Institution: University of Oxford

Unit of Assessment: 4 – Psychology, Psychiatry and Neuroscience

1. Unit context and structure, research and impact strategy

Our strategy has been to sustain, energise and expand key elements of the environment that we believe enable excellent researchers to do the highest quality research with maximum impact. We have made transformational new investments in people and research infrastructure, complemented by significant progress in our approaches to career development, staff support, equality and diversity, open science, and reproducible research. Reflecting our commitment to excellence and vitality, we have achieved significant growth in grant income, and in depth and breadth of our impacts.

Highlights include:

- £288.3M research income, with 71% increase between 2013 and 2019.
- New Centres with significant external funding: MRC Brain Network Dynamics Unit (**BNDU**; £11.3M, 2015), Wellcome Centre for Integrative Neuroimaging (**WIN**; £11.5M, 2017), Wolfson Centre for Prevention of Stroke and Dementia (**WCPSD**; 2020, £11M).
- Award of the mental health-dedicated NIHR Oxford Health Biomedical Research Centre (**OHBRC**; £12.8M, 2017), and renewal of the NIHR Oxford Biomedical Research Centre (**OBRC**; £114M, 2017) and the NIHR Oxford cognitive health Clinical Research Facility (**OchCRF**; £3.7m, 2017).
- 186 people (169.35 FTE) submitted, compared with 107 (98.3 FTE) in REF2014.
- 13 professorial and other senior researchers recruited from outside Oxford.
- A Wellcome-funded clinical doctoral training programme dedicated to mental and cognitive health.
- Significant improvements in representation of women, reflected in acquired and renewed Athena SWAN Silver awards, and new initiatives and investments in other areas of Equality, Diversity and Inclusion (**EDI**), and in mental health.
- Seven spinouts, attracting investments of over £700M.
- Substantial new infrastructure projects, including the £202M Life and Mind Building, and plans to redevelop the Warneford site.
- Leadership of major COVID-19 projects.
- Markers of esteem and influence, including eight Presidents of learned societies, and six journal Editors.

1.1 Unit context and structure

Figure 1 shows the Unit's structure and context within the University's **Medical Sciences Division** (MSD). Our research takes place primarily within three departments: Experimental Psychology (**DEP**), Psychiatry (**DP**), and the Nuffield Department of Clinical Neurosciences (**NDCN**). The facilities total approximately 13,800m^2 research space, in 17 buildings, on three campuses, including two hospital sites (**Figure 2**).

Some of our discipline-specific research is best described as occurring within one of these departments; this is facilitated by the devolved nature of the University, such that departments have a high degree of autonomy and budgetary control. Departments also have dedicated research administrative staff and designated research leads. However, departmental boundaries are porous, interdisciplinarity is encouraged, and much of our research occurs across departments and Divisions (§4.1.1 and §4.1.2).

- 26% of our researchers are based in one of the Centres described below.
- 40% of senior recruits in this REF period have joint appointments between departments.

Much of our translational and clinical research benefits from local NHS and NIHR-funded facilities and personnel, notably the two Oxford-based NIHR Biomedical Research Centres. We also have major research ventures with other institutions and partners, reflecting our position as a global hub for neuroscience, psychology, psychiatry and neurology (§4.1.3 and 4.1.4).

In what follows, we cross reference our Institutional Environment Statement (REF4a, *IES*] and our impact case studies (REF3, *ICS*).

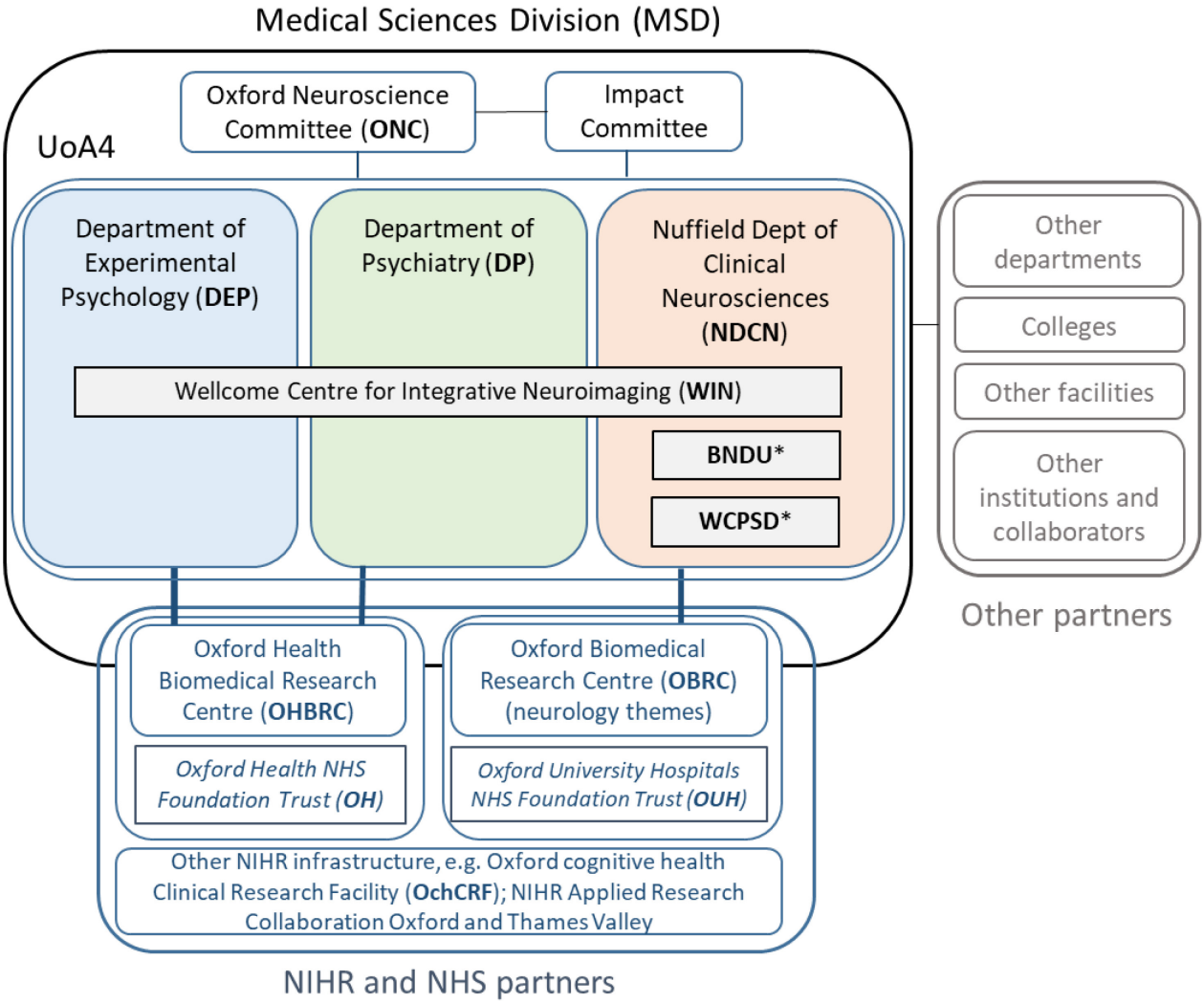

Figure 1. Components of UOA4 and relationships with constituent departments and other partners.
*BNDU: MRC Brain Network Dynamics Unit.
WCPSD: Wolfson Centre for the Prevention of Stroke and Dementia.

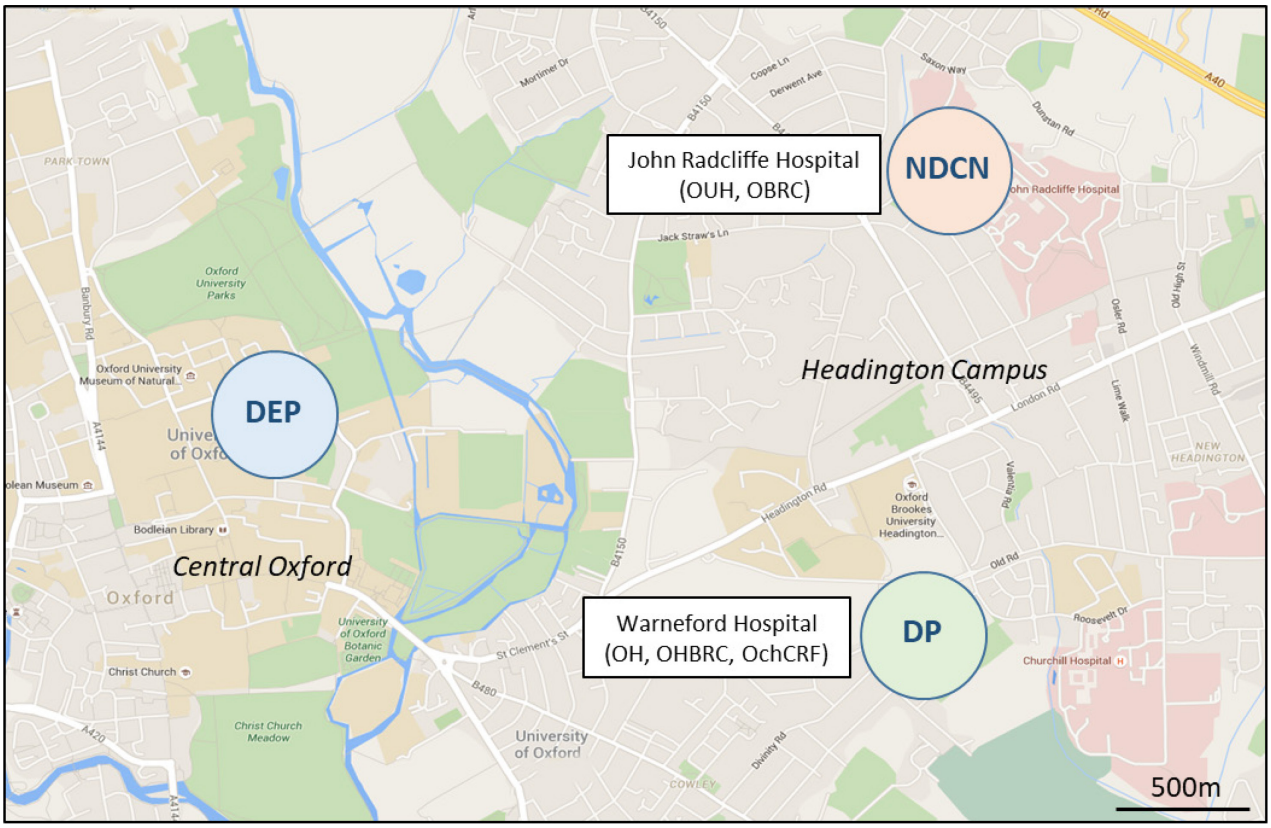

Figure 2. Location of the three core Oxford UOA4 departments, our Centres, and our major NHS partners. OBRC: NIHR Oxford Biomedical Research Centre. OchCRF: NIHR Oxford cognitive health Clinical Research Facility. OH: Oxford Health NHS Foundation Trust. OHBRC: NIHR Oxford Health Biomedical Research Centre. OUH: Oxford Universities Hospital NHS Foundation Trust.

1.1.1 Our Departments

***Department of Experimental Psychology (DEP**;* Head: *Nobre;* Associate Head for Research: *Rushworth*) is based in central Oxford and employs 166 FTE. Two major events have impacted on DEP. First, in 2016, Glyn Humphreys, head of department, died suddenly. Second, DEP was based in the Tinbergen Building, which required rapid evacuation in 2017 due to asbestos [IES 2.1]. Our rapid, multifaceted and successful responses to these challenges are described in §3.4.

***Nuffield Department of Clinical Neurosciences (NDCN**,* Head: *Talbot,* [formerly *Tracey* until 2018]) is based at the John Radcliffe Hospital, part of the **Oxford University Hospitals NHS Foundation Trust** (**OUH**, which provides acute medical services). NDCN has 320 FTE staff. Research in NDCN is organised into six divisions: Clinical Neurology, Anaesthetics, Ophthalmology, and the three Centres listed below (WCPSD, WIN, and BNDU).

***Department of Psychiatry (DP**;* Head: *Geddes*; Associate Head for Research: *Harrison*) is based at the Warneford Hospital, and has 207 FTE. Co-located on the site are the Oxford Centre for Human Brain Activity, the NIHR **Oxford cognitive health Clinical Research Facility (OchCRF**), and the **Oxford Health NIHR Biomedical Research Centre (OHBRC**), as well as the base for the **Oxford Health NHS Foundation Trust** (**OH**, which provides mental health and community services).

1.1.2 Our major Centres

***Wellcome Centre for Integrative Neuroimaging (WIN**;* Director: *Johansen-Berg*) was funded by a £11.5M award in 2017. It brought together the Oxford Centre for Functional MRI of the Brain (FMRIB, based in NDCN), the Oxford Centre for Human Brain Activity (based in DP), and animal MRI (based in DEP) to bridge the gap between laboratory neuroscience and human health.

***Medical Research Council Brain Network Dynamics Unit (BNDU**;* Director: *Brown*) opened in 2015 with a £11.3M quinquennial MRC award, renewed in 2020 with increased funding (£12.3M). The BNDU focuses on understanding and exploiting the brain circuits underlying movement and memory. Based in NDCN and housed in its own building, it includes 70 staff.

***Wolfson Centre for the Prevention of Stroke and Dementia (WCPSD**;* Director: *Rothwell*) was opened early in 2020 in a new building part-funded by the Wolfson Foundation and the Wellcome Trust. It houses 30 researchers.

***NIHR Oxford Health Biomedical Research Centre (OHBRC)**:* The OHBRC (£12.8M; Director: *Geddes*) is dedicated to mental health and dementia. Hosted by OH, it was established in 2016.

NIHR Oxford Biomedical Research Centre (OBRC) is a separate BRC, hosted by OUH. OBRC covers the rest of medicine and includes several research themes relevant to this UOA, including neurology, stroke and imaging. OBRC and OHBRC collaborate closely and are complemented by other NIHR-funded infrastructure (§3.3).

Alzheimer's Research UK Oxford Drug Discovery **Institute**. Opened in 2015 with £10M from ARUK, with *Lovestone* as co-lead applicant. It lies primarily in UOA1.

1.2 Research strategy

Our fundamental goals are unchanged from REF2014: to recruit and retain the best people, enable them to do the highest quality research into timely and important questions, and help them achieve the maximum impacts. Nevertheless, at the start of this REF period we recognised the need to revitalise our strategy, increase flexibility, refocus priorities, and develop new processes and procedures to deliver on the strategy. Our strategy is nested within the University's Strategic Plan [IES 2.1].

1.2.1 Identification of research priorities

Our research foci result from combining our collective capabilities with major external strategic drivers and opportunities. These include the MRC Global Challenges Research Fund (2015), the Prime Minister's challenges on dementia 2020 (2015), MRC Strategy for Lifelong Mental Health Research (2017), OSCHR Life Sciences Industrial Strategy (2017), UKRI Strategic Prospectus (2018) and the emerging Wellcome Mental Health programme strategy (2019). Our strategic developments in dementia, adolescent mental health, and global health, described below, reflect our responses to these policies and initiatives. Equally, our decision to move urgently and substantively into COVID-19 research (§1.2.2) illustrates the agility and flexibility of our strategy; our successes doing so were enabled by our research environment and culture.

Shaped by the external and internal drivers, each Department produces a strategic plan that is discussed at the Oxford Neuroscience Committee (**Box 1**) and agreed with MSD to ensure broad alignment with overall Divisional objectives, and strengthen the case for financial support from Divisional or University funds when required. Each Department and Centre holds an annual awayday at which achievements and objectives are reviewed; each has a management group where decisions are made and implemented.

Box 1: Oxford Neuroscience Committee (ONC)

The ONC (Chair: *Nobre*) oversees and coordinates strategy and all research activities across the UOA4 departments, and with the molecular neuroscience returned in UOA5 (see 4.1.2). The ONC holds minuted quarterly meetings. Each Head of Department is on the committee, together with representatives for a range of other parties (e.g. Centre Directors, ECRs, graduate studies, EDI, communications, impact). ONC roles include discussion and agreement of strategy including major investments (recruitments, buildings); sharing best practice for career development; supporting fellowship and grant applications, and building an inclusive, diverse community. ONC is supported by a full time Neuroscience coordinator funded by the departments.

These structures and processes provide the framework of support for infrastructure and other institutional commitments necessary for research strategy to be implemented and ideas realised. However, our researchers are not just enabled but encouraged to pursue their own interests and ideas. That is, the culture is one of academic freedom and independent scholarship, with relatively little top-down control, allowing researchers' expertise and enthusiasm to drive the science, form the best collaborations, and obtain the necessary funding.

1.2.2 Examples of strategic developments

- We recognised the opportunity to extend our reach and impact in translational research. Hence a key part of our strategy was to target NIHR funding opportunities as they emerged, resulting in our successful award of the OHBRC in 2016, refunding of the OchCRF, and our leadership and involvement in other new NIHR infrastructures (§3.3).
- With the decision to increase our focus on dementia, we recruited *Lovestone*, *N Buckley, Nevado-Holgado, Raymont*, and *Gallacher,* who brought the MRC Dementia Platform UK to Oxford (§4.1.3), attracted by our research environment and proximity to UK Biobank.
- We identified that the excellence of Oxford's neuroimaging – hitherto not underpinned by any specific funding stream - made it competitive for a Wellcome Centre application. We supported this development in various ways (§3.3), resulting in the creation of WIN in 2017 (§1.4.1).
- To support our development in stroke and dementia epidemiology, we provided significant funding to complement the Wolfson Foundation's support for WCPSD (§3.4, ICS-16TIA).
- Building on our strengths in pain research, we have made major investments in this area (§1.4.3).
- With Wellcome's new focus on developmental mental health, we bolstered our strategy to focus more on childhood (§1.4.5). We recruited *Creswell*, and will include a new theme on adolescence in our OHBRC renewal.
- Our strategic responses to COVID-19 are shown in **Box 2** and future strategy in **Box 3.**

1.2.3 Effect of Tinbergen closure on DEP strategy

Occurring only a year after Glyn Humphreys' sudden death, the disruption caused by the closure of this building led to an urgent review of DEP strategy. Our responses, and how our environment enabled successful outcomes are described in §3.4. Efforts now focus on designing the Life and Mind Building to help deliver the future strategy (§3.7).

Box 2: Effects of COVID-19 on research strategy

We made rapid decisions to commit to major COVID-19 research programmes, whilst supporting researchers moving to front-line care and managing the disruptions to our research facilities. Our ability to respond at scale and speed was greatly facilitated by our research environment: the seamless working across departments, the close relationship with our Biomedical Research Centres, and our external collaborations. To realise this potential, funds were made available to pilot COVID-19 research.

- The OchCRF was used as the site of the initial trial of the Oxford/AZ vaccine in May 2020 accelerating this process when other clinical facilities were unavailable. It was enabled by the formal roles of *Geddes* and *Cipriani* in University and OH management structures.

The success of our initial COVID-19 strategy is shown by the achievements delivered before the end of the REF period:

- External funding, including UKRI/MRC COVID-19 priority grants to *Creswell* and *Singh* (total £1.2M) and a bequest from the Duke of Westminster to DP (£1M).
- Via philanthropic funds the University created a COVID-19 Research Response Fund, through which our researchers were supported (11 awards, totalling £707k).
- Rapid COVID-19 publications on mood regulation (*Saunders*, in JAMA Psychiatry), conspiracy theories (*Freeman*, in Psychological Medicine), and the mental health correlates (*Harrison* and *Geddes,* in Lancet Psychiatry).
- Rapid production of advice and support on coping during lockdown, and open-access evidence syntheses (*Cipriani*).
- *D Clark* has been instrumental in helping the English Improving Access to Psychological Treatments (IAPT) adapt protocols and move to remote working.
- The C-MORE multi-organ imaging study of COVID-19, with sub-studies focused on mental health (*Saunders*) and neuroimaging (*Pattinson, Woolrich*), supported by funds from MSD and DP.
- *Espie* led the International COVID-19 Sleep Study.

1.3 Impact strategy

Our impact strategy is inextricably linked to our research strategy, with potential impact being of the highest priority in the latter. Equally, in 2014 we recognised that achieving the maximum and most rapid impacts requires proactive and ongoing interventions, rather than just being left to happen. Our support for impact has thus been enhanced markedly during this REF period.

Impact Committee. Our **Neuroscience Impact Committee** (Chair, and Associate Head for Impact: *D Clark*) has visited departments and Centres every quarter, meeting with researchers, identifying potential impacts and facilitating achievement of impacts in the broadest sense. The Committee includes industry representatives, other research users, and science communicators. It reports to the ONC.

- In 2015, the Committee organised ImpactFEST, to ensure a continuing and sharpened focus on impact between REF cycles. A range of speakers from charities and other research beneficiaries talking about impact was followed by breakout discussions. 97% of attendees said it helped them understand the importance of impact.
- The University's external appointments policy helps enable impact by allowing 1 month per year of external consultancies without loss of salary [IES 2.2]. 152 new consultancies have been held by our researchers during this REF period.
- The Impact Committee has improved our impact culture and has facilitated achievement of impacts of various kinds (§4.3 for examples) in addition to our impact case studies.

Support for industrial links, spinouts, patents, and IP. We have invested significantly to promote the financial and industrial impacts of our research, and have been successful in these endeavours (§3.5).

Communications strategy. Early in this REF period, we recognised the need to invest in communications to deliver and sustain an ambitious public engagement programme. We developed a strategy and have devoted personnel and resources to support this (§4.2).

1.4 Outcomes of our strategy illustrated by selected research themes

Here we highlight how our strategic approach has allowed growth and productivity, selecting six themes that illustrate our research portfolio. It is not an exhaustive list. The themes introduce the interdisciplinarity of much of our research, a feature highlighted further by the many collaborations with other UOAs, described in §4.1.2.

1.4.1 Neuroimaging

Neuroimaging has been a long-standing strength of Oxford neuroscience, yet until recently it was not underpinned by appropriate funding. A strategic decision was made early in this REF period to provide foundations of this kind. WIN reflects the success of this approach and has allowed us to cement our position at the forefront of neuroimaging. Under the directorship of *Johansen-Berg* and a team of Principal Investigators, WIN has four scientific themes.

- *Cross-species relationships*: major investments in animal imaging facilities, and development of bespoke pipelines and tools. Achievements include discovering homologies between humans, rodents and macaques in brain anatomy, connectivity, behaviour, and computational signatures, and using ultrasound as a non-invasive tool to manipulate deep brain activity.
- *Cross-scale integration*: the relationships between micro and macro level measurements. Insights include using biophysical models to define non-invasive markers of neural computation with validation against cellular recordings and MRI markers of axonal dispersion and myelination validated against histology.
- *Population neuroimaging*: leading neuroimaging within UK Biobank (§4.1.3), and central roles in the Human Connectome Project and other international programs (§4.1.4).
- *Clinical neuroimaging*: WIN is embedded within many projects to bring research findings and expertise into psychiatry and neurology. One example is the Oxford Brain Health Centre, a partnership between WIN, DP, NDCN and OHBRC (§4.3.1). The clinical element of WIN is enhanced by funding of a fulltime clinical imaging coordinator.

WIN also has a theme on Open Neuroimaging (§1.6) and an innovative Public Engagement programme (§4.2). The extension of Wellcome Centre funding until 2024 provides time to ensure sustainability and explore opportunities for further growth.

1.4.2 Behavioural neuroscience

To investigate neural mechanisms of behaviour, we continue to have a strong capability in research using rodents and non-human primates (NHPs). 18 of our researchers have substantial activity in this area. Based in the Biomedical Sciences Building, our behavioural neuroscience has been strengthened by funding of WIN, which has animal research embedded in three of its themes, and which allowed recruitment of *Lerch*, upgrade of the NHP 3T scanner, and a new 7T rodent scanner. Research has also benefitted from the establishment of the MRC BNDU which has rodent work as a core component, and by state-of-the-art facilities for neurophysiology, voltammetry, optogenetics, calcium imaging, lesioning, and ultrasound neuromodulation. Research using NHP behavioural models has been coordinated via a Wellcome Trust Strategic Award (led by *Duncan*). Rodent behavioural research is coordinated by the Jeffrey Gray Behavioural Neuroscience Unit (Director, *Bannerman*), which provides a hub for collaborations across UOA4, and departments returned in UOA5.

1.4.3 Pain

In the last REF period, a strategic decision was made within MSD to invest in pain research, building on the work of *Tracey*. Recruitment of *Bennett* in 2014 was an initial important step and has been followed by *Wiech, A Clark, Slater*, and recently *Seymour*. The work is multidisciplinary, ranging from basic science through to clinical trials in infants and adults, and with active collaborations with surgeons, engineers, paediatricians, and industry. Our researchers lead or co-lead major initiatives including the EU Horizon 2020 DOLORisk project, the NIHR-Bridge neuropathic pain consortium, and Wellcome Pain Consortium, as well as three EU Innovative Medicines Initiative projects. The growth and success of the pain group is reflected in grant income of over £16M, major funding from several pharma companies, award of two patents, and several esteem indicators (§4.4).

1.4.4 Circadian biology and sleep

Through the activities of the Sleep and Circadian Neuroscience Institute (SCNi), funded initially by a Wellcome Strategic Award to *Foster* (2012-17), circadian neuroscience has become an important part of our research portfolio. Strategically, we recruited *Kyle,* equipped two rooms in the OchCRF for sleep studies, and are about to move SCNi into dedicated new space (funded by a Sir Jules Thorn Award). Research spans molecular approaches, animal models, psychiatric aspects, psychological therapies, and digital methods and interventions. In addition to academic outputs, there have been two spin-outs, an ICS [09SLEEPIO], and many media activities.

1.4.5 Developmental psychology and child mental health

We have expanded our established research base in child development to enhance clinical and social aspects. A strategic decision to increase integration and leadership in this area was made, spearheaded by recruitment of *Creswell* to a joint DEP/DP appointment, to head a large programme of work on childhood anxiety, including the UKRI Emerging Minds Network that she leads. Her work includes schools-based studies and interventions, and links closely with studies of adolescent mental health by *M Fazel*, *Park*, and *P Waite*. Other achievements in this research theme include novel interventions for stuttering (*Watkins*); understanding how early attention and executive functions predict numeracy skills (*Scerif*); explaining how sleep impacts on linguistic and cognitive development (*Plunkett*); understanding interrelationships between neurodevelopmental disorders (*Bird, Bishop*), and study of reading and language processing and development of effective interventions (*Nation, Snowling*).

1.4.6 Global mental health

Through the Global Challenge Research Fund (GCRF), the Africa Oxford Initiative (AfOx), and major external funding, we have a significant and interdisciplinary involvement in global health research, especially in children and adolescents. *Stein* leads collaborative programmes in South Africa and Brazil (totalling £6.9M), including a Wellcome/DFID/MRC Joint Global Health Trials award to ameliorate depression and enhance child development in mothers with HIV. He also leads a component of the GCRF Accelerating Achievement for Africa's Adolescents program. *Bowes* works with UNICEF to develop and test bullying interventions in low- and middle-income countries (LMICs), and *Scerif* is working on an MRC-funded study to enhance adolescents' cognitive functioning. *Newton* studies autism and epilepsy in several African countries, with projects ranging from genomics to an NIHR-funded trial of caregiver skills training. *Singh* is developing ethical frameworks for research in LMICs, funded by UKRI, British Academy, and others.

1.5 Progress against future plans outlined in REF2014

Several aims were set out in REF 2014, and we have made substantial progress in most domains. As planned:

- we developed our expertise and capacity in dementia research, notably via the funding of the OHBRC, several strategic recruitments (§1.2.2), and support for ECRs in this area (*Brosnan, Koychev, Suri*).
- we were successful in forming the BNDU and securing funded from MRC.

- we established MRI in DP, and upgraded our magnetoencephalography facility (§3.3).
- we achieved our goal of substantially increased NIHR support to drive our translational research (§3.1).

After Humphreys' death we did not pursue the plan to host a single centre EU Initial Training Network, though we are now part of three international networks.

1.6 Open and reproducible research

We are committed to an open research environment, beyond open access and archiving [IES 2.4]:

- In 2015 *Bishop* chaired a symposium on reproducibility organised by the Academy of Medical Sciences. Subsequently she has chaired the advisory board of the UK Reproducibility Workshop, and co-organised an annual summer school on reproducible methods funded by BBSRC from 2015-18.
- In 2018, enthusiastic students in DEP set up ReproducibiliTea – a grassroots journal club which has rapidly spread to 112 institutions in 25 countries. ECRs and graduate students then formed Reproducible Research Oxford (RROx), which holds workshops, hosts resources, and promotes good practice (e,g. petitioning to move statistics teaching from proprietary programs to 'R') [IES 2.4]. In 2019, RROx was awarded £120K by the University to employ a full-time reproducibility and open science coordinator.
- WIN has Open Science as one of its core themes, with resources committed to facilitating them, including a full-time Open Science Engagement Co-ordinator. Theme goals cover data, protocols, tools, paradigms and communities.
- We have taken a leading role in promoting openness in animal research, including virtual tours of the non-human primate research facility.

1.7 Research integrity

In addition to the growth of open and reproducible science initiatives, we have worked to enhance and promote research integrity. All our policies and procedures meet or exceed the requirements of the UK Concordat to Support Research Integrity [IES 2.7].

- A mandatory online training course was introduced for all research staff and graduate students in Spring 2020, covering diverse aspects of research integrity, and requiring a test to be passed.
- As part of the OHBRC and the allied new Clinical Trials Unit (led by *Raymont)*, new governance structures and procedures have been introduced, applying to all trials and experimental medicine studies, to improve quality and ensure regulatory compliance.
- Through *Singh's* leadership within the Wellcome Centre for Neuroethics, clinical neuroscience research ethics and integrity has been an active research focus.

1.8 Future research strategy

Our research and impact strategy for the next REF period is well developed, building on our strengths and our horizon-scanning, and shaped latterly by the challenges and opportunities provided by COVID-19. Scientifically, our future strategy is concentrating on:

Enhancing translational and clinical capacity. Our NIHR funding has allowed us to increase substantially our clinical and translational outputs and impacts. We see scope to enhance this further, seeking renewal and expansion of the OHBRC and OchCRF, and by support for junior clinical academics (§2.1.6). We are also committed to growing links with the rest of medicine, focusing on multimorbidity research, partnering with the Departments of Primary Care Health Sciences and Population Health (UOA2), and others.

Moving from genomic discoveries to novel therapeutics. Oxford has strengths in 'omics' and bioinformatics via the Wellcome Centre for Human Genetics, Big Data Institute, Structural

Genomics Consortium, Drug Discovery Institute, and the new Centre for Medicines Discovery. We now plan to better utilise these capabilities for neuropsychiatric disease understanding and target discovery. This is being driven by the forthcoming appointment to the Davys Chair in Neuroscience, by junior recruitments, and by funding via OHBRC and other partners. The award in October 2020 to *Tunbridge* of the first Psychiatry Medicines Discovery Catapult grant will further strengthen this activity.

Extending reach to other communities. We seek to increase markedly our reach, and to expand our research programs to underserved populations, capitalising on our recent recruitment of *Bhui*. Our BRC renewals will include a new focus on how deprivation and ethnicity impact on mental health, and we are forging links with other institutions and organisations to help deliver this strategy (§4.5).

COVID-19 research. We will grow our involvement in, and leadership of, the neurological, psychiatric and psychological aspects of COVID-19, building upon our clinical academic expertise and our close NHS/NIHR partnerships (**Box 3**).

Box 3: Future COVID-19 research strategy

- *Geddes* leads the brain health component of PHOSP-COVID, the UKRI-funded study.
- *Creswell* and *P Waite* lead the Oxford arm of the UKRI-funded KCL/Oxford RCT (~£500K) of a family intervention against the behavioural impacts of COVID-19 and lockdown.
- We are a site in the UKRI COVID-CNS study of the neuropsychiatric sequelae (*Husain, Harrison, Jezzard)*.
- *Singh* will lead a £1.4M project from December 2020, funded by Wellcome, for the 'Ethics Accelerator', to provide urgent reviews of COVID-19 issues.

2. People

Recruiting, retaining, supporting, and developing our staff is critical to creating the best possible research environment. We have made significant strides in ensuring we achieve these goals. Of the 186 researchers (169.35 FTE) submitted for REF2021:

- 70 (38%) are clinicians, including 21 neurologists, 19 psychiatrists, 14 clinical psychologists, 4 neurosurgeons and 4 ophthalmologists.
- 75 (40%) identify as female.
- Of the 168 with recorded nationalities, 113 (67%) are from UK, 34 (20%) from EU, and 21 (13%) from other countries.
- 13 (7%) have taken up a senior position with us from outside Oxford, during this REF period.
- 31 (17%) are funded by independent Fellowships, including 7 Sir Henry Dale Fellows, 7 Sir Henry Wellcome Fellows, 4 MRC Career Development Fellows, 3 Wellcome Post-doctoral Clinical Fellows, 3 Royal Academy of Engineering Fellows, 2 British Academy Fellows, and 1 BBSRC David Phillips Fellow, UKRI Future Leaders Fellow, and MRC Skills Development Fellow.
- In total, 42 (23%) of our submitted staff (REF1) meet the HESA definition of ECRs (within 4 years of their first independent post) including those who have developed independence through responsibility for a part of a larger project.

2.1 Staffing strategy

We have achieved sustainability and vitality through a range of new appointments and new processes to enhance career progression and staff support. All developments have been designed to underpin and support our research and impact strategy outlined in §1.2-1.4. Whilst academic excellence and potential remain the primary considerations, we have paid increasing attention to **Equality, Diversity and Inclusion** (**EDI**) and wellbeing issues, through a range of new initiatives, policies and procedures.

2.1.1 Recruitment

We have made 13 senior appointments from outside Oxford (*Bhui, Bird, Creswell, Gallacher, Hepach, Kuyken, Lerch, Lovestone, Raymont, Salkovskis, Seymour, Singh, Vincent*). Only three were refilling of statutory posts; the others were created to invest in research leadership and capabilities. These recruitments, together with internal staff development, reflect our strategic plan to sustain and expand specific areas in which we already had significant research expertise (e.g. neuroimaging and clinical psychology) or to grow areas where we had identified the need to do so (e.g. dementia).

Several of these appointments required significant investment, primarily devolved to departmental decisions based upon a scientific business case developed by the senior management team, in liaison with MSD and ONC. Departmental commitments have included supporting salary when external funding has been applied for but not secured, is insufficient, or has ended. We have also funded administrative and research assistants for senior appointees to ensure research programmes can start smoothly. Academic staff are encouraged to take sabbatical leave [IES 3.1].

We have used honorary departmental memberships and visiting Professorships to recognise key individuals who are actively involved with our research programmes to promote further collaborations and opportunities for impact, e.g., Linda Richter (University of Witwatersrand), Trevor Young (University of Toronto), Daniel Weinberger (Lieber Institute for Brain Development).

2.1.2 Career development and support

We have introduced a range of policies and procedures of benefit to all our staff, in addition to activities targeted specifically at junior researchers (§2.1.3), graduate students (§2.1.4), and with a focus on EDI (§2.2).

Improved processes include:

- An induction and welcome pack. Induction includes links to all relevant policies, an introduction to Athena SWAN and EDI contacts, and mandatory online courses including research integrity, implicit bias, bullying and harassment, and racial bias.
- Personal development review (PDR) for all staff was introduced in 2014. Initially, uptake was low (25-40%). We therefore sought and received feedback, resulting in simplified forms and more training for those conducting PDR. These changes have seen a steady increase in completion rates and satisfaction (Table 1).
- Better communications, including weekly Head of Department briefings, newsletters, and web-based information on seminars, training opportunities and other events.
- Support staff have been included in many of these developments, as well as having their own arrangements, including a working group, and a fund for career development.
- Pastoral and mental health support, through a range of activities described in §2.3.

We conduct regular surveys of our research and support staff. **Table 1** shows responses to the largest recent survey (2016; n=409).

Question /statement	% of women agreeing	% of men agreeing
Were you offered induction?	85	86
Was induction useful?	92	87
My contributions are valued	93	91
Are you supported to think about professional development?	84	82
Do you take time to reflect on, and plan for, career development?	84	88
Have you had a PDR within the past two years?	77	72
If so, was your PDR useful?	92	89
How useful did you find mentoring to be?	97	93
I feel integrated into my team	92	95
Overall I am satisfied in my job	91	89
I would recommend working in my department to a friend	91	89

Table 1. Results from staff survey

2.1.3 Postdoctoral and early career researchers

Enhancement of opportunities and support for junior researchers is a strategic priority, led within MSD by an Academic Advocate for Research Staff Development. Our researchers are encouraged to take advantage of the wide range of free training, management, and personal development programmes run by the University [IES 3.1]. In addition, we have introduced and evolved a range of UOA4-specific efforts to support those early in their careers. Facilitated by new departmental administrative appointments, these procedures are increasingly standardised across our departments and Centres, with good practice shared.

- Each department has a faculty lead who coordinates activities, including a peer-to-peer support network. The lead reports to the departmental senior management team and serves as first port of call for queries from junior researchers.
- A seminar series ensures regular opportunities for researchers to present their work. All formal meetings (e.g. away-days: the annual Oxford Neuroscience Day) have slots dedicated to junior researchers. For example, at the DP 50th anniversary 2-day meeting in 2019, 12 gave a talk, and others led the Q&A sessions.
- Mentoring is offered (by trained mentors) to all postdocs and ECRs. We have published processes for researchers wanting to apply for Fellowships, to ensure these are equitable.
- We encourage and facilitate fellowship applicants to discuss their ideas with senior colleagues. DP holds fortnightly research meetings for potential applicants to present their proposals; these meetings are highly rated and attended regularly by 30-100 people. We run ‘mock’ grant panel interviews for all fellowship applicants, which are highly rated in our surveys.
- The Colleges provide additional opportunities for developing research independence, particularly through formal Junior Research Fellowships (JRF), some of which are stipendiary, and all of which provide access to College resources and funding. 12 of our ECRs have a JRF.
- We provide mid-term reviews for all Fellows, with at least two senior researchers, one of whom is external to the host department, to review progress and plans.
- We provide information to enable researchers to understand better the academic career tracks, and the criteria for becoming a Principal Investigator in their Department and for the titles of Research Lecturer or Associate Professor (and give support for these applications).
- Support specifically for clinical researchers is described in 2.1.6.

Our postdocs and research fellows have appreciated these developments:

- In 2014 only 35% were clear about training and career opportunities; by 2018 this figure had risen to 79%, with 85% agreeing that they were given time and support to reflect and plan for career development.
- Mentoring has increased. For example, in DEP in 2016 35% reported being mentored; improved advertising and procedures culminated in a figure of 92% in 2020, with 91% reporting it useful.

Of the ECRs who left during this REF period, onward appointments include: Jerome Sallet (Sir Henry Dale Fellow, now at INSERM), Matt Apps (UKRI Future Leader Fellow) and Pat Lockwood (MRC Skills Development Fellow), both now at Birmingham University; Tamar Makin (Sir Henry Dale Fellow, now Professor in Cognitive Neuroscience, UCL), Falk Eippert (now group leader, Max Planck Institute, Leipzig), Erie Boorman (Sir Henry Wellcome Fellow, now Associate Professor, UC Davis).

Early Career Researchers' experiences

"I got a lot of career support in the department. In addition to lab and PI-based support, the ECR workshops were very helpful. Certainly, contacts via these events, as well as direct mentors, were useful in negotiating start up, understanding what was reasonable etc. I also thought the PDR process, and the idea on self-reflecting on what would help one's career was very useful throughout my time as a postdoc."

"I had a tremendous amount of support…which I believe was crucial in enabling me to successfully obtain the award. I feel very lucky to work in this Department and am grateful for all the opportunities it affords me."

"Staff development and training is very prominent…there are always lots of interesting things to get involved with".

2.1.4 Graduate students

As with ECRs, we have substantially enhanced and refreshed our provision for graduate students, the majority studying for a DPhil. These apply to all students, whether admitted in one of our externally funded doctoral programmes (**Box 4**) or directly to a specific project, funded by departmental, University or external scholarships. We awarded 387 DPhils during this REF period (REF4a; **Figure 3**).

Overall responsibility is taken by the Director of Graduate Studies (DGS) within each department [IES 3.3]. Each DGS works with an administrative assistant. Each DGS holds regular one-to-one meetings with graduate students. Our DGSs sit on the Graduate Studies Committee, which reports to the MSD Educational Policy and Standards Committee. Recruitment is coordinated through the Medical Sciences Graduate School for consistency and to share best practice.

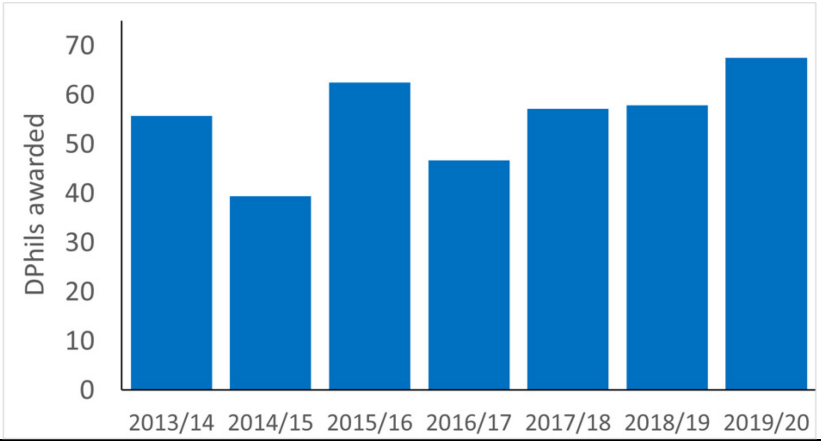

Figure 3. DPhils awarded during this REF period [REF4a].

Box 4: Funded DPhil programmes

Wellcome MSc/DPhil Neuroscience programme. This programme remained highly competitive, (193-250 applicants per year) with all 35 students in this REF period having 1st class degrees. 60% are female; 53% come from the EU, and 20% from other countries. The students have authored 147 papers during their doctorates, including 14 in *Journal of Neuroscience*, 9 in *Neuron*, 6 in *PNAS*, and 5 in *Nature Neuroscience*. Of those who have completed, all except two remain in research; one returned to clinical medicine and one is a science writer.

Wellcome clinical doctoral programme – mental and cognitive health. In 2014 Wellcome funded a stream of their Oxford clinical doctoral programme dedicated to mental and cognitive health, open to psychiatrists, clinical psychologists, and behavioural neurologists. This was the first such programme in England. It has so far supported 7 psychiatrists, 8 clinical psychologists and 2 neurologists. 6 (35%) are men, 11 (65%) are women. 15 (88%) were new to Oxford. All students carry out therapeutically focused projects, have placements in a research clinic, and complete a range of training courses to equip them for an academic clinical career.

On arrival: All new students attend induction sessions covering academic, administrative, library and other resources, safety, welfare and training issues. Materials are available online and students are provided with a copy of the course handbook. The websites also provide general information relating to buildings and facilities, finance, human resources and communication arrangements, and policies on EDI, information security, and harassment and bullying.

Supervision: All doctoral supervisors complete mandatory training every three years and adhere to the Code of Practice for Supervisors. Each student has at least two supervisors, with whom they meet regularly and who write termly reports, reviewed by the DGS [IES 3.3]. Any identified problems are followed by an action plan and reviewed the following term. Our students have formal checkpoints in their 4th term and again in 8th or 9th term, via a written report and viva with two independent academics. These allow progress to be assessed and any concerns identified and remedial actions put in place.

Broad and responsive training:

- Several compulsory courses are completed within three months of starting the DPhil: (Avoiding Plagiarism, Research Integrity, Unconscious Bias, Challenging Behaviour, and Information Security [redone annually]). Although not mandatory, all first year DPhil students are encouraged to attend a series of statistics workshops.
- After their first year, graduate students are encouraged to gain teaching experience, with the agreement of their supervisors, and opportunities are provided. Before doing so, they complete the 'Preparing for Learning and Teaching' course run by the MSD Skills Training Programme. Bespoke courses for lecturing, tutoring and practical teaching are also run.
- All students have a formal Training Needs Analysis, discussed with their supervisors at the start of the DPhil programme and reviewed at every termly meeting.
- We are responsive to requests for additional training. For example, in 2017, the DP student survey revealed a wish for more statistics teaching. In response, we employed a senior statistician one day a week, and in 2019 held a one-week statistics workshop. Feedback was extremely positive and we will repeat it.
- Doctoral students are encouraged to learn about and participate in public engagement, reproducibility, and open science, via initiatives described in §1.6, §1.7 and §4.2.
- Our students contribute to the MSD DPhil day, the showcase of Oxford doctoral research. NDCN has an annual Thomas Willis Day at which all students present a poster. In DEP, doctoral students have a science day dedicated to them at the start of the second year.

College support. All students are also members of a College, which provides additional pastoral, financial and academic support. There is integration between Colleges and departments, with College advisers reading and augmenting the termly reports written by supervisors.

Our data and surveys show that these processes are successful, with high and prompt completion rates (85% within 4 years) and a high level of satisfaction. We assess graduate student satisfaction annually via anonymous 'Student Barometer' surveys. These show consistently high ratings. In 2013, there was a 77-90% overall satisfaction across our Departments; in 2018 the figures were 90-95%. In 2018, 100% were satisfied with their supervisors, of whom 78% were very satisfied.

To broaden the reach of our recruitment into doctorates, we introduced two new MSc programmes:

- An on-line MSc in Sleep Medicine in 2016. This was the first online MSc course approved within MSD. 43 students have so far enrolled (65% overseas; 60% female).
- An MSc in Clinical and Therapeutic Neuroscience started in 2019. The first year had 20 places and was oversubscribed. More than half the students in 2019/20 were from outside the UK.

Quotes from graduate students

"I am really grateful for everything the department provides. The academic and non-academic staff are amazing – warm and friendly and brilliant. It's a wonderful place to study. Thank you."

"Thank you to the leadership and support of the staff for the exceptional work during this Pandemic."

"This was a fantastic opportunity…these meetings are very friendly and provide a great setting to practise for when I present my work at more official occasions." (DPhil student presenting work internally).

"Students spoke very highly of the DGS, who was reported as very accessible and responsive". (From the 2016 external review of DP).

2.1.5 Doctoral training in clinical psychology (DClinPsych)

In 2018 the Oxford doctoral training programme in clinical psychology (DClinPsych) appointed a new Director (*Salkovskis*). The course has been transformed, moving from Postgraduate Training to Postgraduate Research status, and increasing from 14 to 32 students per year. There are now strong research links with DEP and DP, and the course is growing the workforce of research-trained clinical psychologists.

- The course is highly competitive, with ~700 applicants for 32 places. Gender distribution (5 men, 27 women for 2019 intake) reflects that of psychology as an undergraduate degree.
- DClinPsych students are supported by an equivalent range of processes as described for DPhil students.

2.1.6 Clinical academics and Category C staff

In addition to the 70 clinical academics returned here, we work closely with many NHS clinicians. Through the strong partnerships we have forged with our local Trusts (OUH and OH), we can greatly enhance translational research opportunities, accelerate clinical applications, and foster a rich collaborative environment in which category C staff thrive, with their contributions – and needs – fully appreciated by both University and NHS. Oxford's unique hosting of two NIHR Biomedical Research Centres (OBRC and OHBRC) reflects, and further promotes, the exceptionally close relationship between NHS and University (§3.3 and 4.3.1).

Category C staff: Excluding clinical research fellows (see below), at least 25 consultants from OUH and OH make substantive contributions to our research: Examples include:

- Peter Charbel Issa – consultant ophthalmologist, part funded by OBRC. Collaborates with *MacLaren* on a gene therapy trial.
- Rupert McShane – consultant psychiatrist, Associate Professor, part-funded by OHBRC. Runs a ketamine clinic and works with *Harmer* and *Hunt*.
- Jacqueline Palace – consultant neurologist, leads the Oxford Multiple Sclerosis and Neuromyelitis Group. She contributes to research projects with *De Luca, Leite* and *Waters.*
- Sarah Pendlebury – consultant physician and Professor in NDCN. Researches dementia and delirium, including collaborations with *Rothwell*.
- Arjune Sen – consultant neurologist and Senior Research Fellow in OBRC. He leads the Oxford Epilepsy Research Group, holding a grant on pharmacoresistance (£1.3M) and working with *Newton, Husain* and *Waters*.
- Philip Cowen is an MRC scientist and psychopharmacologist. He works closely with *Browning, Godlewska, Harmer,* and *S Murphy*, with sharing of resources.

To facilitate these interactions:

- we offer honorary membership of the relevant department (providing access to University resources, e.g., library and computing services);
- we invite them to all academic meetings (and many regularly attend);
- in 2017, the NDCN Staff Development Officer completed an in-depth analysis of challenges for female clinical academics, resulting in formation of the Women in Clinical Neuroscience Network, and a meeting for 100 UK female clinical academics arranged for 2020 (delayed due to pandemic).
- In 2018 DP designed new consultant psychiatrist posts in which 0.5 FTE is ring-fenced for research for three years. To date, two promising academic clinicians have been recruited and funded by OH.

Clinical research fellows. We are fortunate to have many clinical academics on Fellowship schemes, including 5 currently funded by Wellcome, 3 by MRC, and 3 by NIHR. They play a key role in our research and we support them via the Oxford University Clinical Academics Graduate School (OUCAGS), through student provision where relevant (Section 2.1.4), and as specific to their Fellowship. Nevertheless, we remain aware of the ongoing challenges that clinical academic trainees face, and have worked hard to make the local environment as supportive as possible:

- In addition to the Wellcome clinical programme (**Box 4**), we have actively recruited neurologists and psychiatrists to NIHR Academic Clinical Fellowships (n=39) and Academic Clinical Lectureships (n=8), and support research projects within the Academic Foundation Programme.
- We have a psychiatry mentorship scheme whereby we identify medical students with academic potential and continue to support them after qualification and into specialist training.
- Our forthcoming OHBRC renewal application will include funding specifically to support trainee academic psychiatrists and psychologists.

2.2 Equality, Diversity and Inclusion (EDI)

2.2.1 Gender equality and Athena SWAN (AS)

All departments have AS Silver awards (DP: 2014, renewed 2018; NDCN: 2015, renewed 2020; DEP: 2015, renewal in preparation for submission November 2020) and have shown commitment and an upward trajectory consistent with these awards. Examples of our progressive procedures include:

- Each department has an academic AS lead, and an AS working group or committee which has wide representation (e.g. for LGBT+, ethnicity) and which oversees all activities and reports to the departmental management team. Recommendations that have been

adopted include a Parents and Carers fund, a handbook covering parental leave issues, seminars on impostor syndrome and gender identity, and Bystander training.

- A total of £92,610 has been awarded to our researchers from the Returning Carers Fund, as grants normally up to £5k to overcome barriers on returning from carers leave.
- Departments have employed people for time-limited periods to develop specific aspects of strategy (e.g. to evaluate views and experiences regarding parental leave).
- AS and EDI are standing items at all departmental meetings.
- All meetings and seminars are now scheduled within core hours (0930-1600).
- Gender balance is audited for a wide range of activities – e.g. application success rates, shortlisting, guest speakers, seminars, administrative burden, websites, etc.
- We identified that women were less likely to apply for professorial titles. Departments now invite women to discuss their candidacy with the Head of Department, and we offer support with their applications.
- Reflecting the above efforts, women now have a higher success rate than men in the Recognition of Distinction exercise (62% vs. 52%) and in Fellowship applications (46% vs. 31%).
- In 2018, DP identified a gender imbalance in the use of fixed-term contracts. A review was held, leading to five people (4 female) being moved onto permanent or open-ended contracts.
- To increase visibility, a high-profile female psychologist delivers the annual Anne Treisman Lecture.
- In 2016, DEP nominated *Bishop* as one of twenty portraits to celebrate University Women commissioned by the University in 2016. The portrait is on permanent display in central Oxford.
- The EPICS project website celebrates 100 female DEP graduates who have gone on to make meaningful contributions in academia and beyond.

We regularly survey our staff's views on these and other AS-driven changes, with positive feedback.

- In NDCN, the proportion of people who would recommend working in the department has risen steadily, from 83% in 2014 to 93% in 2018 (with no difference between genders).
- In DP in 2018, 92% (35/38) of staff with caring responsibilities are happy with core hours, and 94% agree that meetings are scheduled to accommodate caring responsibilities.

Experiences of EDI support

"One of the biggest challenges I have faced as a woman in science is balancing raising a young child with a career. I was very grateful for the support that I received... My mentor provided immense support and encouragement. The session on 'How to handle your career with a young baby' with senior academics offered practical advice and personal experience… Upon return from maternity leave, I received support from the Returning Carers fund […] which was particularly helpful in speeding up my research and setting me up for funding applications. These boosted my confidence in continuing to pursue a career in science." (Junior researcher who took maternity leave).

"Very good. Easy to organise, flexibly implemented. Took a lot of stress out of things." (Junior researcher who took paternity leave).

Representation of women. Of the 186 research staff returned here, 75 (40%) are female. Reflecting our efforts, a range of metrics show how representation of women in our departments has increased:

- A significant increase in the proportion and number of female full professors. 23 of 63 (37%) are now women, compared to 11 of 50 (22%) in 2013.
- The trajectory towards equality, including at senior level, is set to continue, since 50% of ECRs and 48% of Associate Professors are now female.
- The proportion of female clinical ECRs has increased from 41% in 2015 to 58% in 2019.

- Women hold more leadership roles. For example, *Nobre* (Head of DEP and Chair of ONC), *Johansen-Berg* (Head of WIN, and of the Institutional Strategic Research Fund), *Tracey* (Head of NDCN, now Warden of Merton College).

2.2.2 Broader EDI initiatives

We are proud of our ongoing efforts towards gender equality but are fully aware that they need to be complemented by EDI actions to allow equivalent progress in other domains. '*Our science is better if we are diverse. Our workplace is better when we are inclusive*' is the mantra adopted by WIN, now being implemented across all our departments. These efforts occur within the context of the MSD setting up an EDI Steering Group, on which we are represented.

LGBT+. NDCN, DEP and WIN all have groups to support and represent LGBT+, and DP is implementing one also. LGBT+ was the major EDI focus of WIN for 2019-20 and involved both top-down and bottom-up initiatives, such as role model visibility, ally training, and provision of a bespoke information toolkit.

Race and ethnicity. We realise that we have room for significant improvement in this area, and have embarked on several initiatives. In 2019, race and ethnic equality was chosen as our EDI strategic priority for the coming year. Many of the initiatives will come to fruition during the next REF period, but some were realised before the end of July 2020:

- *Miller* received a £77K environment enrichment grant from Wellcome, linking WIN and the two other Wellcome Centres in Oxford. This funds a 0.5 FTE post working alongside a consultant for two years to develop and implement initiatives in mental health for staff and students from marginalised groups. Departments provided matched funding (0.5FTE) to translate EDI efforts into the broader landscape.
- *Bhui* was appointed in May 2020, and his expertise with regard to ethnicity and mental health is being utilised across our research portfolio, as well as informing our EDI activities and priorities.
- Remunerated Associate Head of Department (People and Culture) posts have been created in DP and DEP with specific remit to lead on EDI issues, each working with a Race Equality Working Group.
- Our DClinPsych course (§2.1.5) has an active outreach and mentorship scheme for BAME applicants and those from deprived communities; the course currently has 25% BAME representation.

Bullying and harassment. All our departments have several Harassment Advisers who have undergone formal training provided by the University. The WIN EDI committee have all also been trained. In DP and DEP, an anti-bullying week is held each year with a talk and discussion.

Other areas. Working groups have been set up to focus on neurodiversity, disability, and women in engineering. Each area is driven by motivated junior researchers who we encourage to come up with activities and initiatives that are then supported by the relevant department(s).

EDI within this REF submission. The University considered this issue carefully when preparing the Code of Practice [IES 3.4]. The UOA4 co-ordinator played no role in decisions about eligibility. All nominated outputs were reviewed by at least two reviewers, with scores moderated by the co-ordinator. Initial selection and attribution were done anonymously to reduce effects of unconscious bias, and to distribute outputs as broadly as possible within the quality profile.

2.3 Mental health and wellbeing

This REF period has seen a new and substantial focus on wellbeing. Initiatives and achievements include:

- We have funded >25 staff to attend two-day training courses to become mental health first-aiders. They act as a first point of call for staff and students experiencing distress.
- DP introduced a weekly yoga class which was over-subscribed, and DEP has 'Mindful Mondays'

- *Miller* and *O'Shea* lead a cross-departmental initiative, THRIVE, which focuses on resilience and promoting wellbeing. It is a funded initiative, informed by personal experiences, and provides signposting and materials to support and empower staff with regard to mental health.
- A two-hour session on mental health for all doctoral supervisors is held annually by the University Counselling Service.
- Issues related to COVID-19 have been addressed **(Box 5**).

Box 5: Staff support and wellbeing during COVID-19

Our researchers have been active in tackling COVID-19-related mental health issues (Boxes 2 and 3). We have not neglected our own staff and students in this regard:

- Mental health training for line managers has been introduced, run by the Charlie Waller Memorial Trust, with a focus on skills to support staff who are working at home and at risk of mental health difficulties.
- Departmental briefings and communications have moved on line, and become weekly rather than monthly.
- Webinars have been held to share experiences and tips regarding home working, the effect of COVID-19 on career development, and on how to stay healthy.
- Departmental websites include pages devoted to COVID-19, and link to other online resources for information and advice.
- A WIN survey found 95% of staff felt well supported during the pandemic.

2.4 Future plans

Recruitment: We will continue actively to seek endowments and other donations to support recruitment, retention and career development. Key areas have been identified where recruitments will be prioritised, in line with the strategic plan outlined in Section §1.

Career development: As well as the new academic clinical posts planned in the OHBRC renewal (§2.1.6) we will create further new posts for junior academic psychiatrists using a flexible funding model with OH. DEP are creating five career development lectureships as 4-year transitional posts, linked to a College.

EDI: Despite the removal of a Silver award as a requirement for NIHR funding, we remain fully committed to AS and all other aspects of EDI. We will remain proactive and innovative to address other inequalities through departmental and broader initiatives. We will be involved in the new 'in2research' mentorship programme for students from low-income and BAME backgrounds.

Doctoral students. Sustaining and expanding top-quality graduate training is a top priority. With the ending of the Wellcome MSc/DPhil Neuroscience program, we look to replace these studentships from other sources, including the new NeurotechEU program (§4.1.4). Other innovative approaches to fund studentships are also underway.

2.4.1 Mental health and wellbeing

- A transformation of mental health services for all graduate students is being developed, to provide a bespoke service (led by *Saunders* and *Geddes*).
- A group of senior clinical psychologists in DP and DEP is being established to advise how better to develop and implement mental health supports and therapies to staff and students.
- WIN has made Wellness and Mental Health its EDI strategic focus for 2020-21.
- DEP created a seminar series to educate staff about mental health and how to promote it.
- DP ran a series of webinars, available on YouTube, where public figures discuss mental health issues with our researchers (e.g. Mariella Frostrup with *Creswell*; Dame Kristin Scott Thomas with *Foster*).

3. Income, infrastructure and facilities

We have increased our income to allow new investments in our estate – as well as in our staff described in section 2 – enabling us to enhance the quality and capacity of our research.

3.1 Summary of income

We have achieved substantial growth of research income, with a **71% increase** from £27.4M in 2013-14 to £49.0M in 2019-20. Total funding over this REF period was **£288.3M** (**Figure 4A**), equating to £1.7M per submitted FTE.

- The increase has occurred across all sectors and funders, including Wellcome (+28%), research councils (+97%), and NIHR (health research, 5-fold), as well as industry (+350%) (**Figures 4B and 4C**). In 2019-20, our research income came from Wellcome (30.6% of total), research councils (27.1%), NIHR (health research, 13%), industry (8.5%), EU government (7.5%), UK public sector (4.6%) and other sources (6.7%) (**Figure 4C**).
- The proportion of income from industry increased from 4.3% in 2013-14 to 8.5% in 2019-20.
- Major grants during this period include WIN (£11.5M), WCPSD (£7M), MRC BNDU (£23.6M, including renewal), and OHBRC (£12.8M).
- Funding for our COVID-19 research obtained by July 2020 totalled £2.45M.
- Research income reported for 2015/16 in REF4b includes £3M capital income that was incurred in other years, due to a change in HESA reporting conventions.

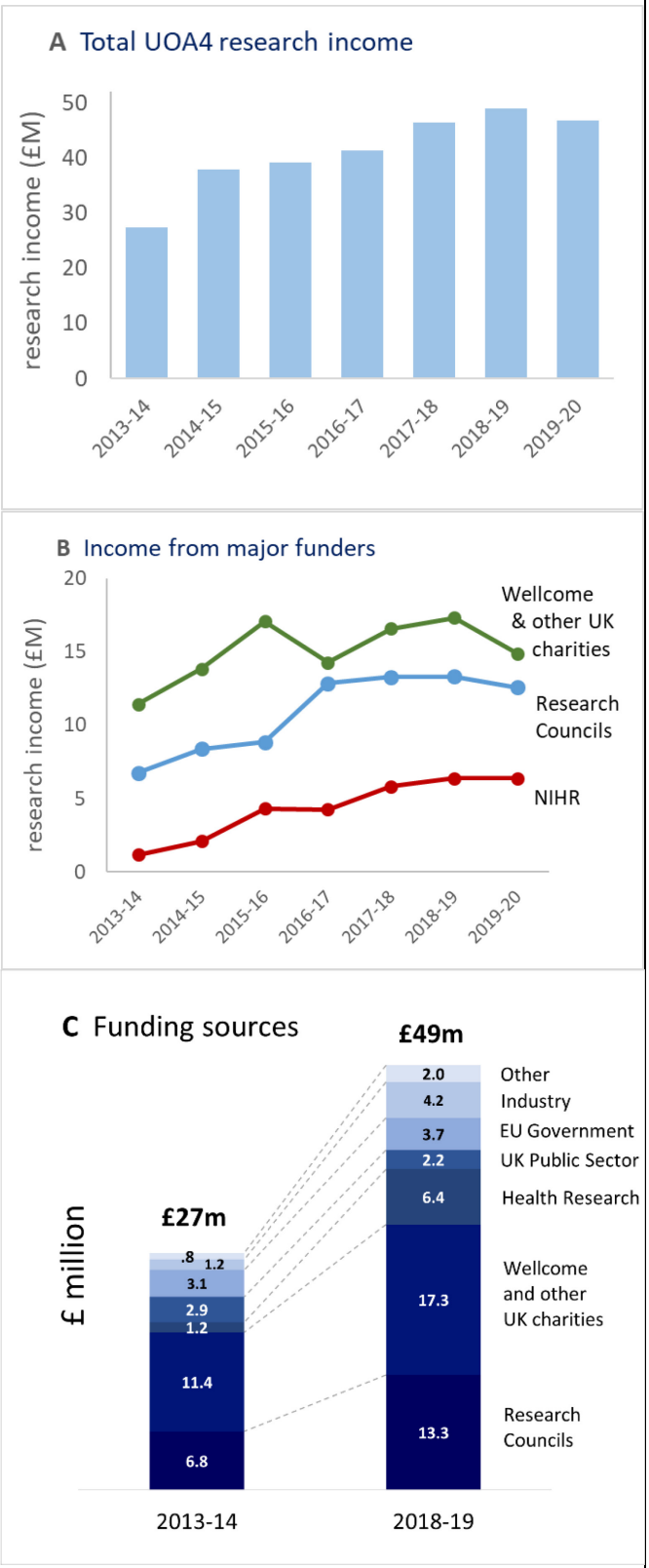

Figure 4. UOA4 research income:
(A) Total per year from all sources [REF4b],
(B) from major funders,
(C) comparison of 2013/14 to 2018/19.

3.2 Strategies for generating research income

Our strategy for generating research income is an integral part of our overall research and impact strategy. That is, we seek to create the optimal environment to make our research attractive to the full range of funders. This includes focusing on research topics which are timely and which will produce impact, and having the staff and infrastructure that allow us to deliver major research programmes.

We approach the cost recovery and sustainability of our research income 'in the round', taking into account the overall benefits to our research activities, and our desire to support young researchers. For example, we support junior researchers whom we identify as having the potential to apply for Fellowships, even if the scheme is cash limited and cannot fully cover its costs, where aligned with our research strategy.

We support our strategy to generate research income by judicious use of internal funds to pump prime and leverage external applications.

- The Oxford-Wellcome Institutional Strategic Support Fund (ISSF) provides funding for strategic needs to complement or leverage external support. Our researchers have received six ISSF awards during the period (over £246k).
- The John Fell Fund provides funding to develop research ideas [IES 2.1] and has provided £964k in pump-priming awards to UOA4 researchers over the period.
- *Creswell* built on data from an award from the COVID-19 Research Response Fund (**Box 2**) to apply successfully for a UKRI COVID-19 award.

3.2.1 Strategic approach to philanthropic funding

We have increased our efforts to support research with philanthropic funding, coordinating activity through ONC and the MSD Development Office. We highlight initiatives that may be attractive to donors. We have held events (e.g. at the Royal Society) at which our researchers showcase their work and meet with individuals who may be interested. Major donations received in this REF period include:

- The Wolfson Foundation provided £4M towards the WCPSD (*Rothwell*).
- The Sir John Ritblat Family Foundation endowed a Chair in Mindfulness and Psychological Science (£3.5M*, Kuyken*) and allowed expansion of the Oxford Mindfulness Centre.
- A private family trust donated £1M via the Motor Neurone Disease Association to support research (*Talbot)*.
- The Swiss International Foundation provided €1.14M in 2019 to support virtual reality research (*Freeman)*.
- The Duke of Westminster donated £1M to DP to support research into how COVID-19 has affected the mental health of adolescents.

3.3 Development of NHS and NIHR infrastructure

There is exceptional integration and synergy between our UOA4 departments and local NHS infrastructure and resources (**Box 6**), which we have developed during this REF period, driven by our successful strategy to expand dramatically our support from various NIHR funding streams.

3.3.1 Oxford's NIHR Biomedical Research Centres

In the previous REF period, we identified securing major NIHR funding for research infrastructure as a priority, taking full advantage of our strong track record in translational research, and our excellent NHS partnerships.

Box 6: Integration between University and NHS facilities

Our clinical research environment and relationships are facilitated by close physical co-location, with both DP and NDCN based on hospital sites, and having shared as well as dedicated buildings. These sites also host our UOA1 and UOA2 departments, promoting cross-UOA relationships. Co-location ensures our researchers are in touch with contemporary clinical neurology and psychiatry and are – literally – best placed to develop the translational impact of their research. Co-location also ensures seamless patient flows and promotes research participation – exemplified by the new Oxford Brain Health Centre (§4.3.1). The overall environment is a vibrant, integrated and multi-disciplinary health sciences campus that underpins the scale, scope, and success, of our research. Our shared University/NHS vision and estate will be advanced dramatically by the Warneford Park development (§3.6).

By the start of this REF period, we had set up the NIHR OchCRF (§1.1), established mental health and dementia themes in the Oxford Academic Health Sciences Centre and, critically, had the support of MSD and OH to apply for a bespoke mental health and dementia BRC in the 2016 round (OHBRC) to complement the existing general medical OBRC (§1.1 and Figure 1). OHBRC (Director, *Geddes*) has three research themes: adult mental health, aging and dementia, and precision psychological approaches; supported by cross-cutting themes of experimental medicine, neuroimaging, digital methods, training and PPI, OHBRC propels our discovery neuroscience towards clinical applications.

OHBRC has contributed significantly to our research infrastructure in several key respects:

- Part funding of several researchers returned here (e.g. *Browning, S Murphy, Saunders*) as well some category C staff (§2.1.6), and funding posts for ECRs and support staff.
- Provision of core support and facilities, e.g. pharmacy, assays, image analysis, and computing.
- Provision of support for PPI, PPE, and engagement with local NHS services.
- Leverage of external grant applications via pump priming and other focused use of funding.
- Facilitating industrial collaborations (§3.5.4).
- We benefit in similar ways from themes contained within OBRC, led by *Rothwell* and *Husain*, which provide support to their research programs and highlight our close working across the two Biomedical Research Centres and their host NHS Trusts.

3.3.2 Other Oxford NIHR infrastructure

We have also successfully embedded mental health and dementia within other Oxford-based NIHR infrastructures, enhancing our research and our ability to achieve translation and clinical impact:

- **NIHR Oxford Collaboration for Leadership in Applied Health Research and Care (CLAHRC)**, 2014-2019. *Lennox* was Deputy Director, and *Sharpe* led the theme on multimorbidity between psychiatric and physical health.
- Replacing the CLAHRC, the **NIHR Applied Research Collaboration Oxford and Thames Valley (ARC)**, includes a major theme on mental health across the life course, led by *Creswell*.
- **NIHR Thames Valley and South Midlands Local Clinical Research Network (CRN**, Director *Lennox*) supports clinical research across the region. Our staff lead themes in Dementia, Neurological Disorders, Ophthalmology, Mental Health and Stroke.
- **NHS Oxford/Thames Valley Academic Health Sciences Network (AHSN**). Funded in 2013 and renewed in 2018, research networks include psychological medicine (*Sharpe*), early intervention (*Lennox)*, IAPT (*D Clark)* and patient safety (*Vincent*).
- In 2020, the Oxford Academic Health Sciences Centre was competitively re-designated by NIHR/NHS England as **Oxford Academic Health Partners (OAHP)**. OAHP links the University with OH, OUH, and Oxford Brookes University. OAHP underpins joint working

in translational research, clinical research training, streamlined research governance, and clinical research facilities, providing additional opportunities for our researchers to increase their health, economic and social impacts. *Geddes* sits on the OAHP board.

We have added to these various NIHR funding schemes through investments of our own, as described in §3.4. These major infrastructure developments are complemented by our strategic recruitments, described elsewhere, to enhance our capacity, leadership and sustainability of the research.

3.4 Major investments in infrastructure

We have complemented our external income with institutional investments to improve and grow our research infrastructure beyond our core estate. The latter comprises approximately 13,800m^2 research space across DP, DEP and NDCN.

Life and Mind Building. As noted in §1.2.3, the sudden closure of the Tinbergen building which housed DEP (and Zoology (UOA5)) displaced 700 researchers and led to intensive planning to provide solutions. An emergency £30M from central funds [IES 2.1] provided high quality purpose-built modular laboratory and other facilities, and other locations across Oxford were adapted to provide additional office and teaching space. There was outstanding teamwork across MSD, central University, and Colleges, with remarkably limited disruption to research and other activities. The current arrangements will remain until the £202M Life and Mind Building is completed (§3.7).

The *Behavioural Neuroscience Unit* houses our rodent and non-human primate research (§1.4.2). As part of the WIN award, we committed £1.5M to upgrade animal neuroimaging facilities and other building works, and DEP has supported the Unit to a total of £113K as part of our commitment to maintaining an animal facility of the highest quality – reflected in visits from researchers from many countries including China, USA and European countries seeking to establish or upgrade facilities in their own institutions.

WCPSD and WIN annexe. A new building to house WCSPD, and part of WIN, was opened in early 2020. The building cost £11M, of which the Wolfson Foundation donation was £4M, £1M from Wellcome and the remainder from NDCN and central University capital budgets.

- As part of the WIN award, we made a range of other financial commitments and investments, totalling over £3.5M. This included the £1.5M to expand animal neuroimaging facilities mentioned above, plus £500K towards other building costs, funding of 7 doctoral studentships, and underwriting of one post for seven years.

Oxford Centre for Human Brain Activity (OHBA). As part of our strategic plans to expand translational and clinical research, an MRI scanner (Siemens Prisma 3T) was installed in DP for the first time, located in OHBA. DP budgets provided £2.4M in 2015 to fund the building work and the scanner (with central funds providing a further £2M). Additionally, DP funded replacement of the magnetoencephalography scanner (£1.7M).

- These investments have borne fruit with OHBA becoming part of WIN, and allowing seamless neuroimaging between NDCN, DP and DEP. Moreover, we have used these facilities to integrate research and clinical scanning at the new Oxford Brain Health Centre (§4.3.1).

3.5 Supporting industrial collaboration

3.5.1 Infrastructure supporting industrial interactions and impacts

Links with industry are facilitated by the **Translational Research Office (TRO)** and the **Business Partnerships Office (BPO)**.

The TRO provides support for early-stage translational projects, creating a pipeline for investment and commercial uptake. Established in 2019, this £200k/year provision ensures researchers have access to expertise from academic, clinical and commercial sectors to enrich research

programmes and maximise their potential for clinical uptake and commercialisation. This support helps increase the impact of research and feeds the pipeline of commercialisation projects. 15 projects in UOA4 have received TRO support during the REF period.

The BPO provides expertise, advice, and hands-on support for forming and maintaining alliances with pharma, and its personnel provide dedicated input to this UOA.

- A recent example is the precompetitive Oxford Janssen Neuroscience Alliance, with funding of projects in dementia, neuroinflammation and mood disorder worth over £2M to date.
- *Lovestone* is Vice-President for Neurodegeneration, Janssen-Cilag, whilst retaining a part-time appointment in DP. Two other senior Janssen scientists hold honorary appointments in DP. These relationships, monitored by an independent ethical oversight group, have helped drive the current Alliance as well as facilitating strategic discussions.

3.5.2 Patents and commercial deals

Facilitated or handled by **Oxford University Innovation (OUI)**, our well-established technology transfer organisation [IES 2.2], during this REF period our researchers have:

- signed 58 commercial deals,
- filed 156 patents,
- initiated 90 intellectual property projects.

OUI's support has facilitated a number of our case studies [ICS 08OCS, 09SLEEPIO, 10CNS, 18NIGHTSTAR).

3.5.3 Spin outs

OUI also supports our spinout activities, which have benefitted additionally from creation of **Oxford Science Innovation (OSI)**, a >£600M venture capital vehicle [IES 2.2].

Our researchers have launched 7 spinouts since 2014, with investments to date estimated at ~£710M:

- *Nightstar* was a biotech spun out in 2014 from the *MacLaren* lab. Within 5 years, Nightstar was leading international clinical trials of gene therapies for inherited retinal diseases and had become the world's largest retinal gene therapy company by market capitalisation. Nightstar was acquired by Biogen for $877 million in 2019 [ICS-18NIGHTSTAR; IES 2.1].
- *OxfordVR* spun out in 2016 to develop virtual reality (VR) treatments for psychosis and acrophobia (*Freeman*). With £14.3M of investments, Oxford VC employs over 30 people on three UK sites. The main investor is Optum Ventures, the innovations arm of United Health Group (the largest healthcare company in the world), enabling the treatments programmed by OxfordVR to reach the US market.
- *Akrivia Health*, formerly Cristal Health, was set up by *Lovestone* and others in 2018 as a partnership with the University of Oxford and OH, to make electronic medical records from UK mental health Trusts available to accelerate research and improve recruitment to clinical trials, whilst retaining the highest standards of information governance. It is the largest such dataset in the world.
- *OxSight* was founded in 2016 by Hicks (then a researcher at NDCN) to develop and market augmented-reality glasses for blind people. OxSight has raised £7.2M, employs 25 full-time staff, and has recently been valued at £40M.
- *Circadian Therapeutics (Foster)* was established in 2016 with an initial £1.5M, followed by a further £7M committed by OSI in January 2020 for development, manufacture and Phase I trial of a new drug, working with the charity Blind Veterans UK.
- *Oxford Brain Diagnostics (Jenkinson)* applies novel technologies to aid drug development. Set up in April 2020, it already employs 8 full time staff. A finalist in the 2020 Nature Spinoff Prize, its software received US FDA Breakthrough Device Designation in September 2020.
- *Oxford StemTech* (*Cader*) was set up in July 2020, with an initial £250K investment.

3.5.4 Other industrial partnerships

P1Vital is a CNS clinical research organisation, spun out of DP in 2008. During this REF period, P1Vital licensed *Harmer's* Emotional Test Battery to five major pharma, and received £5.1M industrial funding to conduct clinical trials using the battery. The ongoing relationship between our researchers and P1Vital, supported by OHBRC and OchCRF (§3.3.1), is reflected in shared grants from IMI, MRC and others, totalling >£7.5M.

SomaLogic is a US biotech who in 2016 established their European base on the DP site via a collaboration with *Lovestone*. As well as facilitating biomarker translation, the agreement provides our researchers with a >30% cost subsidy. Three studies using SomaLogic technology have been completed.

3.6 Wider infrastructure

College contributions. Some Colleges have neuroscience-focused resources and facilities that augment our research environment: e.g. the *Centre for the Creative Brain* (St Edmund Hall) and the *Mind, Brain and Behaviour* cluster (Wolfson College) both hold regular interdisciplinary events.

Gardens, Libraries and Museums (GLAM). GLAM provide staff and resources for many of our public engagement activities (§4.2). Each department is supported by a named specialist librarian, in addition to the central support for Open Research and Open Access [IES 2.4]. We have a funded project with the Botanic Gardens and Ashmolean Museum for social prescribing research.

3.7 Future investment plans

Life and Mind Building. Planning permission was granted in January 2021, and completion due in 2024. The building will not only allow DEP to be reunified and deliver on its strategy, it will promote substantial interactions and synergies with the newly formed Department of Biology (UOA5) and a new centre funded by a gift from INEOS which will enhance interdisciplinary and global opportunities [IES 2.1].

Warneford Park. Plans are being developed to transform the Warneford Hospital (home of DP) into Warneford Park, a major re-development including re-provision and expansion of DP, together with parts of DEP and NDCN, alongside a new research-focused psychiatric hospital and with shared space for industrial partners. A partnership between OH, the University, and a major donor, has been put in place, and outline planning permission is expected to be sought as a next step.

4. Collaboration and contribution to the research base, economy and society

4.1 Collaborations

A strongly collaborative culture is explicitly encouraged by the ONC and facilitated by our organisational structures and their flexibilities.

4.1.1 Collaborations across this UOA

The extent of collaborations within this UOA is considerable. The successful funding of our Centres (§1.1.2) reflects this collaborative environment, and now enhances it.

- Collaborative award-type funding includes: Wellcome Collaborative Awards to *Behrens* (2018) and *Smith* (2019); a Wellcome Strategic award to *Duncan* (2014), and a Wellcome multi-user equipment award (*M Buckley,* 2016).
- Of our 423 selected outputs, 142 (34%) include authors from more than one UOA4 department.

- The C-MORE COVID-19 study (**Box 2**) is an example of a research programme involving all three UOA4 departments, and colleagues in UOA1.

4.1.2 Collaborations with other UOAs

We work with a range of departments returned in other UOAs (**Box 7**).

- 15% of projects during this REF period include a co-investigator from another UOA.
- 24% of our selected outputs include authors from other Oxford UOAs.
- These collaborations are promoted by the co-location on hospital sites with UOA1 and UOA2 departments (**Box 6**) and the location of DEP in central Oxford adjacent to other UOAs (**Fig. 2**).

Box 7: Major collaborations of our returned researchers with other UOAs

UOA1: 32 researchers collaborate with Clinical Medicine, including the ARUK Oxford Drug Discovery Unit, Structural Genomics Consortium, and Target Discovery Institute.

UOA2: 21 researchers have collaborations with the Nuffield Department of Public Health, Nuffield Department of Primary Care, or Big Data Institute (BDI). The links with BDI underpin our imaging work on UK Biobank; one of the WIN PIs, Tom Nichols, has a position in BDI (and returned in UOA2).

UOA5: 23 researchers collaborate with neuroscientists in the Departments of Physiology, Anatomy and Genetics (DPAG) and Pharmacology. The Oxford Parkinson's Disease Centre, based in DPAG, works closely with NDCN and includes three of our clinical academics (*Hu*, *Paarkinen, Antoniades)*.

UOA10 (Mathematical Sciences): Fruitful collaborations have been forged with the Alan Turing Institute. For example, advanced mathematical methods were applied to demonstrate differences between overlapping psychiatric disorders (*Saunders).*

UOA12 (Engineering): Some of our researchers are engineers, and 16 actively collaborate with engineers. *Seymour* and *Denison* have joint appointments with the Institute of Biomedical Engineering. *Chiew, Okell* and *Wu* are Royal Academy of Engineering Fellows.

UOA20 (Social Work and Social Policy): *Stein* leads the mental health component of the £20M UKRI GCRF Accelerating Achievement for Africa's Adolescents Hub, led from the Department of Social Policy and involving the Blavatnik School of Government.

UOA23 (Education): as our research into education, and schools-based research, has grown, we collaborate increasingly with colleagues in Education. This includes *Snowling's* work (see 4.3.2) and collaborations involving *M Fazel, Hsiao, Nation* and *Scerif*.

We also have collaborations with: **UOA8** (Chemistry; *N Buckley, Burnet, Rinaldi*), **UOA14** (Geography; *Spitschan, Warnaby*), **UOA16** (Economics and Econometrics; *Stein);* **UOA28** (History; *Bowes, Nation, Snowling*), and **UOA30** (Philosophy; *Cohen Kadosh; Heyes, Kringlebach, Singh*).

4.1.3 National collaborations and networks

91 researchers (49%) report leadership of or involvement in at least one national collaboration. These include:

- *Dementia Platform UK* - DPUK (Director: *Gallacher*) works with 18 academic institutions, 12 industrial partners, and an international network of collaborators. Achievements include over 220 publications, a data portal with 42 cohorts totalling 3.4M people, two research registers (53,000) and an experimental medicine incubator attracting £11.5M industry support. In 2020, DPUK was renewed by MRC until 2025 (£7.5M).
- *UK Biobank*. WIN (*Smith, Miller, Jezzard* and others) lead the neuroimaging component of UK Biobank, by far the largest brain imaging study ever carried out. WIN created the

imaging protocol, developed an automated analysis pipeline, and has to date disseminated imaging derived phenotypes from 40,000 subjects, with linked genomic data.
- *Alan Turing Institute*. Oxford was a founding partner in 2017, and our researchers have contributed to and benefited from the resulting interactions, as noted above.
- *NIHR Translational Research Collaborations (TRCs)*. TRCs enhance research by linking BRCs together. Our researchers play major roles in both relevant TRCs - Mental Health (co-led by *Geddes)*, and Dementia (*Mackay)*.

Our collaborative work with other UK institutions is reflected in 51% of our selected outputs having at least one non-Oxford UK author.

4.1.4 International collaborations and networks

117 researchers (63%) are involved in at least one international collaboration or network. Examples of our international profile include:

- WIN has led the majority of the neuroimaging analysis research in the game-changing Human Connectome Project (HCP; >$70M across 3 NIH grants). WIN also leads the connectivity analysis component in the €15m ERC Developing-HCP "baby connectome" project. WIN is also an integral part of Prime-DE, the first open-source non-human primate MRI database.
- WIN is working with other imaging centres to integrate its FMRIB Software Library (FSL) into BIDS format. It has transferred its MRI acquisition software to 27 external institutions. In 2018 alone, FSL had >20,000 downloads and 5 million web views; FSL is in use in over 5,000 labs worldwide.
- IMPRIND is an €8M Innovative Medicines Initiative (IMI) collaboration led by *Tofaris*, started in 2017, to develop models to investigate drugs blocking aggregate propagation in neurodegenerative diseases.
- IM2PACT (led by *Cader*) is an €18M IMI collaboration between 23 EU institutions and pharma, started in 2019, and developing blood-brain barrier models for therapeutic research.
- Neuroscience is a major part of the Oxford-Berlin Partnership [IES 2.6]. In 2018-19 the Partnership provided €240K seed funding for 8 neuroscience projects, as well as six workshops, and a graduate training alliance for computational neuroscience.
- We are part of NeurotechEU, the European University of Brain and Technology Partnership. Funded by a five-year €5M award in April 2020, it brings together 8 universities to enhance scientific collaborations, training, and impact.
- Our work on global mental health (§1.4.6) includes significant collaborations with WHO and UNICEF, with commitments to local capacity building and training.
- 56% of all papers by our submitted researchers during the REF period had at least one author from outside the UK (source: SciVal).

4.2 Communications and public engagement

4.2.1 Enhancing communications and promoting public engagement

Early in this REF period we recognised the need for a strategy for, and investment in, public engagement. As a result, our departments, as well as WIN and BNDU, have employed communication officers and have identified a lead researcher to oversee activities. These developments occur as part of the University's approach to public engagement [IES 2.2].

- The communications officers report to the relevant senior management team and are represented on the ONC. They work within the MSD Communications Team and participate in the MSD Communications and Public Engagement Network, which holds termly meetings to share best practice, offer training and mentoring support. Our communications officers took part in the University's inaugural public engagement with research conference in 2018, and then 2020.
- In addition to these core communications posts, major research programs have allocated funding for their own communications officers to support public engagement; examples

include the Dementia Platforms UK (*Gallacher*), Sleep and Circadian Neuroscience Institute (*Foster*), and the Young People and Ethics program (*Singh).*

The communications officers, and the above processes, have helped embed public engagement and communications in our research environment. For example:

- seed funding is available for public engagement activities. One such award was made, along with departmental funding and in collaboration with the Ashmolean Museum, to the Picturing Parkinson's project to help researchers understand better the impact of the disease; the insights have already fed into improvements in how clinics are run and how questionnaires are phrased;
- researchers are encouraged to apply for the Vice Chancellor's Public Engagement with Research Awards. It was won by *Tunbridge* in 2016 for her 'Neurococktails' sessions at the Science Museum, Cheltenham Science Festival and Royal Society Summer Exhibition (> 2000 participants in total). The prize has also been won by *Clare* and *Smithson* for other activities;
- WIN and NDCN established a Public Engagement Ambassadors programme, in which researchers commit to specific activities and receive bespoke training. Since 2017, 33 researchers have participated;
- a departmental annual prize for public engagement is offered, e.g. won in 2019 by *S Murphy* and *Creswell;*
- there is an open door for researchers to discuss public engagement opportunities and how best to deliver them, publicised in regular e-newsletters;
- assistance with, and promotion of, press releases via the Science Media Centre (which we financially support);
- a section on communications is included in each departmental and Centre annual report;
- our websites are regularly updated and interlinked, overseen by the Neuroscience Coordinator.

4.2.2 Examples of specific public engagement activities

- Annual open days, e.g. in 2015, the Oxford Brain Bank attracted 80 people. Comments included ''*Excellent day and very, very informative*' and *'It was an amazing experience*';
- the annual Oxford Neuroscience Day, at which talks are given and posters presented. It is attended by over 300 people, including representatives from charities and funders;
- a Brain Awareness week held at the Ashmolean Museum, visited by over 900 people;
- our research featured prominently in the Curiosity Carnival, an Oxford-wide programme of activities in 2017 that attracted 42,000 people in person or via webcasts, and 280,000 online engagements, with strong outreach to disadvantaged groups. Over 90% reported that it had been an excellent or good overall experience;
- the Brain Diaries Exhibition ran from March 2017-January 2018, based at the Museum of Natural History with an extensive public programme and online digital resources. It was funded by Wellcome and the Negaunee Foundation, and won the Vice Chancellor's Award. Over 50 of our researchers contributed. The programme and exhibition reached more than 168,000 visitors;
- a collaboration between *Tunbridge* and an artist on representations of neuroscience and mental health led to a public exhibition at the Barbican and other venues in 2019 (over 1500 visitors);
- WIN holds various activities with schoolchildren, including the Big Brain Roadshow, so far with over 800 11 year olds, and a week-long Neuroscience Experience for 24 year 12 pupils;
- in 2019 we held a Brain Discovery Week which included MRI experiments using Facebook Live. Over 3,000 people visited the website, and the videos reached over 70,000 people;
- a 2-day meeting celebrating the 50th anniversary of DP in 2019 was live-streamed, viewed by over 900 people, and generated 2,600 tweets and >36 million Twitter impressions;
- in 2019, 'SHElock' was set up by ECRs and students in WIN, who hosted three hands-on sessions for 16 schoolgirls to learn about the brain;
- an annual open day for the OHBRC is held in DP to promote our mental health research;

- 89 of our researchers (48%) are active on Twitter;
- we have been active in public engagement and openness in animal research (§1.6).

Our researchers have also been prominent in the media. In addition to many interviews on news bulletins, programmes include: The Life Scientific (*Foster*, Radio 4, August 2013); Start the Week (*Johansen-Berg,* Radio 4, 2014); The Inflamed Mind (*Lennox*, Radio 4, 2016); Trust Me I'm a Doctor Special (*Irani* and *Lennox*, BBC2, 2017); How the NHS Changed our World (*Aziz*, *FitzGerald* and *Jagannath*, BBC2, 2018); The Life Scientific, and All in the Mind (*Tracey,* Radio 4, 2019); A History of Delusions (*Freeman*, Radio 4, 2019); Desert Island Discs (*Foster,* Radio 4, 2019); The New Anatomy of Melancholy (*Espie* and *Geddes*, Radio 4, Spring 2020).

4.2.3 Patient and public involvement (PPI)

Our involvement in PPI has grown dramatically and is now central to all our human research, ranging from identification of priorities, to experimental design and coproduction. Our PPI occurs in several ways:

- OHBRC has a cross-cutting PPI theme (led by *Singh*), and hosts PPI groups who offer input and expertise. PPI groups are also linked to major research programmes; for example *Freeman* works with the McPin Foundation, and WIN and BDNU have dedicated PPI arrangements.
- PPI is the focus of regular meetings involving research users. For example, researchers gave a series of talks to explain the research process, and the BRCs hold annual open days at which researchers and PPI representatives share ideas and discuss perspectives.
- We engage with user groups. For example, *Bishop* and *Snowling* led development of the national support group for parents of children with developmental language delay.
- Within the Wellcome Centre for Human Ethics, *Singh* leads a research program into medical neuroethics, including the consent and use of big data.

4.3 Contributions to sustainability and growth

4.3.1 Contributions to healthcare and the NHS

A theme running throughout this document is that much of our research contributes to sustainability and growth in healthcare and the NHS. These contributions reflect and benefit from the environment we have created to facilitate and sustain this, e.g. the physical environment (**Box 6**), Category C staff (§2.1.6), the BRCs and other NIHR infrastructure (§3.3), and the leadership provided by our three NIHR Professors and our many NIHR Senior Investigators (§4.4.1). Here we summarise some additional aspects of this relationship.

- *Improving Access to Psychological Therapies (IAPT)*. Our researchers play a central role in the NHS England IAPT programme, beyond the development of many of its effective treatments [ICS-05IAPT, 14PTSD]. As NHS England's Clinical and Informatics Advisor for IAPT, *D Clark* has ensured that effectiveness is rigorously evaluated, creating a unique session-by-session monitoring system that collects outcome data on 99.4% of the 606,000 patients treated each year. Our researchers have now used these data to innovate mental health services. For example, local pilots of how to create cost effective, integrated healthcare for people with depression/anxiety and long-term physical health conditions have been adopted nationally, whilst other analyses identified critical quality standards that are now being implemented with demonstrable improvements in outcomes. These examples highlight our seamless working between discovery science, clinical trials, and population benefits. This is made possible by our collaborative approach, our research environment, and our commitment to engage with the NHS to achieve implementation.
- *Oxford Brain Health Centre*. Our researchers, led by *Mackay*, worked with OH and WIN to open a research-focused brain health centre on the Warneford Hospital site in March 2020. It provides an enhanced, standardised care pathway for patients referred to memory clinics, including 3T MRI. It replaces the previous NHS service, which was patchy and used CT scans. All patients are invited to participate in research; to date, 95% have consented.

WIN has also contributed to clinical neuroradiology by providing sequences and tools now being implemented in the NHS.

- *True Colours*. The True Colours app, developed by *Geddes* to monitor mood symptoms, has been expanded during this REF period to allow remote monitoring of many health conditions, including epilepsy and inflammatory bowel disease. It is now in use in many NHS Trusts, with benefits for research and for clinical care. A recent example is that True Colours has been adopted for data collection by the UKRI PHOSP-COVID study.
- *Risk prediction.* Prediction of violence and suicide are major challenges in mental health. *S Fazel* has developed and validated calculators for estimating these risks among forensic patients, prisoners, and those with severe mental illness. They are being rolled out in healthcare and prisons, in UK and internationally (e.g., throughout the Dutch penal system, thus far on over 40,000 prisoners).

4.3.2 Other contributions

Economic: Our spinouts and their economic benefits were described in §3.5.3, and direct economic impacts are illustrated by three of our impact case studies (ICS-09SLEEPIO, 10CNS, 18NIGHTSTAR).

- WIN has a master-research agreement with Siemens (worth £300K), holds 7 major grants with industry partners (~£3.9M), and has 8 researchers who hold joint appointments or consultancies with industry. WIN's FSL tools are critical to the Oxford-Novartis collaboration (UOA1) and have been licensed (via Oxford University Innovation) to over 35 pharma and other companies.

Education: Snowling developed the Nuffield Early Language Intervention (NELI), shown in randomised trials to allow children to make three months extra progress in oral language. NELI has been recommended by the UK government to help children held back by COVID-19 lockdowns and over 5000 schools have registered to receive the intervention.

Research capacity: In addition to our various graduate and MSc programs (§2.1.4), we grow research capacity through specific training initiatives:

- The well-established FSL training course in MRI analysis. Since 2017, the course has been held in five countries, with 572 attendees. A newer annual MEG course of weekly classes attracts over 80 applicants for 35 places.
- An annual 2-day Oxford Autumn School in Neuroscience attracts at least 350 students each year (e.g. 589 in 2018).
- The residential annual 3-day Oxford Course in Experimental Medicine for Mental Health, started in 2019, has trained 35 researchers and clinicians from across the UK. Bursaries are provided.

4.4 Markers of influence and esteem

4.4.1 Honours and Prizes

National awards

Knighthood: *Lovestone*.
CBE: *Bhui, D Clark, Snowling.*
FRS: *Bishop, Behrens, Foster, Rushworth*.
FBA: *Bishop, D Clark, Duncan, Ehlers, Heyes, Lovestone, Nobre, Snowling*.
FAcSS: *D Clark, Nation, Plunkett, Snowling, Vincent.*
FMedSci: *Aziz, Beeson, Bennett, Bishop, Brown, D Clark, Ehlers, Foster, Fugger, Husain, Lovestone, MacLaren, Rothwell, Snowling, Tracey*.

Senior Fellowships

NIHR Professors: *Freeman, Creswell, Cipriani.* These are 3 of the 5 awards made nationally within UOA4 disciplines during this REF period.

Wellcome Principal Research Fellows: *Behrens, Bishop, Ehlers*, *Husain*, *Johansen-Berg*.
Wellcome Senior Research Fellows: *Bennett, S Fazel, Mitchell, Seymour, Slater, Walton*.
MRC Senior Clinical Fellow: *Turner*.
NIHR Senior Investigators: *D Clark*, Geddes*, Creswell, Ehlers, Lovestone*, Maclaren, Rothwell, Sharpe, Vincent* (**emeritus).

Selected awards
British Neurosurgical Society Medal 2019 (*Aziz*); National Academy of Sciences Troland Award 2017 (*Behrens)*; Blavatnik Award 2020 (*Behrens*); Patrick Wall Medal, Royal College of Anaesthetists 2016 (*Bennett*); British Association for Psychopharmacology Senior Clinical Prize 2016 (*Browning*); Academic of the Year, Royal College of Psychiatrists 2018 (*Cipriani*); Spearman Medal 2014 (*Cohen Kadosh*); Lifetime achievement award, American Association for Behavioral and Cognitive Therapy 2015 (*D Clark*); Federation of European Research Societies Research Prize 2018 (*Dupret*); American Psychological Foundation Wilhelm Wundt-William James Award for Trans-Atlantic Psychology 2015 *(Ehlers);* President's Award, British Psychological Society 2020 (*Freeman*); European College of Neuropsychopharmacology Prize 2016 (*Geddes*); FENS-EJN Young Investigator Prize 2020 (*Hunt*); British Association of Cognitive Neuroscience mid-career award 2016 (*Husain*); Broadbent Prize 2019 (*Nobre*); Fellow, US National Academy of Science 2020 (*Nobre*); Queen's Anniversary Prize 2014 (*Rothwell*); Psychiatrist of the Year, Royal College of Psychiatrists 2014 (*Sharpe*); Feldberg Foundation Prize 2017 (*Tracey*); British Neuroscience Association Outstanding Contribution Award 2018 (*Tracey*); Wellcome-Beit Prize (*Lak, Saxe, Tofaris*).

4.4.2 Other markers of esteem and contribution

Learned societies: 31 senior positions, including 8 Presidents: *Foster* (British Neuroscience Association); *Fox* (Society for Affective Science); *Harrison* (British Association for Psychopharmacology); *Heyes* (Experimental Psychology Society); *Jezzard* (International Society for Magnetic Resonance in Medicine); *Salkovskis* (British Association for Behavioural and Cognitive Therapies); *Sharpe* (American Academy of Consultation-Liaison Psychiatry); *Tracey* (Federation of European Neuroscience Societies).

Committees and funding panels**:** MRC Council (*Tracey)*; MRC (4 people); ERC (5 people); Wellcome (11 people); Royal Society (3 people); NIHR (5 people); BBSRC (3 people); UKRI (4 people); ESRC (2 people); NICE Committees and Groups (5 people including chair, (*D Clark*)); NC3R (1 person).

Journal editorial work*:* 108 people have held editorial positions, including 6 as Chief Editor: *Bhui* (British Journal of Psychiatry), *Cipriani* (Evidence-Based Mental Health), *Jezzard* (Magnetic Resonance in Medicine), *Husain* (Brain, elected), *Salkovskis* (Behavioural and Cognitive Psychotherapy), *Watkins* (Founding Co-Editor, Language and Brain).

Contributions to government and policy: *Burnet* (All-Party Parliamentary Advisory Group on the Human Microbiome); *D Clark* (NHS England's Clinical Advisor for Improving Access to Psychological Therapies; ICS 05IAPT); *Espie* (led Public Health England Every Mind Matters sleep campaign; ICS 09SLEEPIO); *Foster* (Expert witness, House of Lords Science Committee); *Kuyken* (All-Party Parliamentary Mindfulness Group; ICS 01MINDFUL); *Salkovskis* (Clinical Advisor, Public Health England); *Singh* (UKRI Covid-19 Research and Innovation Taskforce; DAVOS Summit 2019).

Bibliometrics: In a standardised citation metrics database of 6.9 million researchers across all disciplines (PLoS Biology 2019;17:e3000384), 41 (22%) of our staff are included in the top 1%, with 15 (9%) ranked in the top 0.1%.

- 12 researchers are in the 2020 ISI Highly Cited Researchers list, as well as Goodwin and A Vincent who retired in 2018. Reflecting the breadth of our research, they include psychiatrists (*Cipriani, S Fazel, Geddes*), engineers (*Jbabdi, Jenkinson, Miller*), basic neuroscientists (*Rushworth, Smith, Waters, Woolrich*), a psychologist (*Kuyken*) and a neurologist (*Rothwell*).

4.5 Future plans for collaborations and contributions

As part of our future strategy for research (§1.8), people (§2.4) and infrastructure (§3.7), we will expand the reach and impact of our collaborations (§4.1) and contributions (§4.3). Specific areas include:

- A strengthened, enlarged partnership with the University of Birmingham based on the existing 'M40 Alliance', providing mutual benefits in terms of research capability and capacity, and allowing us to engage better with diverse communities.
- We are engaging with organisations in northern and coastal areas to further this reach; we already have funded links with Blackpool and are developing a major research programme in Liverpool schools (*M Fazel*).
- A UKRI/Versus Arthritis Pain Centre, led by *Tracey* and *Bennett*.