism and researchers who encourage their students to share resources and to move away from strategies of secrecy and personal achievement.
- 5** Reward people who actively and openly communicate science to the public.
- 6** Reward full disclosure of data across networks, including a demand for the disclosure of negative results.

IV. Reforms to influence policy and encourage the pharmaceutical industry to return to neuroscience

Tactical moves to influence policy could alter the neuroscience research landscape and nurture new discoveries and the more rapid translation of science into the clinic.

The European College of Neuropsychopharmacology (ECNP) has various initiatives aimed at tackling the societal challenges of brain diseases today and in the future, for example, ECNP Young Scientist Workshops, and the ECNP Networks Initiative that facilitates scientific networking on translational research and public outreach.

David Nutt, Professor of Neuropsychopharmacology at Imperial College London and past President of the BNA and the ECNP summarised the role of the ECNP. “Part of our job is trying to find out what the problems are so we can engage with the people who have the authority and resources to change them.”



The ECNP four-point plan to tackle brain disease in Europe

The four-point plan comprises increasing investment; increasing research; rationalising regulations; and empowering patients.

1. Increase investment and increase research

Professor Nutt pointed out the differences in spend between the US and Europe and the degree of consolidation/fragmentation of research activities.

For example, for brain diseases, the overall spend is low relative to other research areas; the US spends much more than Europe, and the overall field is very fragmented. Dementias, in particular, show this in the extreme. “We personally think that Europe should at least be competitive [with the US] given that we’re similar economies and we have similar numbers of talented people.”

Echoing other speakers, Professor Nutt also noted the need to incentivise companies to return to neuroscience. He highlighted the large difference in time to market for a cancer treatment versus a treatment for a brain disease: 5-8 years versus 11-13 respectively. “Patent protection for a cancer drug or a brain disease drug is the same, demonstrating that there is no relationship between the protection a drug is awarded and the time or the cost it takes to produce it,” said Professor Nutt.

2. Rationalising regulations

Professor Nutt noted the challenges presented by European regulations relating to treatments for brain disorders. For instance, unlike the US, European registration of psychiatric compounds requires companies to show efficacy over a timeframe of six months beyond the initial proof that the treatment works. Clinical trials in Europe are significantly more expensive than those in the US where drugs can be licensed on a time frame of weeks. Also, unlike in the USA, European law does not permit cost sharing between industry and the EC for research into clinical efficacy.

Professor Nutt also pointed out that add-on designs to clinical trials were needed. For example, add-on designs in epilepsy studies have yielded 10 new drugs in so many years. By comparison, add-on designs are not encouraged in depression with one new drug in the same timeframe. Furthermore, placebo controlled trial regulations in psychiatry require revision since many European countries do not allow them yet regulators still demand them.

3. Aiding experimental brain research

Taking a stance on issues related to brain research, Professor Nutt highlighted that tools were needed to enable researchers to ask questions of the human as is currently done with animals; drugs that were researched but shelved previously should be re-investigated using new research tools and to this end the ECNP's 'Medicine's Chest' project was investigating archived drugs. He also noted that the European clinical trials directive was designed to protect participants in clinical trials of new drugs, but that it was now applied too extensively.

One attempt to redress some of these issues is the new ECNP experimental medicine network across Europe. The ECNP is also looking to build on the data mining of existing datasets carried out by the Innovative Medicines Initiative (IMI) to improve the understanding and methodology of trials, and reduce trial failure due to design issues.

4. Empower patients

Professor Nutt believes society in general undervalues brain disorders. "We should be spending 30% of medical research investment on brain disorders, and Horizon 2020 spend should be proportionate." He added that there should be less discrepancy between funding for cancer research and research for brain disorders. Empowering patients can help manifest change.

Key points: regulation, incentives and spend on brain diseases research in Europe

- Research spend in Europe should be proportionate to the needs of the community – hence spend on brain disorders should be double what it is today
- Incentives to encourage the return of pharmaceutical research to Europe such as patent proportionality to development duration of medicines, and the harmonisation of HTA hurdles, should be developed
- Unnecessary regulations that slow research and treatment innovation such as the European Clinical trials directive should be rapidly scrapped

Action points

- 1** Develop an intensive dialogue with the European Commission and Parliament to improve current regulations relating to research e.g. the European Clinical Trials Directive and some aspects of the EMA procedures
- 2** Develop a European network of Centres of Excellence in human brain translational medicine across Europe under the Horizons2020 and ROAMER initiatives
- 3** Incentivise pharmaceutical companies to make tool compounds available for human neuroscience research

V. Overview of the day

Richard Morris, Professor of Neuroscience at the University of Edinburgh; and **Trevor Robbins, Professor of Cognitive Neuroscience at University of Cambridge,** provided an overview of the day's discussions.

Richard Morris drew attention to the societal challenge that brain disorders represent in Europe. "Further work on costs by the EBC is welcomed because figures help to persuade politicians that these things matter," he said.

He also focused on the fact that the population is living longer, "Giving older people further years of independence I think is a very valuable thing, certainly within the UK."



Regarding the outlook for neuroscience research, he acknowledged the potential in reaching out to partner institutions in the Pacific Rim and India where opportunities exist to build and engage in various collaborations. "The kind of energy you get from going to a major institution in India to do science can be actually enormously exciting."

Professor Morris pointed out that there were numerous unmet needs in neurological and psychiatric disorders. Echoing John Williams' introduction earlier, and highlighting an area of special interest to him concerning mental health, Professor Morris mentioned the launch of the new mental health research charity, MQ, which stands for mental quality of life. "With seed-funding from Wellcome, MQ has the aim of gradually building a research charity for mental health similar to Cancer Research UK. That's the ambitious aim of our chairman and the other trustees, including myself."

He added that it was the view of MQ that now was a timely moment to continue a concerted effort in the mental health domain. He emphasised the progress in genetics, brain imaging, the growing understanding of biochemical and signal transduction abnormalities that are related to psychiatric disorders, and developments in evidence-based psychological treatments, that have collectively led scientists to think that the public will understand that their money would be well-spent on a range of projects.

Also, acknowledging the importance of public engagement, Professor Morris recognised that scientists founded their claims on a cumulative body of knowledge that forms the basis for developments and products to improve quality of life. "If one aim of this Summit is to maximise our influence on science policy, funders, government, and most importantly, society at large, we should guard that reputation."

Professor Robbins stated that his overall summary would be a need for determined synergy across diverse cultures including academia, industry, health services, government and society. "That's what we have to achieve. Competition and collaboration



– you need a balance of both. That’s how the brain works and that’s how we train our students both to be part of a team as well as forge their own identities.”

He pointed out, a message to funding agencies would be to encourage their advanced research fellows, not only to first-author papers, but also to be part of a multi-author partnership and to work within a team to produce more general gains other than their career advancement. Finally, he made the important point that we also have to work especially with informed members of the media to optimise the case for further funding of the area from Government and also to overcome the major obstacle of stigma in mental health.

VI. Conclusions



Professor Russell Foster focused on the BNA's role in tackling the societal challenges of brain diseases. He began by noting that over the past 20 years, neuroscience as a whole has gained a fundamental understanding of brain function, and that the potential for the future was truly exciting. "Both the academic and industrial neuroscience community is now in a position to address understanding of the bigger picture of how the brain functions, through multiple coordinated levels, to produce both normal and abnormal behaviour."

He added that the expansion of experimental medicine was providing new research opportunities to not only deliver evidence-based clinical intervention, but also to provide a fundamental understanding of mechanisms.

How the BNA can deliver a more coordinated approach across the UK

The BNA has changed, said Professor Foster. "We're in the business of developing a broader and more proactive strategy to expand and sustain world-class neuroscience research, public engagement, industry and health in the UK."

He explained that the BNA is promoting 5 themes:

- Membership at all academic levels, and geographic regions across the UK.
- To listen, to enable us to solicit, poll, and understand both the interests and concerns of neuroscientists and non-neuroscientists across the UK.
- To communicate, inspire, inform and educate both neuroscientists and non-neuroscientists from all sectors across the UK.
- To collaborate, to deliver research and public engagement programmes across the UK.
- To interact with policymakers in order to define the neuroscience research agenda for the UK.

Professor Foster then provided examples of the BNA's capacity to deliver. The organisation has developed local groups around the country, led by Trevor Bushell. "Across the UK, we've established a network of talented individuals in the neurosciences. We are working with the BBSRC to connect these local groups with regional neuroscience-related industries."

Various symposia have also promoted British neuroscience geared towards early-career scientists and it is seeking new ways to support their career path.

The recent BNA2013: Festival of Neuroscience, held in London in April 2013, illustrated the power of collaboration with almost 2000 registered science delegates from around the world. Together with the Wellcome Trust-funded 'Wonder, Art and Science of the Brain' events, the Festival attracted an estimated 15000 members of the public.

“We like to think of ourselves as the voice of British neuroscience. What we’ve been able to achieve so far is real engagement with government for example, we are talking to government on a regular basis,” said Professor Foster.

Over 150 organisations in the UK have an active role in the promotion, funding or support of some aspect of neuroscience. “We need to work together to establish a clear strategy that can be communicated to government.”

Needs and potential solutions identified by the BNA Summit

- A need to move from the mind-set of single laboratories holding project grant-level support to a more integrated approach, allowing molecular, cellular and behavioural questions to be addressed simultaneously. **Future funding strategies should promote and reward collaboration.**
- Within such a collaborative framework, individual contribution must be recognized. Currently there are limited ways to acknowledge the innovation and ideas of individuals within research consortia. **Authorship in publications needs a “root-and-branch” reassessment, away from the first and last author hegemony.**
- Junior researchers must not be buried within research consortia. In addition to acknowledging their contribution in publications, young researchers should be rewarded and not penalised for working within a team. **The development of career path criteria that enable young researchers, who are part of a research team, to emerge, gain independent recognition and career promotion.**
- Future research consortia in the neurosciences need to truly work with and integrate the expertise and resources of the pharmaceutical industry. The different practices across the university sector and pharmaceutical companies regarding funding, overheads and intellectual property are a major impediment to research. **Develop a national code of practice to promote research and interactions across the university and pharmaceutical sectors. Agreed and uniform practice across all stakeholders will attract and promote research in the UK.**
- Research infrastructure and equipment is becoming increasingly expensive, and as a consequence, is an impediment to research. **Future public funding in this area should give incentives to research consortia and institutions which support major shared resources.**
- A greater emphasis on **translating brain research** into useful products and services

British Neuroscience Association

The British Neuroscience Association is the largest UK organisation representing all aspects of neuroscience from ion channels to whole animal behaviour to neuroscience applications in the clinic. It has around 1800 members. The BNA is the 'voice of British neuroscience.' www.bna.org.uk

European Brain Council

European Brain Council is formed by organisations in neurology, neurosurgery, psychiatry, basic brain research, patient organisations and pharma companies and biotech industries. It works in close partnership with the European Parliament and Commission, national governments and other policy making bodies. www.europeanbraincouncil.org

European College of Neuropsychopharmacology

European College of Neuropsychopharmacology is committed to ensuring that advances in the understanding of brain function and human behaviour are translated into better treatments and enhanced public health. www.ecnp.eu

Federation of European Neuroscience Societies

Federation of European Neuroscience Societies represents a large number of national European neuroscience societies and several monodisciplinary societies. www.fens.org

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