

Human Functional Brain Imaging 1990–2009

September 2011



This summary describes a portfolio review of human functional brain imaging over the past 20 years, focusing on the Wellcome Trust's role within this landscape.

Since our inception in 1936, providing funding for neuroscience research has been one of our priorities; the first grant awarded in 'neuroscience' and, indeed, the first grant ever awarded by the Wellcome Trust was in 1938 to Dr Otto Loewi. Dr Loewi shared the 1936 Nobel Prize in Physiology or Medicine with Sir Henry Dale – one of our first Trustees. Understanding the brain remains one of our key strategic aims today.

Introduction and background

This portfolio review was designed to help us to evaluate the impact of our funding on the landscape and inform future directions, taking a macro and long-term view. The analysis combines retrospective analysis (looking back) and prospective analysis (looking forward). Our aims in doing this were three-fold:

- to identify the key landmarks and influences on the human functional brain imaging research landscape over the past two decades (1990–2009)
- to consider the key features of the Wellcome Trust's impact on this landscape
- to consider the future direction of human functional brain imaging and identify where there may be opportunities for future funding strategies for us and other research funders.

We undertook four complementary streams of work (see the full report for further detail: www.wellcome.ac.uk/functionalbrainimaging):

- landscape analysis, comprising bibliometric analysis (which describes patterns in scientific research publication outputs over time), funding analysis and policy analysis
- narrative case studies, providing key examples of Wellcome Trust funding and describing scientific breakthroughs in our understanding of functional brain imaging
- expert assessment to provide an independent view of key landmarks in the development of human functional brain imaging, the role of the Wellcome Trust and potential future directions

- semi-structured interviews with brain imaging experts working in industry, undertaken to gather perspectives on the role of industry-based research and development and challenges for the future.

We hope this portfolio review will highlight areas where new and continued research is required and help to inform how we and other funders of human functional brain imaging research can provide support in the best ways.

Overview and key findings

We have provided substantial funding for neuroscience and mental health research, including funding to the Wellcome Trust Centre for Neuroimaging and the Behavioural and Clinical Neuroscience Institute. Between 1990 and 2008, we committed £114 million to human functional brain imaging research, accounting for around 2 per cent of our total funding commitment.

Our most notable impacts are thought to have been through:

- providing a sustained stream of funding specifically for equipment, tools and technologies to enable key breakthroughs in human functional brain imaging to emerge
- providing long-term and sustained funding for multidisciplinary research hubs, which are thought to have underpinned the development of the field as a whole
- supporting researchers building independent research careers through training programmes and fellowship funding; several Wellcome Trust-supported researchers are currently world leaders in human functional brain imaging and have contributed to some of its most important breakthroughs.

Human functional brain imaging enables non-invasive analysis of brain function by direct and indirect measures of neural activity to show the living human brain at work. In comparison with 20 years ago, we know considerably more about how the living brain works and functions. In this review, we found that much of the development of

human functional brain imaging as a field has emerged through collaboration across disciplines; many key research successes to date have occurred in dynamic ‘hubs’ where individuals from a range of disciplinary backgrounds and sectors have come together.

Among our experts, there was a general consensus that the field has today reached a crossroads; although there have been major advances in our knowledge of brain function, human functional brain imaging techniques exist primarily as research tools. For these tools to have a significant impact upon clinical practice and the wider health of populations, greater integration between professions is required; researchers and scientists across disciplines and sectors need to consider research questions together and work to develop solutions.

Challenges ahead

Looking to the future of human functional brain imaging, we have identified a range of challenges and opportunities for the functional brain imaging research and funding community, some of which we are already beginning to address:

- An approach akin to the ‘grand challenge’ model – in which specific goals are identified and research organised to best deliver them – may provide a timely way to progress human functional brain imaging to move beyond the crossroads our experts described. Our experts suggested that this might be facilitated through an international frontiers meeting on human functional brain imaging – bringing together people from across disciplines and sectors to work collaboratively to identify the current step limiting factors and work out what the goals and targets for human functional brain imaging research could or should be.
- There is no doubt that the future of human functional brain imaging research requires continued input from a wide range of disciplines and sectors. The importance of physical research hubs and co-location of all of the key researchers, scientists and technicians remains crucial, and there is a need to facilitate collaboration between research hubs. Supporting a more solution-based approach to human functional brain imaging research calls for novel and tailored funding mechanisms that can transcend traditional funding barriers.
- Training of researchers remains essential. In the field of human functional brain imaging, the value for researchers of awareness and experience working with the different contributory disciplines and across sectors should not be underestimated. Broad cross-disciplinary training is essential to ensure that a sufficient cadre of high-quality researchers is built to sustain researcher capacity.
- In addition to involving clinicians in discussions about the ‘big research challenges’, funders across sectors

should do more to ensure the involvement of world-class clinicians in the evaluation of new functional brain imaging technologies. For real impact on patients, it is important that the clinical requirements for brain imaging techniques are shared with the basic neuroscience research community, so the real challenges in the diagnosis and potential treatment of brain disorders are shared with researchers and technicians in the best place to resolve them.

- Our industry experts emphasised the opportunities for brain imaging researchers to work more closely with industry to help improve current paradigms for drug development. There are important opportunities for funders – including the Wellcome Trust – to develop strategic partnerships with pharmaceutical companies, especially in the support of high-risk, high-reward research to revolutionise molecular imaging.
- Comparing human functional brain imaging studies in a clinical setting can be challenging, partly because of methodological variability and the variability between human brains; only very limited epidemiology-based work has been conducted to date in this field. By encouraging greater collaboration across research hubs – more multi-centre analysis – there might be opportunities to share datasets and research findings, thereby increasing sample sizes and thus future predictive and diagnostic potential.
- Our experts largely agreed that the future for the field will involve combining existing techniques and new technological innovations that could substantially improve existing imaging equipment and extend capabilities in novel ways. Specific technological challenges and research needs were highlighted; in the short term, these include improvements in quantification, sensitivity, temporal precision and spatial resolution for current scanning technologies.
- Key emerging challenges in the field of human functional brain imaging include reporting clinically relevant research findings to study participants and managing the increasingly large and complex datasets generated by research in this field. In neuroscience, as in other fields, much work is needed to build and sustain the infrastructure, tools and culture that are needed to underpin this. It remains crucial that we, as funders, work together with the research community and other key funders to address the issues of incidental findings and data management and protection.

Although this portfolio review demonstrates that much has been achieved in the field of human functional brain imaging over the past two decades, there is much to be done – not least to support the translation of these achievements for clinical benefit. We believe the way forward necessarily involves collaboration across disciplines, between funders and across sectors.

For more detail on the findings and methodology of this portfolio review, see the full report at: www.wellcome.ac.uk/functionalbrainimaging.

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